



INFORMS ANNUAL MEETING

PHILADELPHIA
NOV 1-4
2015
PENNSYLVANIA

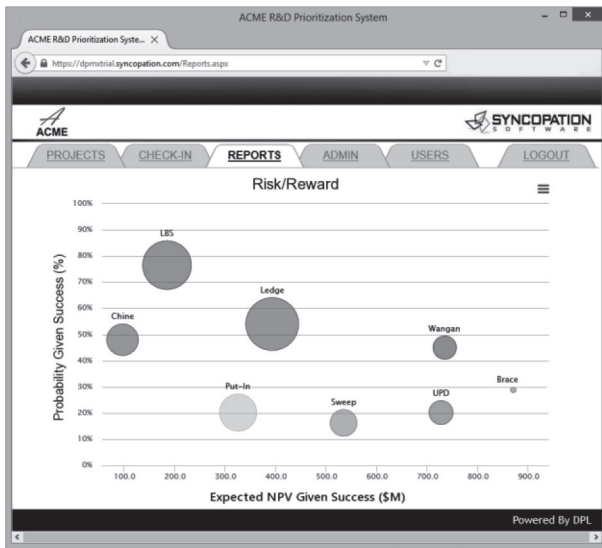


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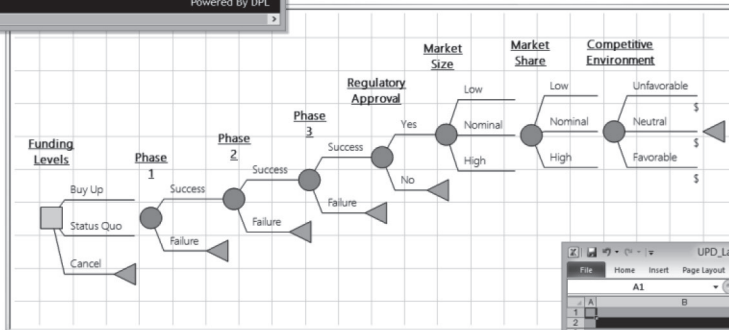
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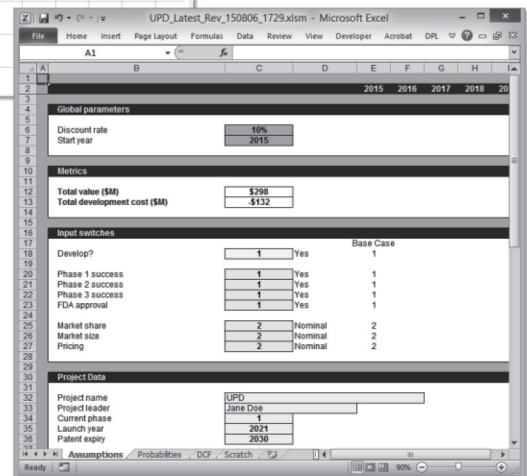
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	Tutorials Chairs Dionne Aleman University of Toronto	Aurelie Thiele Lehigh University
	Contributed Sessions Co-Chairs Hande Benson Drexel University	Virginia Miori Saint Joseph's University
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	Plenary/Keynotes Co-Chairs Paul Griffin Georgia Institute of Technology	Katya Scheinberg Lehigh University
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Copies of papers abstracted in the meeting program are available only from the authors. Requests for papers should be sent to the authors at the addresses shown in the program. Published annually prior to the meeting by INFORMS. Individual issues of the program are available upon request. Please contact the INFORMS office for additional information, 800.446.3676. Orders must be prepaid.

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Dear INFORMS Friends and Colleagues,

Welcome to the 2015 INFORMS Annual Meeting! It is my great pleasure and privilege to welcome you to Philadelphia. The City of Brotherly Love is a vibrant city of rich history and a rapidly evolving city of diverse culture, where emerging industries are right at home alongside centuries-old universities. The conference program reflects the intellectual richness that the host city can offer. Its broad scope covers cutting-edge topics from data analytics to healthcare applications; from novel optimization methodologies to comprehensive analysis strategies; from powerful modeling and software tools to intriguing industrial applications.

The vibrant intellectual sphere of the conference offers endless opportunities to meet old and new friends, network, and build and enhance your career. Please take advantage of the many networking opportunities, including the Welcome Reception on Sunday evening, the General Reception on Tuesday evening, and mingling in the melting pot of the conference exhibition and job fair area.

The 2015 Annual Meeting offers captivating plenary and semi-plenary presentations, panel discussions, tutorials, and thousands of oral and poster presentations from leading academics and industry experts.

The presentations survey the state-of-the-art of the analytics movement as it penetrates industry and society. The plenary speakers set the tone: Margaret Brandeau reviews how O.R. creates impact in healthcare; Michael Jordan explores ways to think about big data; Bill Rouse sheds light on the complexity of healthcare; and Alfred Spector discusses the role of empiricism and optimization in the world of big data. Another highlight of the program is the Presidents' Panel, at which four university presidents discuss the role that analytics and data-driven decision making play in the rapidly changing landscape of higher education.

The prize winners' presentations are always a treat for the curious mind. Besides the numerous subdivision-supported award presentations, the winners of the Franz Edelman Award, the UPS George D. Smith Prize, and the Daniel H. Wagner Prize, and the finalists of the Nicholson Student Paper Competition, will give presentations. Please join those sessions to celebrate the exceptional achievements of the finalists and winners.

Organizing such a major event would not be possible without having a solid organization, and without the efforts of many people. My special appreciation goes to the highly professional and efficient INFORMS staff, who are always there to help and guide the organizing committee. The INFORMS Meetings Committee is dedicated to do all that is possible, and beyond, to ensure that the Annual Meeting is a sound success. Program co-chairs Larry Snyder and Jeff Lindereth were responsible for assembling a high-quality program overall. Gino Lim and Mohammad Oskorouchi served as Invited Cluster Chairs; Noah Gans and Ted Ralphs worked with sections and societies as Sponsored Session Chairs; Contributed Session Chairs Hande Benson and Virginia Miori organized the overall submissions into coherent sessions; Wenjing Shen, Ming Wang, and Allen Holder organized the poster competition and poster sessions; Tutorial Chairs Dionne Aleman and Aurelie Thiele assembled a superb set of tutorials; Keynote Chairs Paul Griffin and Katya Scheinberg lined up an exceptional set of featured speakers; Practice Chairs Manoj Chari and Stefan Karish coordinated the industry contributions; and Neil Desnoyers organized plant tours and local arrangements. I would like to thank all who contributed to the success of this great meeting. Without your support and contribution, the general chair's job would have been impossible.

I would also like to thank to all of the sponsors for their generous support of the conference. Special thanks go to our Platinum sponsors: AIMMS, IBM and Seth Bonder Foundation. Finally, I acknowledge the tremendous support of Lehigh University, which celebrates its 150th anniversary this year. In addition to being a Platinum sponsor of the conference, the university, its College of Engineering, and the ISE Department generously supported the organizing committee and the student volunteers.

I thank you for your participation and continued support of INFORMS, and I hope you enjoy the conference and will have fond memories of the 2015 INFORMS Annual Meeting. I also encourage you to explore the rich history and vibrant cultural life that Philadelphia has to offer.

A handwritten signature in black ink that reads "Terlaký Tamás".

Tamás Terlaký, General Chair

BADGES REQUIRED FOR TECHNICAL SESSIONS

2015 INFORMS Annual Meeting badges must be worn to all sessions and events. Badges will be checked at the entrance to technical session areas, as well as the Exhibit Hall. Attendees without badges will be directed to the INFORMS registration desk to register and pick up their badges. *All attendees, including speakers and session chairs, must register and pay the registration fee. Lost badges can be replaced at the registration desk for a fee of \$5.*

REGISTRATION FEE

Your registration fee includes admittance to the complete technical program, the Exhibit Hall, Career Center, Technology Center, and most special programs. The following social/food events are also included: Sunday evening Welcome Reception and Awards Ceremony, Tuesday evening General Reception, and all morning and afternoon coffee breaks. No other meals are included.

Guest Registration

If your guest would like to accompany you to the major social events, you can purchase a guest registration (\$80) that covers admission to the Sunday Welcome Reception, Sunday Awards Ceremony, and Tuesday General Reception. Guests are not eligible to attend the technical sessions. You can register your guest at the INFORMS Registration Desk.



QUICK REFERENCE GUIDE

Including the Master Track Schedule & Maps

Don't miss this handy reference that was provided to you with your program!

KEY: M - Marriott C - Convention Center

FRIDAY, OCTOBER 30

Combined Colloquia		
Registration	M – Registration Desk, Level 5	5:30-6:30pm
Dinner	M – Salon I/J, Level 5	6-8pm
Executive Committee Working Dinner (invite only)	M – 501, Level 5	6:30-8:30pm

SATURDAY, OCTOBER 31

Registration	C – Exhibit Hall A, 200 Level	7am-5:30pm
CIST		
Breakfast/Welcome	M – Salon E, Level 5	7:15-8am
Sessions	M – Salons C & D, Level 5	8am-6:10pm
Coffee Break	M – Salon C/D Foyer, Level 5	9:45-10:15am
Lunch/Speaker	M – Salon E, Level 5	12:20-1:35pm
Refreshment Break	M – Salon C/D Foyer, Level 5	4:05-4:35pm
Combined Colloquia		
Breakfast	M – Salon H, Level 5	7-8am
Doctoral Student Colloquium	M – Salon G, Level 5	8am-4:30pm
New Faculty Colloquium	M – Salon J, Level 5	8am-4:30pm
Teaching Effectiveness Colloquium	M – Salon I, Level 5	8am-4:30pm
Coffee Break	M – Salon H, Level 5	9:30-10am
Lunch	M – Salon H, Level 5	11:30am-1pm
Coffee Break	M – Salon H, Level 5	2:30-3pm
Reception	M – Salon F, Level 5	5-6pm
INFORMS Board		
Breakfast	M – Salon A/B, Level 5	7:30-8:30am
Board Meeting	M – Salon A/B, Level 5	8:30am-4:30pm
Data Mining & Analytics Workshop		
Breakfast & Welcome	M – Franklin 3, Level 4	8-8:30am
Sessions	M – Franklin 1 & 2, Level 4	8:40am-4:50pm
Lunch/Speaker	M – Franklin 3, Level 4	12:10-1:10pm
ISR Editors	M – 501, Level 5	8am-2pm
Vendor Workshops		
AIMMS	C – 103A, 100 Level	9-7:30pm
Optimization Direct	C – 104A, 100 Level	9-11:30am
Maximal Software	C – 105A, 100 Level	9-11:30am
Do Analytics	C – 105B, 100 Level	9-11:30am
IBM	C – 107B, 100 Level	12noon-2:30pm
FICO	C – 104A, 100 Level	12noon-2:30pm
Forio Simulations	C – 106A, 100 Level	12noon-2:30pm
IBM	C – 107B, 100 Level	3-5:30pm
SigmaXL	C – 103B, 100 Level	3-5:30pm
AnyLogic	C – 103C, 100 Level	3-5:30pm
GAMS Development Corp	C – 104A, 100 Level	3-5:30pm
SAS	C – 104B, 100 Level	3-5:30pm
LINDO Systems	C – 105A, 100 Level	3-5:30pm
Gurobi Optimization	C – 105B, 100 Level	3-5:30pm
SAS JMP	C – 106B, 100 Level	3-5:30pm
Frontline Systems	C – 107A, 100 Level	3-5:30pm
INFORMS Membership Meeting/Reception	M – Salon H, Level 5	5-6pm
ISS Awards & ISR Editors Reception	M – Salon L, Level 5	6:30-8pm

SUNDAY, NOVEMBER 1

Registration	C – Exhibit Hall A, 200 Level	7am-5pm
New Member Breakfast (invite only)	M – Salon E, Level 5	7-8am
Career Center Breakfast & Meeting	M – Salon F, Level 5	7:30-9am
Technical Sessions (SA)	Convention Center & Marriott	8-9:30am
Organization Science Competition	M – 501, Level 5	8am-5pm
INFORMS Board	M – Salon A/B, Level 5	8:30am-5:30pm
CIST		
Breakfast	M – Salon E, Level 5	7:15-8:15am
Sessions	M – Salons C & D, Level 5	8:15am-3:30pm
Coffee Break	M – Salon C/D Foyer, Level 5	9:45-10:15am
Lunch/Awards Ceremony	M – Salon E, Level 5	12noon-2pm
Coffee Break	C – 100 Level Concourse	9:30-10am
	M – Franklin Foyer	
Welcome & Plenary: Margaret Brandeau	C – Grand Ballroom B, Upper 200 Level	10-10:50am
Technical Sessions (SB)	Convention Center & Marriott	11am-12:30pm
CIEADH	M – Salon I, Level 5	10am-5:45pm
Exhibits, Career Center, Technology Center	C – Exhibit Hall A, Level 200	12noon-5pm

KEY: M - Marriott C - Convention Center

Lunch Break (on your own)		12:30-1:30pm
Junior Faculty Interest Group Lunch (ticketed event)	M – Salon F, Level 5	12:30-1:30pm
M&SOM Associate Editors Lunch (invite only)	M – Salon L, Level 5	12:30-1:30pm
Service Science Editorial Board (invite only)	M – Salon J, Level 5	12:30-1:30pm
Omega Rho Committee Lunch & Meeting	M – 502, Level 5	12:30-3pm
Technical Sessions (SC)	Convention Center & Marriott	1:30-3pm
Keynote: Kavita Ramanan	C – Grand Ballroom A, Upper 200 Level	3:10-4pm
Keynote: Stephen Wright	C – Grand Ballroom B, Upper 200 Level	3:10-4pm
Keynote: 2015 Edelman Reprise	C – 201C, 200 Level	3:10-4pm
Coffee Break	C – Exhibit Hall A, 200 Level	4-4:30pm
	M – Franklin Foyer	
Technical Sessions (SD)	Convention Center & Marriott	4:30-6pm
INFORMS Community Meetings	See p. 9	
INFORMS Social Networking Reception	M – Salon L, Level 5	6:30-7:30pm
Welcome Reception-Exhibits Open	C – Exhibit Hall A, 200 Level	7:30-9pm
Minority Issues Forum Reception	M – Salon F, Level 5	8-9pm
Awards Ceremony & Dessert Reception	M – Salon G/H, Level 5	8:30-9:45pm
Awards ceremony open to all. Doors close at 8:45pm.		

MONDAY, NOVEMBER 2

Registration	C – Exhibit Hall A, 200 Level	7am-5pm
International Activities Breakfast	M – Conference Suite 1, Level 3	7-8am
Transportation Science Associate Editors Breakfast Meeting (invite only)	M – Salon K, Level 5	7:30-9am
ITE Editors & Editorial Board	M – Pubs Suite	7:30-9am
ACORD Breakfast & Meeting	M – Salon I, Level 5	7:30-9am
Technical Sessions (MA)	Convention Center & Marriott	8-9:30am
Chapters/Fora Committee	M – 502, Level 5	8:30-9:30am
Exhibits, Career Center, Technology Center	C – Exhibit Hall A, 200 Level	9am-5pm
Section/Societies Committee	M – Salon L, Level 5	9:30-10:30am
Decision Analysis Editors (invite only)	M – 501, Level 5	9:30-11am
Coffee Break	C – Exhibit Hall A, 200 Level	9:30-10am
	M – Franklin Foyer	
Plenary: Michael Jordan	C – Grand Ballroom B, Upper 200 Level	10-10:50am
Technical Sessions (MB)	Convention Center & Marriott	11am-12:30pm
Education Committee Meeting	M – Conference Suite 1, Level 3	11am-12noon
Lunch Break (on your own)		12noon-1:30pm
Sections/Societies Officers Lunch (invite only)	M – Salon L, Level 5	12:30-1:30pm
BYOL – Learn about INFORMS Connect	C – Exhibit Hall, Student Lounge	12:30-1:30pm
Bonder Scholarship Lunch	M – Salon J, Level 5	12:30-1:30pm
COIN-OR Members & Users	M – Franklin 9, Level 4	12:30-1:30pm
Service Science PhD Colloquium	M – Salon I, Level 5	12:30-1:30pm
PSOR Business Meeting & Lunch (ticketed event)	M – Salon C, Level 5	12:30-1:30pm
Poster Session	C – Exhibit Hall A, 200 Level	12:30-2:30pm
Publications/Editors-in-Chief	M – Salon K, Level 5	12:30-3:30pm
Fellows Lunch (invite only)	M – Salon H, Level 5	12:45-2:30pm
Technical Sessions (MC)	Convention Center & Marriott	1:30-3pm
Subdivisions Council	M – 501, Level 5	2:30-4:30pm
Keynote: President's Panel	C – Grand Ballroom A, Upper 200 Level	3:10-4pm
Keynote: John Glaser	C – Grand Ballroom B, Upper 200 Level	3:10-4pm
Keynote: 2015 UPS George D. Smith Prize	C – 201C, 200 Level	3:10-4pm
Coffee Break	C – Exhibit Hall A, 200 Level	4-4:30pm
	M – Franklin Foyer	
Technical Sessions (MD)	Convention Center & Marriott	4:30-6pm
INFORMS Community Meetings	See p. 9	
Interfaces Editorial Board Meeting (invite only)	M – Pubs Suite	6:15-7:15pm
International Activities Reception	M – Salon L, Level 5	7:30-9pm
Student Awards Ceremony & Reception	M – Salon E/F, Level 5	7:30-9:30pm
WORMS 20th Anniversary Networking & Dessert Reception	Maggiano's Little Italy	8-10pm

EXHIBITS, INTERNET, EMAIL

Name badges must be worn for admittance to the Exhibit Hall, located in the Pennsylvania Convention Center, 200 Level, during the following hours:

Sunday, Nov. 1	12noon–5pm (7:30–9pm Welcome Reception)
Monday, Nov. 2	9am–5pm
Tuesday, Nov. 3	9am–5pm
Wednesday, Nov. 4	9am–3pm

Free Wi-Fi is available in the Technology Center. Some computers are available if you do not have your own. Name badges should be worn for admittance.



UNIVERSITY RECEPTIONS

Saturday, October 31

University of Texas at Dallas Reception

M- Salon K, Level 5
6–8pm

Monday, November 2

Carnegie Mellon

M – Salon K, Level 5
6–8pm

University of Florida

M – Salon C, Level 5
6–7:30pm

University of Michigan

M - Salon A, Level 5
7–9pm

Cornell University

M – Salon J, Level 5
7:15–8:15pm

Northwestern University

M - Salon D, Level 5
7:30–9:30pm

University of Texas at Austin

M – Salon B, Level 5
7–9pm

University of North Carolina at Chapel Hill

Loews Hotel–PSFS Room
7:30–9:30pm

KEY: M - Marriott C - Convention Center

INFORMS CENTER

Visit the INFORMS Center in Exhibit Hall A for key Annual Meeting activities.

SUNDAY

12noon–2pm

Headshots taken for INFORMS Connect.

12noon–12:30pm

Trivia Challenge in the Student Lounge.

3:30–5pm

Crop Challenge/Syngenta/Analytics Section and **Bonder Scholarships**.

7:30–8:30pm

Meet the **INFORMS Board of Directors and Staff**.

MONDAY

9–10:30am

Meet the editors from **INFORMS Journal on Computing, Math of OR**, and **Information Systems Research**

9:30–10am

Come volunteer for **Pro Bono Analytics**

12:30–1:30pm

Do you need some pointers on **INFORMS Connect**? Meet in the Student Lounge for a tutorial.

3:30–5pm

Speak with editors from **Organization Science** and **Editor's Cut**. See the website that the **History & Traditions Committee** built to celebrate the history of our profession. Meet with officers from the **SpORts** section.

TUESDAY

9–10:30am

Meet the editors from **Management Science** and **INFORMS Transactions on Education**.

11am–1pm

Headshots taken for INFORMS Connect

3:30–5pm

Celebrate 40 years of **Omega Rho** and 20 years of Women in OR/MS (**WORMS**). Propose new **INFORMS initiatives**.

WEDNESDAY

9–10:30am

Health of INFORMS

11am–1pm

Headshots taken for INFORMS Connect.

TUESDAY, NOVEMBER 3

Registration

Chapters/Fora Officers Breakfast

IFORS Officer Breakfast Meeting

Korea Chapter Breakfast

Boathouse Sports Tour (*ticketed event*)

Student Chapter Officers Meeting

OR & Mathematical Analytics for H.S.

Math Teachers (*registration required*)

Technical Sessions (TA)

Exhibits, Career Center, Technology Center

Coffee Break

Plenary: Alfred Spector

Technical Sessions (TB)

Lunch Break (*on your own*)

Keynote: Sanjay Mehrotra

IJOC Editorial Board Meeting (*invite only*)

Women in OR/MS Lunch (*ticketed event*)

Poster Session

Technical Sessions (TC)

Keynote: Alper Atamturk

Keynote: Mihai Anitescu

Keynote: 2015 Wagner Prize Winner

Coffee Break

Technical Sessions (TD)

Exhibitor & Organizing Committee Reception

INFORMS Community Meetings

Certified Analytics Professional Reception

General Reception

WEDNESDAY, NOVEMBER 4

Registration

Technical Sessions (WA)

Exhibits, Career Center, Technology Center

Coffee Break

Plenary: William Rouse

Technical Sessions (WB)

Technical Sessions (WC)

Coffee Break

Technical Sessions (WD)

Technical Sessions (WE)

CAP Exam

C – Exhibit Hall A, 200 Level

M – Salon I, Level 5

M – Salon J, Level 5

M – Salon F, Level 5

C – 12th & Arch St., West Side Tunnel

M – Salon I, Level 5

Drexel University – Lebow Hall

Convention Center & Marriott

C – Exhibit Hall A, 200 Level

C – Exhibit Hall A, 200 Level

M – Franklin Foyer

C – Grand Ballroom B, Upper 200 Level

Convention Center & Marriott

C – Grand Ballroom B, Upper 200 Level

M – Salon L, Level 5

M – Salon H, Level 5

C – Exhibit Hall A, 200 Level

Convention Center & Marriott

C – Grand Ballroom A, Upper 200 Level

C – Grand Ballroom B, Upper 200 Level

C – 201C, 200 Level

C – Exhibit Hall A, 200 Level

M – Franklin Foyer

Convention Center & Marriott

M – Salon J, Level 5

See p. 9

M – Salon K, Level 5

C – Grand Hall, 200 Level

7am–5pm

7–8am

7:30–9am

7:30–9am

8–11am

8–8:45am

8am–3:30pm

8–9:30am

9am–5pm

9:30–10am

10–10:50am

11am–12:30pm

12noon–1:30pm

12:30–1:20pm

12:30–1:30pm

12:30–1:30pm

12:30–2:30pm

1:30–3pm

3:10–4pm

3:10–4pm

3:10–4pm

4–4:30pm

4:30–6pm

5–6pm

5–6:30pm

7:30–9:30pm

C – Exhibit Hall A, 200 Level

Convention Center & Marriott

C – Exhibit Hall A, 200 Level

C – Exhibit Hall A, 200 Level

M – Franklin Foyer

C – Grand Ballroom B, Upper 200 Level

Convention Center & Marriott

Convention Center & Marriott

C – Exhibit Hall A, 200 Level

M – Franklin Foyer

Convention Center & Marriott

Convention Center & Marriott

M – 501, Level 5

7am–4:30pm

8–9:30am

9am–3pm

9:30–10am

10–10:50am

11–12:30pm

12:45–2:15pm

2:15–2:45pm

2:45–4:15pm

4:30–6pm

6–9pm



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Business, Receptions, and Networking...All Welcome!**KEY: M - Marriott C - Convention Center****SUNDAY, NOVEMBER 1**

Information Systems	M – Salon J, Level 5	4:15–5:15pm
Aviation Applications	C – 113C, 100 Level	6:15–7:15pm
Data Mining & Artificial Intelligence	C – 203B, 200 Level	6:15–7:30pm
Decision Analysis Society Council	C – 113A, 100 Level	6:15–7:15pm
Energy, Natural Resources, & Environment	C – 111B, 100 Level	6:15–7:15pm
Forum on Education (INFORM-ED)	C – 111A, 100 Level	6:15–7:15pm
Location Analysis Section (SOLA)	C – 109A, 100 Level	6:15–7:15pm
Manufacturing & Service Ops. Mgt.	C – Ballroom A, Upper 200 Level	6:15–7:15pm
Military Applications Society Board	C – 204B, 200 Level	6:15–7:15pm
Minority Issues Forum	C – 201B, 200 Level	6:15–7:15pm
Multiple Criteria Decision Making	C – 201A, 200 Level	6:15–7:15pm
Optimization	C – 204A, 200 Level	6:15–7:15pm
Railway Applications	C – 202A, 200 Level	6:15–7:15pm
Revenue Management & Pricing	C – 103B, 100 Level	6:15–7:15pm
Simulation	C – 204C, 200 Level	6:15–7:15pm
Telecommunications	C – 203A, 200 Level	6:15–7:15pm
Transportation Science & Logistics Board	C – 201C, 200 Level	6:15–7:15pm
Women in OR/MS	C – 108B, 100 Level	6:15–7:15pm
Revenue Management & Pricing Board	C – 103B, 100 Level	7:15–8:15pm

MONDAY, NOVEMBER 2

Public Sector OR (PSOR)	M – Salon C, Level 5	12:30–1:30pm
Analytics	C – 105B, 100 Level	6:15–7:15pm
Applied Probability	C – 203B, 200 Level	6:15–7:15pm
Computing	C – 201A, 200 Level	6:15–7:15pm
CPMS Isolated Practitioners	C – 104A, 100 Level	6:15–7:15pm
Decision Analysis	C – 113A, 100 Level	6:15–7:15pm
eBusiness	C – 202B, 200 Level	6:15–7:15pm
Financial Services	C – 106A, 100 Level	6:15–7:15pm
Health Applications	C – 201B, 200 Level	6:15–7:15pm
Military Applications	C – 204B, 200 Level	6:15–7:15pm
Quality, Statistics & Reliability	C – 106B, 100 Level	6:15–7:15pm
Social Media Analytics	C – 202A, 200 Level	6:15–7:15pm
Tech, Innovation Mgmt, & Entrepreneurship	C – 204A, 200 Level	6:15–7:15pm
Transportation Science & Logistics	C – Ballroom A, Upper 200 Level	6:15–7:15pm
Behavioral Operations Management	C – 107B, 100 Level	7:15–8:15pm
Military Applications Reception	C – 204B, 200 Level	7:15–10:15pm

TUESDAY, NOVEMBER 3

SpORts	C – 107B, 100 Level	6–7pm
CPMS Section Membership Reception	C – 104A, 100 Level	6:15–7:15pm
Service Science	C – 107A, 100 Level	6:15–7:15pm

**INFORMS COMMUNITIES
FUTURE MEETINGS****Winter Simulation Conference**

December 6-9, 2015
Hyatt Huntington Beach
Huntington Beach, California
Chair: Charles M. Macal, Argonne
National Laboratory
<http://www.wintersim.org/2015/>

**2016 INFORMS Organization
Science Workshop**

February 4-7, 2016
Canyon Resort, Park City, Utah
Chair: Zur Shapira, NYU Stern
<http://pubsonline.informs.org/page/orsc/winter-conference>

**2016 INFORMS Optimization
Society Workshop**

March 17-19, 2016
Princeton University, Princeton, NJ
Chair: Warren Powell, Princeton University

**2016 INFORMS
Telecommunications Conference**

March 20-22, 2016
Renaissance Hotel, Boca Raton, Florida
Chair: Michael R. Bartolacci, Penn State Berks
<https://sites.psu.edu/informstelecom2016/>

**2016 INFORMS Revenue
Management and Pricing**

June 16-17, 2016
New York University, New York
Chairs: Ilan Lobel, Srikanth Jagabathula
and Gustavo Vulcano, New York University

**2016 INFORMS Marketing
Science Conference**

June 16-18, 2016
Shanghai, China
Chair: Icey Han, Fudan University

2016 INFORMS TSL Conference

June 20-22, 2016
George Tech, Atlanta, GA
Chair: Alejandro Toriello, Georgia Tech.

**2016 INFORMS Revenue
Management and Pricing**

June 29-30, 2016
CWI, Amsterdam
Chair: Arnoud Den Boer,
Centrum Wiskunde & Informatica

**INFORMS Southeastern
Chapter Conference**

October 7-8, 2016
Myrtle Beach Hilton Resort
Myrtle Beach, SC

Winter Simulation Conference 2016

December 11-14, 2016
Crystal Gateway Marriott
Arlington, VA
Chair: Todd R. Huschka, Mayo Clinic

SATURDAY, OCTOBER 31**INFORMS Membership Meeting & Reception**

5–6pm
Salon H, Level 5, Marriott

The INFORMS Board of Directors encourages all members to bring their ideas, opinions, and suggestions to this annual meeting. Current business and future directions for INFORMS are on the agenda. Wine and cheese will be served.

SUNDAY, NOVEMBER 1**New Member Welcome Breakfast**

7–8am
By Invitation Only
Salon E, Level 5, Marriott

New INFORMS members received an invitation for this welcome breakfast. The session will feature a presentation on member benefits, a brief orientation to navigating the meeting, and a chance to relax and connect with colleagues. Representatives from INFORMS Communities will facilitate networking tables where you can meet other members who share your professional interests.

Junior Faculty Interest Group Luncheon

12:30–1:30pm
Salon F, Level 5, Marriott
\$35 (\$25 students, \$45 nonmember)

A limited number of tickets may be available on-site. Go to *INFORMS Registration* for information on availability. **No tickets will be sold at the door.**

The winners of the 2015 JFIG Paper Competition will be presented with awards. All junior faculty are invited to participate. This event gives junior faculty in engineering and business schools the opportunity to discuss career development and exchange ideas.

Sponsored by *University of Arkansas, Department of Industrial Engineering; North Carolina State University, Department of Industrial Systems Engineering, Georgia Southern University; Iowa State University, Department of Industrial and Manufacturing Systems Engineering; and University of Tennessee, Knoxville*

INFORMS Connect and Social Networking Reception

6:30–7:30pm
Salon L, Level 5, Marriott

What's your social networking strategy for yourself or for INFORMS? We invite all contributors to INFORMS social networking

sites to come and meet face-to-face. Join us for refreshments and drinks - we are your INFORMS Online community!

Minority Issues Forum Reception

8–9pm
Salon F, Level 5, Marriott

Come meet old friends and make new ones while talking about minority issues, other intellectual issues, and opportunities. Posters submitted to the Minority Issues Forum Poster Competition will be on display during the reception.

Sponsored by *North Carolina Agricultural and Technical State University, Department of Industrial and Systems Engineering; Texas A&M University, Industrial and Systems Engineering; North Carolina State University, Industrial and Systems Engineering; University of Michigan; University of Maryland, Department of Operations and Information Technology; and Cornell University*

MONDAY, NOVEMBER 2**BYOL - Bring Your Own Laptop and Learn About INFORMS Connect**

12:30–1:30pm
Exhibit Hall A, Student Lounge, Convention Center

Bring your laptop, your INFORMS username and password, and a lunch. We will cover frequently asked questions about this INFORMS member benefit. Prepare your questions and enjoy the chance to Connect with members both virtually and IRL (in real life).

COIN-OR Members & Users Meeting – (Bring Your Own) Bag Lunch

12:30–1:30pm
Franklin 9, Level 4, Marriott

Anyone interested in open-source software tools, open standards, and data/model repositories for any aspect of operations research are encouraged to attend this Computational Infrastructure for OR (COIN-OR) meeting. Please bring your own lunch and ideas.

PSOR Business Meeting/Lunch

12:30–1:30pm
Salon C, Level 5, Marriott
\$15 Section member (\$25 nonmember)

A limited number of tickets may be available on-site. Go to *INFORMS Registration Desk* for information on availability. **No tickets will be sold at the door.**

This lunch and business meeting is open to members of the INFORMS Section on Public Programs, Service and Needs, and those who are interested in joining the section.

PSOR Lunch sponsored by *George Washington University, Department of Engineering Management and Systems Engineering; and University of Michigan, Department of Industrial and Operations Engineering*

INFORMS Fellows Luncheon

12:45–2:30pm
By Invitation Only
Salon H, Level 5, Marriott

This luncheon honors INFORMS Fellows, examples of outstanding lifetime achievement in operations research and the management sciences. These individuals have demonstrated exceptional accomplishments and made significant contributions to the advancement of OR/MS over a period of time. Their service to the profession and to INFORMS has culminated in election to the INFORMS Fellow Award.

Class of 2015 Newly-Elected**INFORMS Fellows**

C. Allen Butler	Jack Levis
G�rard Cachon	Pitu Mirchandani
Pinar Keskinocak	Benjamin Van Roy
Eva K. Lee	Rakesh V. Vohra

Student Awards Ceremony & Student Reception

Awards Ceremony: 7:30–8pm
Reception: 8–9:30pm
Salon E/F, Level 5, Marriott

All students registered for the meeting are invited to attend the Student Awards Ceremony. The Chapters/Fora Committee will present the winners of the Student Chapter Annual Awards and the Judith Liebman Awards. Join us to recognize the great contributions of our most dynamic student volunteers. Plan to stay for the Student Reception, which immediately follows the ceremony.

The reception that follows the Student Awards Ceremony is open to all students – join us for an evening of food and drink, fun and networking. Come relax after a busy day of sessions and mingle with fellow students from universities around the world.

Thank You

 The Seth Bonder Foundation

WORMS 20th Anniversary Networking Dessert Reception

8–10pm
Maggiano's Little Italy, 1201 Filbert St.,
Philadelphia, PA 19107

Come celebrate the 20th anniversary of the Forum for Women in OR/MS with a buffet of delicious Italian desserts. Make new connections in an informal setting. Open to all INFORMS members (members of WORMS or not), female and male! Soft drinks are complimentary. One free alcoholic drink for the first 50 guests.

TUESDAY, NOVEMBER 3

Women in OR/MS Forum Luncheon

12:30–1:30pm
Salon H, Level 5, Marriott
\$28 (\$18 students) **SOLD OUT. No Tickets will be sold at the door.**

All those interested in issues related to women professionals in OR/MS are invited to join us.

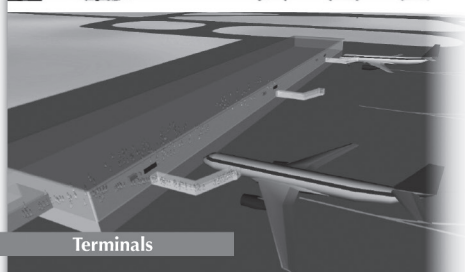
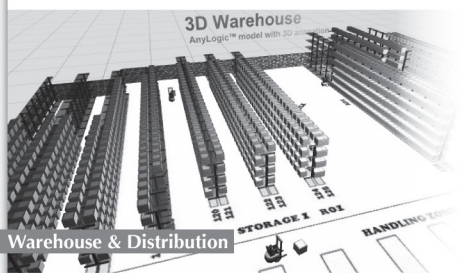
Sponsored by University of Southern California, Marshall School of Business; Gilbert Laporte, Ph.D., University of

Michigan, Industrial and Operations Engineering Department; The Department of Operations & Decision Technologies at the Kelley School of Business; Eindhoven University of Technology; Inverse Limit, LLC; UCLA Anderson School of Management; University of Texas at Austin; University of Texas at Dallas; Texas A&M University; Harvey Mudd College; European Business School (ICSM); The Ohio State University, Integrated Systems Engineering; University of Arizona, Systems and Industrial Engineering; New York University; University of Chicago, Booth School of Business; California State University, Long Beach; H. Milton Stewart School of Industrial and System Engineering, Georgia Institute of Technology; University of Illinois at Urbana-Champaign, ISE Department; Candace Yano; University of Florida, College of Engineering; Southern Methodist University, Cox School of Business; Southern Methodist University, Lyle School of Business; Duke University, Fuqua School of Business; Pennsylvania State University, Supply Chain and Information Systems Department; University of Florida, Warrington College of Business; and The University of Texas at Arlington, Department of Industrial, Manufacturing, and Systems Engineering

ESPECIALLY FOR STUDENTS

Coffee with a Member

This wonderful program connects INFORMS students with some of INFORMS most enthusiastic members for 15-minute impromptu meetings and some sage INFORMS advice. We know the Annual Meeting can be a bit overwhelming and hope these casual meetings will make students more comfortable, knowledgeable, and enthusiastic about both the meeting and INFORMS. Student attendees were offered the opportunity to sign up before the meeting on a first-come, first-served basis (it is not possible to sign up in Philadelphia.) We will follow up after the meeting with a short survey to the students and members who participated to help us improve the program for future meetings.



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SUNDAY

WELCOME RECEPTION
& EXHIBITS

7:30–9pm

Exhibit Hall A, 200 Level, Convention Center

The Welcome Reception is the perfect venue to meet with colleagues and visit the exhibits. Light snacks will be served. Soft drinks are complimentary, with a cash bar for other beverages.

INFORMS AWARDS CEREMONY
& DESSERT RECEPTION

8:30–9:45pm (Doors close at 8:45pm)
Salon G/H, Level 5, Marriott

The INFORMS Board of Directors invites you to honor and celebrate the achievements of our colleagues at the annual Awards Ceremony. You can attend the Welcome Reception first and then proceed to Salon G/H in the Marriott for the Awards Ceremony. Following the ceremony, you'll have an opportunity to congratulate the awardees at a special dessert reception. Please note that the reception is part of the ceremony event, open to the awardees, their friends and colleagues, and all those who attend the Award Ceremony itself. We are sorry we cannot accommodate guests at the reception who do not also attend the ceremony.

These prestigious awards will be presented during the ceremony:

Saul Gass Expository Writing Award
Martin Lariviere, Northwestern University

INFORMS President's Award
To Be Announced at Awards Ceremony

Frederick W. Lanchester Award
To Be Announced at Awards Ceremony

Prize for the Teaching of OR/MS Practice
Thomas W. Lucas, Naval Postgraduate School

George E. Kimball Medal
Jack Levis, UPS
Anne G. Robinson, Verizon Wireless

John von Neumann Theory Prize
To Be Announced at Awards Ceremony

Bonder Scholarship for Applied Operations Research in Health Services
Hadi El-Amine, Virginia Tech

Bonder Scholarship for Applied Operations Research in Military Applications
Major Ross Schuchard, George Mason University

Four student awards will also be announced during the ceremony: George E. Nicholson Student Paper Competition, George B. Dantzig Dissertation Prize, Doing Good with Good OR Student Competition, and Undergraduate Operations Research Prize.

TUESDAY

GENERAL RECEPTION

7:30–9:30pm

Grand Hall, 200 Level,
Convention Center

Philadelphia is the home of many culinary institutions, both gourmet and local. Join us as we serve up a fun, locally inspired menu including the Philly cheesesteaks created in Philadelphia in the 1930s. This year's General Reception will also feature a traditional Mummers string band for entertainment. Complimentary soft drinks and a cash bar will be available. This reception provides the perfect atmosphere for fellowship and networking, while also having a bit of fun after a long day of sessions.



informs

EDITOR'S CUT®

INFORMS Editor's Cut is a comprehensive online multimedia portal designed to enrich the knowledge base of those interested in analytics and operations research applied across a variety of topics. These unique collections, curated by recognized thought leaders, provide users with a simple and effective way to access the vast wealth of INFORMS content.

Current volumes include Healthcare in the Age of Analytics and Analytics in Sports. Visit the INFORMS Center on Monday, 3:30–5pm to meet editors and learn about Editor's Cut.

<http://pubsonline.informs.org/editorscut>



MOBILE APP



The INFORMS Meetings App is available for iOS and Android devices. Detailed information, including the schedule of sessions, session abstracts, meeting locations maps, exhibit details, and much more can be found on the app. This dynamic app can be downloaded directly to your device by visiting the iTunes Store or the Google Play Store and searching for "INFORMS Meetings."

When you view the meeting program in the app, you can either browse through the parallel sessions and special events or search for a specific speaker or keywords. As you locate the events, sessions and presentations you are interested in, click on the star button, which bookmarks it to the My Schedule itinerary. Use My Schedule for a quick reference tool.

One of the great features of the conference app is that it allows you to use the Badge Scanner - located in the top-right of the user menu - to send another member a contact request through INFORMS Connect. Simply scan the QR code on their meeting badge, click "Add Friend" and it will send them a contact request.

New This Year: INFORMS Walking Leaderboard

Who can accumulate the most steps over the course of the Annual Meeting? Log into "My Profile" found in the user menu of the app, select INFORMS Walking Leaderboard, and enter in the number of steps you walked that day by checking your phone or fitness tracker for steps. To be a leader for a particular day, you must enter your steps by 11:59pm EST. If you forget to track a day's steps, you can still enter your steps to be added to your cumulative total. We will award daily prizes, in addition to a FitBit sponsored by the **INFORMS SpORtS** section for the cumulative total champion.

SELF-SERVICE KIOSKS

Receipts – Print your conference receipt on demand by going to Exhibit Hall A, 200 Level, Convention Center, located near INFORMS Registration.

Program Flip Books – Three kiosks are available for full program information. Two are located in Exhibit Hall A and the third kiosk will be located in the Marriott on Level 4.

Express On-site Registration – Avoid the lines and make use of the two express kiosks that are available for express on-site registration in Exhibit Hall A, 200 Level, Convention Center near INFORMS Registration.

Ribbons – Are you a Session Chair, Cluster Chair or an attendee that is "Going Green" and need your ribbons? New this year we have a 'ribbon wall' where you can select a ribbon or ribbons that can be added to your badge holder!

ENGAGE WITH ONLINE TOOLS

Blogs

Check out the Philadelphia 2015 website for posts from our talented group of bloggers during and after the meeting:

Ana-Iulia Alexandrescu	David Morrison
John Angelis	Anna Nagurney
Aaron Burciaga, CAP	Scott Nestler, CAP
C. Allen Butler	Patrick Noonan
Sertalp Çay	Paul Rubin
James Cochran	Matt Saltzman
Walt DeGrange	Harrison Schramm, CAP
Neil Desnoyers	Thiago Serra
Burcu Keskin	Bismark Singh
S. Phil Kim	Francis Sneddon
Marco Lübbecke	Shivaram Subramanian
Laura McLay	Aurelie Thiele
Polly Mitchell-Guthrie	Michael Trick

All attendees are welcome to blog. For instructions, email mary.leszczynski@informs.org or drop by the INFORMS Center in Exhibit Hall A, 200 Level.



Join the Twitter Conversation

Add the hashtag #informs2015 to your tweets to associate them with the meeting. Tweets with #informs2015 will be displayed in the Attendee Twitter Feed on the homepage, along with official conference tweets that will alert you to late-breaking information. If you haven't become a Twitter-ite but would like an introduction, stop by the INFORMS booths for a quick lesson. Follow @INFORMS2015 for official meeting announcements.



LinkedIn

Connect with other attendees on the Annual Meeting LinkedIn group to discuss key topics. Go to the Annual Meeting website homepage to find a link leading to the Annual Meeting LinkedIn group.



Pinterest

Visit our Pinterest Annual Meeting Board to view a collection of fun things to do and see while visiting Philadelphia: <https://www.pinterest.com/informs/2015-informs-annual-meeting-philadelphia/>.



Share Your Conference Photos

Attendees are encouraged to take photos and videos at the meeting. Send your photos to photosandvideo@mail.informs.org so we can post them in our Flickr album and on the meeting blog.

eNews Daily

INFORMS is publishing the eighth volume of its popular Annual Meeting eNews Daily in Philadelphia. This official record of the Annual Meeting is delivered each day to your inbox, providing a recap of the previous day's happenings and a preview of the upcoming can't-miss events. There are links to each issue on the Annual Meeting website. If you would like to advertise in eNews Daily, visit the sponsor page on the Annual Meeting website.

All Plenary & Keynote Presentations will take place in the Convention Center.

SUNDAY, NOVEMBER 1

WELCOME & PLENARY

10–10:50am

Grand Ballroom B, Upper 200 Level

Welcome

Tamás Terlaky, General Chair, INFORMS Annual Meeting Chair: Department of Industrial and Systems Engineering, Lehigh University

Edward H. Kaplan, President-Elect, INFORMS
William N. and Marie A. Beach Professor of Operations Research, Professor of Public Health & Professor of Engineering, Yale University

PLENARY

Omega Rho Distinguished Lecture

Creating Impact with Operations Research in Health

Margaret L. Brandeau, Coleman F. Fung Professor of Engineering and Professor of Medicine (by Courtesy), Stanford University

OR-based analyses have the potential to improve decision making for many important problems in healthcare. However, scholars – particularly junior scholars – often avoid working on practical applications in health because promotion and tenure processes tend to value theoretical studies more highly than applied studies. This talk discusses the speaker's experiences in using OR to inform and influence decisions in health, and provides a blueprint for researchers who wish to find success by taking a similar path. We also suggest how journals, funding agencies, and senior academics can encourage such work by taking a broader and more informed view of the potential role and contributions of OR to solving healthcare problems.



Margaret L. Brandeau is Coleman F. Fung Professor of Engineering and Professor of Medicine (by Courtesy) at Stanford University. Her research focuses

on the development of applied mathematical and economic models to support health policy decisions. Her recent work has focused on HIV prevention and treatment programs, programs to control the spread of hepatitis

B virus, and preparedness plans for bioterror response. She has published extensively in the areas of health policy modeling, operations management, management science applications, and bioterrorism preparedness planning. She is an INFORMS Fellow, and has received the INFORMS President's Award (recognizing important contributions to the welfare of society), the Pierskalla Award from INFORMS (for research excellence in healthcare management science), the Award for Excellence in Application of Pharmacoeconomics and Health Outcomes Research from the International Society for Pharmacoeconomics and Outcomes Research (ISPOR), and a Presidential Young Investigator Award from the National Science Foundation, among other awards. Professor Brandeau earned a BS in mathematics and an MS in operations research from MIT, and a PhD in engineering-economic systems from Stanford University.

OMEGA RHO

OMEGA RHO, the official Honor Society of INFORMS, was founded in 1976 to recognize superior scholarship and encourage leadership in operations research, management science, and related disciplines. The society has 40 active collegiate chapters, more than 5,000 student and faculty members, and is a member of the Association of College Honor Societies. In addition to sponsoring OMEGA RHO Distinguished Lectures at INFORMS Annual and International meetings, OMEGA RHO provides financial support to the annual INFORMS Colloquium. Honorary membership in OMEGA RHO is bestowed upon individuals who provide leadership and extraordinary support for the encouragement of operations research and management science through their professional activities. Prior to delivering the OMEGA RHO Distinguished Lecture, Margaret L. Brandeau will be inducted as an Honorary Member of OMEGA RHO.



KEYNOTE

3:10–4pm

Grand Ballroom A, Upper 200 Level

Stochastic Networks: Scaling Limits, Performance Analysis and Optimization

Kavita Ramanan, Professor, Division of Applied Mathematics, Brown University

Stochastic networks are ubiquitous and arise in diverse fields including telecommunications, service systems for call centers and healthcare, computer networks, and biological systems. These networks are typically too complex to admit an exact analysis. However, it is often possible to obtain tractable approximations of both transient and equilibrium behavior that can provide key insight into network performance. These include both deterministic or fluid approximations that describe mean behavior and diffusion approximations that capture stochastic variability. The accuracy of these approximations in a suitable network parameter regime can be rigorously justified through "limit theorems." While the mathematical methods required to justify these approximations are fairly well developed for some classes of single-server networks that use so-called head-of-the-line scheduling policies, new approaches are required to analyze many other classes of networks that are of relevance for applications, such as large-scale load-balancing networks used, for example, in distributed memory machines and Web servers. We provide a survey of these mathematical methods and the associated scaling limits, with an emphasis on recent developments, and illustrate through a number of concrete examples how these approximations can be used to develop new algorithms and optimize network design.



Kavita Ramanan is a professor in the Division of Applied Mathematics at Brown University. She was a professor at the Mathematical Sciences Department at

Carnegie Mellon University and a member of technical staff at the Mathematical Sciences Research Center at Bell Laboratories. Her research lies in the area of probability theory, stochastic processes, and their applications, including the study of stochastic networks that arise in telecommunications and operations research. She has served on numerous editorial boards including the

All Plenary & Keynote Presentations will take place in the Convention Center.

Annals of Probability, Annals of Applied Probability, and Mathematics of Operations Research and Queueing Systems. She is a recipient of the Erlang Prize of the INFORMS Applied Probability Society (2006), was elected fellow of the Institute for Mathematics and Statistics (IMS) in 2013, and was an IMS Medallion Lecturer in 2015.

KEYNOTE

3:10–4pm
Grand Ballroom B, Upper 200 Level

Optimization Techniques in Data Analysis

Stephen J. Wright, Professor of Computer Sciences, University of Wisconsin-Madison

Optimization perspectives have provided valuable insights into machine learning and data analysis problems, and optimization formulations have led to practical algorithms with good theoretical properties. In turn, the rich collection of problems arising in learning and data analysis is driving new fundamental research in optimization, reviving interest in well-established techniques and stimulating development of new methods. We discuss research on several areas of learning and data analysis, including regression/classification, signal and image reconstruction, and manifold learning, in each case describing problem areas in which optimization algorithms have been developed and successfully applied.



Stephen J. Wright is a professor of computer sciences at the University of Wisconsin-Madison. His research focuses on computational optimization and its

applications to many areas of science and engineering. Prior to joining UW-Madison in 2001, Wright was a senior computer scientist at Argonne National Laboratory (1990–2001), and a professor of computer science at the University of Chicago (2000–2001). He has served as chair of the Mathematical Optimization Society and as a Trustee of the Society for Industrial and Applied Mathematics (SIAM). He is a Fellow of SIAM. In 2014, he won the W.R.G. Baker Award from IEEE. Wright is the author or coauthor of widely used text/reference books in optimization including *Primal Dual Interior-Point Methods* (SIAM 1997) and *Numerical Optimization* (2nd ed., Springer 2006, with J. Nocedal). He has published on optimization theory, algorithms, software, and applications.

Wright is editor-in-chief of the *SIAM Journal on Optimization* and has served as editor-in-chief or associate editor of *Mathematical Programming: Series A and B*, *SIAM Review*, and *Applied Mathematics and Computation*.

KEYNOTE

3:10–4pm
201C, 200 Level

Reprise of 2015 Edelman Award-Winning Presentation

Joseph Byrum, Craig Davis, Gregory Doonan, Tracy Doubler, David Foster, Bruce Luzzi, Ronald Mowers, Chris Zinselmeier

Syngenta, a leading developer of crop varieties (seeds) that provide food for human and livestock consumption, is committed to bringing greater food security to an increasingly populous world by creating a transformational shift in farm productivity. Syngenta Soybean Research & Development (R&D) is leading Syngenta's corporate plant-breeding strategy by developing and implementing a new product development model that is enabling the creation of an efficient and effective soybean breeding strategy. Key to the new strategy is the combination of advanced analytics and plant-breeding knowledge to find opportunities to increase crop productivity and optimize plant-breeding processes. Syngenta uses discrete-event and Monte Carlo simulation models to codify Syngenta Soybean R&D best practices, and uses stochastic optimization to create the best soybean breeding plans and strategically align its research efforts. As a result of using these new analytical tools, Syngenta estimates that it will save more than \$287 million between 2012 and 2016.

FRANZ EDELMAN AWARD

The Franz Edelman Award for Achievement in Operations Research and the Management Sciences calls out, recognizes, and rewards outstanding, high impact applications of OR/MS. Each year, six finalists compete in the "Super Bowl" of O.R. in practice. The 2015 finalists include IBM, Ingram Micro, LMI/Defense Logistics Agency, Saudi Arabia Ministry of Municipal and Rural Affairs, Syngenta, and U.S. Army. In this keynote, the first-place Syngenta will reprise their winning presentation.

MONDAY, NOVEMBER 2

PLENARY

10–10:50am
Grand Ballroom B, Upper 200 Level

Computational Thinking, Inferential Thinking and Big Data

Michael I. Jordan, Pehong Chen
Distinguished Professor in the Department of Electrical Engineering and Computer Science, Department of Statistics, University of California, Berkeley

The rapid growth in the size and scope of datasets in science and technology has created a need for novel foundational perspectives on data analysis that blend the inferential and computational sciences. The fact that classical perspectives from these fields are not adequate to address emerging problems in "Big Data" is apparent from their sharply divergent nature at an elementary level—in computational science, the growth of the number of data points is a source of "complexity" that must be tamed via algorithms or hardware, whereas in statistics, the growth of the number of data points is a source of "simplicity" in that inferences are generally stronger and asymptotic results can be invoked. On a formal level, the gap is made evident by the lack of a role for computational concepts such as "runtime" in core statistical theory and the lack of a role for statistical concepts such as "risk" in core computational theory. I present several research vignettes aimed at bridging computation and statistics, including the problem of inference under privacy and communication constraints, algorithm weakening as a tool for trading off the speed and accuracy of inference, and the theoretical study of lower bounds that embody computational and statistical constraints.



Michael I. Jordan is the Pehong Chen Distinguished Professor in the Department of Electrical Engineering and Computer Science and the Department

of Statistics at the University of California, Berkeley. His research interests bridge the computational, statistical, cognitive, and biological sciences, and have focused in recent years on Bayesian nonparametric analysis, probabilistic graphical models, spectral methods, kernel machines, and applications to problems in distributed computing systems, natural language

All Plenary & Keynote Presentations will take place in the Convention Center.

MONDAY CONTINUED

processing, signal processing, and statistical genetics. Professor Jordan is a member of the National Academy of Sciences, National Academy of Engineering, and American Academy of Arts and Sciences. He is a Fellow of the American Association for the Advancement of Science. He has been named a Neyman Lecturer and a Medallion Lecturer by the Institute of Mathematical Statistics. He received the David E. Rumelhart Prize in 2015 and the ACM/AAAI Allen Newell Award in 2009. He is a Fellow of the AAAI, ACM, ASA, CSS, IEEE, IMS, ISBA, and SIAM.

KEYNOTE

3:10–4pm
Grand Ballroom A, Upper 200 Level

President's Panel

Moderated by Tamás Terlaky, General Chair, INFORMS Annual Meeting Chair: Department of Industrial and Systems Engineering, Lehigh University

Panelists: Mark C. Reed, Saint Joseph's University; Dr. Ali A. Houshmand, Rowan University; Stephen Klasko, Thomas Jefferson University and Jefferson Health System; John D. Simon, Lehigh University



Mark C. Reed, Ed.D., began his tenure as the 28th president of Saint Joseph's University, and the first lay president in the University's 164-year history, on July 1,

2015. Formerly, Dr. Reed served as senior vice president and chief of staff at Fairfield University, in Fairfield, CT.

A 1992 graduate of St. Joseph's Preparatory School in Philadelphia, Reed received a B.S. in mathematics from Fairfield University in 1996, a Master of Education in secondary educational administration from Boston College in 1999, an MBA from Fairfield in 2002, and a Doctorate of Education in higher education management from the University of Pennsylvania in 2008.

During his 15-year career at Fairfield and prior to his most recent position as senior vice president and chief of staff, Reed served as the institution's interim vice president for university advancement; vice president for administration and student affairs; vice president for student affairs; associate vice

president and dean of students; and dean of students. He is a past president of the Jesuit Student Affairs Association, and also taught mathematics as an adjunct faculty member at Fairfield. He recently received Fairfield's Distinguished Faculty/Administrator Award. Preceding his career in higher education, Dr. Reed worked as a teacher and administrator in Catholic secondary education.



Dr. Ali A. Houshmand became Rowan University's seventh president in June 2012 after serving approximately six years as provost/senior vice president, CEO, and

interim president. His vision and leadership have set the University on a path of unprecedented transformation, most recently earning Rowan regard as New Jersey's second comprehensive research university.

In just the past three years under Dr. Houshmand's leadership, Rowan opened Cooper Medical School of Rowan University and integrated the School of Osteopathic Medicine from the former University of Medicine and Dentistry of New Jersey. Rowan is now just the second university in the nation to offer M.D. and D.O. degree programs.

Dr. Houshmand remains steadfast in believing the University must stay loyal to its core mission: top-quality, affordable, undergraduate education. To that end, he committed to not raising undergraduate tuition beyond the cost of inflation during his tenure.

Dr. Houshmand is an active partner in economic development. A hallmark of this commitment is the Rowan Boulevard project—a \$300-million collaboration of private developers, the Borough of Glassboro, and the University to create an educational and economic corridor that is reinventing the historic downtown and changing the definition of "town-gown" relations.

He has broadened this philosophy to make the University more entrepreneurial, with a goal of increasing research and academic offerings at the intersection of science, technology, business, engineering, and medicine. Plans are under way to expand the University's technology park and introduce several Ph.D. programs.

Determined to address the severe shortage of access to high-quality undergraduate education in New Jersey's southern half,

Dr. Houshmand has committed to increase Rowan's enrollment from 15,000 to 25,000 students by 2023, increase annual research funding from \$25 million to \$100 million, and increase Rowan's operating budget from \$400 million to \$1 billion, making Rowan one of the region's most important economic engines.

Dr. Houshmand earned his bachelor's and master's degrees in mathematics and mathematical statistics from the University of Essex, United Kingdom. He earned a second master's degree and a doctoral degree in industrial and operations engineering from the University of Michigan, Ann Arbor. He then worked as a staff analyst for United Airlines, developing large-scale optimization and forecasting models. Leaving industry for academia, he joined the University of Cincinnati and, later, Drexel University, where he taught and held several academic administrative positions before coming to Rowan.



Stephen Klasko is president of Thomas Jefferson University and CEO of Jefferson Health System after serving as CEO of USF Health and dean of the University

of South Florida College of Medicine. A board certified OB-GYN, he is bridging the art and science of medicine and healthcare information technology through an entrepreneurial-academic model. After receiving his M.D. and completing his obstetrics and gynecology residency, he completed his M.B.A. at the Wharton School of Business, University of Pennsylvania.

At Jefferson, Dr. Klasko leads an academic medical center that consistently ranks among the top academic health systems in the country with 19,000 employees, five hospitals, and over 2,000,000 patient visits. In 2015, he led the merger of Thomas Jefferson University and Health System and Abington Health Network in one of the nation's first shared governance, "hub and hub" academic medical center mergers.

Over the last several years, he has led the development of the first medical school choosing students based on emotional intelligence, led the team that built the country's largest assessment of technical and teamwork competence center, and created an innovative primary care-driven, patient-centric, Medicare-based accountable care model within the country's largest retirement community and created Jeff Connect:

All Plenary & Keynote Presentations will take place in the Convention Center.

Medicine Without Walls, a unique telehealth and unscheduled care innovation entity.

Dr. Klasko has been on the boards of several national nonprofit hospital systems and is currently on the corporate board of Teleflex (TFX: NYSE), a global medical device company. He has recently been named as a trustee of Lehigh University. He has written extensively on the need to change the "DNA of healthcare" by transforming the selection and education of health professionals. To that end, he has received over two million dollars in grants researching the biases affecting physicians' willingness to accept change. He has written over 200 peer-reviewed articles and books including *The Phantom Stethoscope* (Hillsboro Press 1999) and "Mamas Don't Let Your Babies Grow Up to Be OB-GYNs."



John D. Simon became the 14th president of Lehigh University in July 2015. He previously was executive vice president and provost of the

University of Virginia, where he oversaw the academic activities of more than 20,000 undergraduate and graduate students as well as 2,200 faculty. Under his leadership, the University of Virginia launched several important programs including UVA's Data Science Institute; he created a new physical presence in Asia and established an Endowment for the Arts, among many other notable accomplishments. Before arriving at the University of Virginia, John served as vice provost of academic affairs at Duke University and chairman of Duke's chemistry department. He received his B.A. in chemistry from Williams College and Ph.D. from Harvard University. He is a fellow of the American Physical Society and the American Association for the Advancement of Science. He is the author of more than 250 scientific papers and three textbooks. His most recent research focuses on the chemical properties of pigments preserved in the fossil record.

KEYNOTE

3:10–4pm
Grand Ballroom B, Upper 200 Level

The Advent of the Intelligent Electronic Health Record

John Glaser, Executive Vice President, Cerner

We have made great progress in embedding the electronic health record (EHR) in our

healthcare processes, with use reaching unprecedented rates. Now, we are poised to take it the next level with the intelligent EHR. The intelligent EHR will look very similar to the traditional system – one can still look up patient results and history and write prescriptions but the application will move past transactional functions. The intelligent EHR will be characterized by sophisticated and flexible decision support, rules engines, process monitoring engines, intelligent displays of important patient data, access to knowledge resources, the ability to collect data from multiple care settings through a health information exchange, and tools that enable provider collaboration.

The advent of the intelligent EHR will be necessary if healthcare is to effectively address challenges such as those generated by payment reform and managing the care of chronically ill populations.



John Glaser, executive vice president at Cerner, is responsible for driving technology and product strategies, interoperability, and government policy development.

Glaser has devoted his career to furthering healthcare through innovation. He is committed to helping clients maximize their investment in HIT. Prior to joining Cerner, Glaser was CEO of the Health Services business unit of Siemens Healthcare, where he was responsible for heading Siemens' global healthcare IT business. Cerner acquired Siemens Health Services in February 2015. Formerly, Glaser was vice president and chief information officer at Partners HealthCare, Inc. Prior to that, he was vice president of information systems at Brigham and Women's Hospital. Glaser is a well-respected industry thought leader. He was the founding chair of the College of Healthcare Information Management Executives (CHIME), the past president of the Healthcare Information & Management Systems Society (HIMSS), and has served on numerous boards including the eHealth Initiative, National Alliance for Health Information Technology, and American Medical Informatics Association (AMIA). Additionally, Glaser is a fellow of HIMSS, CHIME, and the American College of Medical Informatics. He is also a former senior advisor to the Office of the National Coordinator for Health Information Technology (ONC). Glaser has published more than 150 articles and three books on the strategic application of information technology in healthcare,

including the most widely used textbook on the topic, *Healthcare Information Systems: A Practical Approach for Health Care Management*. Glaser is on the faculty of the Wharton School at the University of Pennsylvania, the Medical University of South Carolina, and the Harvard School of Public Health. He received his PhD in healthcare information systems from the University of Minnesota.

KEYNOTE

3:10–4pm
201C, 200 Level



Reprise of the 2015 UPS George D. Smith Prize

The Centre for Operations Excellence and the Master

of Management in Operations Research program at the Sauder School of Business, University of British Columbia, provides rigorous practical training in the quantitative analysis of business problems. We will present an overview of the program, starting with a look back at its history, outlining details of how the program is structured (focusing in particular on the "industry project"), and sharing ideas about what has helped the program succeed.

UPS SMITH PRIZE

The UPS George D. Smith Prize recognizes an academic department or program for effective and innovative preparation of students to be good practitioners of O.R., management science, or analytics. The UPS George D. Smith Prize is created in the spirit of strengthening ties between industry and the schools of higher education that graduate young practitioners of operations research. INFORMS, with the help of CPMS, awards the prize annually to an academic department or program for effective and innovative preparation of students to be good practitioners of operations research, management science, or analytics. The UPS George D. Smith Prize is named in honor of the late UPS chief executive officer who was a champion of operations researchers at a leading Fortune 500 corporation. UPS has generously underwritten the award in his memory.

All Plenary & Keynote Presentations will take place in the Convention Center.

TUESDAY, NOVEMBER 3

PLENARY

10–10:50am

Grand Ballroom B, Upper 200 Level

Empiricism and Optimization in the World of Big Data

Alfred Z. Spector, (retired) Vice President of Research and Special Initiatives, Google

In its first decades, computer science combined mathematical analysis (e.g., the study of computability and algorithms) and engineering (e.g., abstraction, encapsulation, and re-use). However, empiricism became an equally important third leg in the 1980s. This happened because of the (1) growth in computer usage and data availability, (2) exponential growth in communications, computation, and storage capabilities, (3) progress in machine learning and optimization, and (4) significant economic and scientific rewards. This presentation will cover the growth and benefits of empirical computer science to date but will focus on key challenges moving forward, particularly considering the advantages, and consequences, of various forms of optimization. In particular, I will discuss open questions regarding big data and artificial intelligence, issues in big data and science (including a discussion of the role of the hypothesis), and some fascinating, if not problematic, societal implications.



Alfred Z. Spector

recently retired as vice president of Research and Special Initiatives at Google. There, he was responsible for research at Google and also

Google's open source, university relations, internationalization, and various education initiatives. He was also the executive engineering lead for Google.org. Previously, Dr. Spector was vice president of strategy and technology at IBM's Software Business, and prior to that, he was vice president of services and software research across IBM. He was also founder and CEO of Transarc Corporation, a pioneer in distributed computing, and was a professor of computer science at Carnegie Mellon University. Beginning in 2004, Dr. Spector has been the lead proponent of "CS+X" – a short-hand for the need to infuse computer science into the study and practice of every discipline, X. Dr. Spector received his Ph.D. in computer science from Stanford and a bachelor's degree in applied mathematics

from Harvard. He is a member of the National Academy of Engineering and a Fellow of IEEE, ACM, and American Academy of Arts and Sciences. Dr. Spector is also the recipient of the 2001 IEEE Computer Society's Tsutomu Kanai Award for work in scalable architectures and distributed systems.

KEYNOTE

12:30–1:20pm

Grand Ballroom B, Upper 200 Level

Optimizing Healthcare and Using Healthcare to Motivate the Development of New Optimization Models, Methods, and Tools

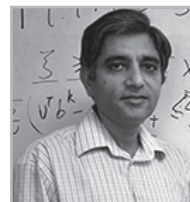
Sanjay Mehrotra, Director, Center for Engineering at Health, Northwestern University

Healthcare globally is a significantly underoptimized system. Policies are determined based on legislated priorities, and decisions are often made without scientific rigor. There is a growing interest in optimal resource utilization while achieving greater equity and access in healthcare. Solutions require a transdisciplinary collaborative approach, where members of the INFORMS community are making significant contributions by developing increasingly realistic data-driven modeling approaches to promote evidence-based decision making and informing policy changes. The need to bring greater realism to the decision models also motivates new methodological developments that can then benefit application in areas other than health.

The central consideration in developing innovative strategies to improve the health system is to save and improve the quality of life of patients. This must be balanced against risks and cost to individuals and society. It leads to problems with multiple objectives, and input from multiple experts weighing in on these objectives. The parameters of the functions modeling the objectives and constraints are uncertain as model recommendations have implications on an unknown future.

In this presentation, after briefly reviewing the global healthcare landscape, we will focus on a few specific examples from our research illustrating how close interactions with transplant surgeons and nephrologists led to the development of alternative strategic models for improving geographical disparity in waiting time for kidney transplant; consideration of a budgeting problem arising in diabetes prevention programs provided insights toward developing new concepts of weight-robustness in multiobjective decision

making; and the need for solving realistic staffing and scheduling problems under demand uncertainty led to the development of a highly efficient computational tool for solving a general class of stochastic mixed-integer programs.



Sanjay Mehrotra is the director of Center for Engineering at Health at Northwestern University. He received his PhD in operations research from Columbia University.

Mehrotra is known for his methodology research in optimization that has spanned from linear, convex, mixed integer, stochastic, multiobjective, distributionally robust, and risk-adjusted optimization. His healthcare research includes topics in predictive modeling, budgeting, hospital operations, and policy modeling using modern operations research tools. He is the immediate past chair of the INFORMS Optimization Society. He has also been an INFORMS vice president representing Chapters/Fora. He is the current Healthcare Department editor of the Institute of Industrial Engineers journal *IIE Transactions*, and also held the role of Optimization Department editor for the same journal.

KEYNOTE

3:10–4pm

Grand Ballroom A, Upper 200 Level

Conic Integer Optimization

Alper Atamturk, Professor of Industrial Engineering and Operations Research, University of California, Berkeley

In the last 25 years we have experienced significant advances in conic optimization. Polynomial interior point algorithms that have already been developed for linear optimization are extended to second-order cone optimization and semidefinite optimization. The availability of efficient algorithms for convex conic optimization spurred many novel optimization and control applications in diverse areas ranging from medical imaging to statistical learning, from finance to truss design. However, the advances in convex conic optimization and linear integer optimization have, until recently, not translated into major improvements in conic integer optimization, i.e., conic optimization problems with integer variables. In this talk, we will review the recent progress in conic integer optimization. We will discuss cuts, lifting methods, and conic reformulations for improving

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computations for general as well as special structured problems and connections to submodular optimization for the 0-1 case. We will present applications of conic integer optimization in probabilistic optimization, portfolio optimization, and location/inventory optimization with risk pooling.



Alper Atamturk is a professor of industrial engineering and operations research at the University of California, Berkeley. He received his Ph.D. from the Georgia

Institute of Technology in 1998 with a major in operations research and minor in computer science. His current research interests are in discrete optimization and optimization under uncertainty with applications to energy, finance and operations interface, cancer therapy, and defense. He serves on the editorial boards of *Discrete Optimization*, *Journal of Risk*, *Mathematical Programming Computation*, *Networks*, and *Operations Research*. He served on the organizing committees of INFORMS, IPCO, MIP, among others. He served as vice chair-integer programming of the INFORMS Optimization Society during 2008–2009. Dr. Atamturk is a U.S. Department of Defense National Security Science and Engineering Fellow.

KEYNOTE

3:10–4pm
Grand Ballroom B, Upper 200 Level

Getting More Out of a Modern Power Grid: The Role of Mathematical Modeling and Optimization

Mihai Anitescu, Senior Computational Mathematician, Mathematics and Computer Science Division, Argonne National Laboratory, and Professor, Department of Statistics, University of Chicago

The electrical power grid (the electricity transmission and distribution system) is one of the most complex engineering achievements of the 20th century. It is also at the center of massive changes in the way we create and consume energy. Such changes are brought about by many drivers, including an increasing use of renewable energy and natural gas. Moreover, the power grid exhibits persistent conceptual difficulties that, while generally successfully contained by engineering practice, have never been fully resolved. In this talk, we discuss some of these difficulties and the important role that mathematical modeling

and optimization can play in solving them. We argue that in some cases a change of the problem framework may be desirable and that this may be made while keeping the solution computationally achievable. We outline a number of existing and emerging fundamental research challenges and discuss some recent promising avenues in the area. A distinguishing feature of power grid applications is that optimization is ubiquitous and it must accommodate simultaneously multiple complexity drivers. These include not only discrete variables, nonconvexity, or stochasticity, but also ordinary and—with the increased usage of natural gas—partial differential equations. We discuss the productivity and performance implications of this fact for the modeling and computational environments.



Mihai Anitescu is a senior computational mathematician in the Mathematics and Computer Science Division at Argonne National Laboratory and a professor in the

Department of Statistics at the University of Chicago. His research interests are in the areas of numerical optimization, computational science, numerical analysis, and uncertainty quantification. He has used techniques from these areas in key applications in power grid and related infrastructure, nuclear engineering, materials science, geosciences, chemistry, chemical engineering, and signal processing. He has co-authored more than 100 peer-reviewed papers in scholarly journals, book chapters, and conference proceedings, and he is on the editorial board of *Mathematical Programming A and B*, *SIAM Journal on Optimization*, *Optimization Methods and Software*, *SIAM Journal on Scientific Computing*, and *SIAM/ASA Journal on Uncertainty Quantification*.

KEYNOTE

3:10–4pm
201C, 200 Level

2015 Daniel H. Wagner Prize Winner Announcement and Reprise



Daniel H. Wagner earned his PhD in mathematics in 1951 from Brown University. He began his career in the U.S. Navy's Operations Evaluation Group (OEG) at the

Pentagon, where he worked on operations research for naval warfare. In 1963, he created the firm of Daniel H. Wagner Associates, Inc., which is still in existence today. During his years as president and principal owner of Wagner Associates, Dan brought many high-quality mathematicians into the operations research community. This led to significant advances in the firm's fields of endeavor and delivery of significant applications to the Navy, Coast Guard, and other clients; many of these applications are still in service today. After retirement from his eponymous company, Dan Wagner continued his commitment to the field of operations research, serving in various teaching and research positions with the U.S. Naval Postgraduate School and the U.S. Naval Academy. He was an active member of ORSA, and then INFORMS, for more than 40 years.

WAGNER PRIZE

The Daniel H. Wagner Prize is awarded for a paper and presentation that describe a real-world, successful application of operations research or advanced analytics. The prize criteria emphasize innovative, elegant mathematical modeling and clear exposition.

All Plenary & Keynote Presentations will take place in the Convention Center.

WEDNESDAY, NOVEMBER 4

PLENARY

10–10:50am

Grand Ballroom B, Upper 200 Level

Understanding and Managing the Complexity of Healthcare

William Rouse, Alexander Crombie Humphreys Chair, School of Systems & Enterprises, and Director, Center for Complex Systems and Enterprises, Stevens Institute of Technology

The overall nature of the healthcare system is considered. It is argued that this enterprise is best modeled as a complex adaptive system. The stakeholders in this enterprise and their interests and objectives are outlined. This provides the basis for discussion of five case studies. The first presents an analysis of the complexity of healthcare using information theoretic metrics. The second case study uses production learning theory to determine how efficient the system would have to be to keep healthcare costs from rising faster than GDP. The third derives providers' optimal response to Medicare price controls. The fourth case study develops a multilevel model of the healthcare enterprise and uses this model to project the economic benefits of employer-based prevention and wellness programs. The final case study considers how providers in New York City have responded to the Affordable Care Act.



William Rouse is the Alexander Crombie Humphreys Chair within the School of Systems & Enterprises, and Director of the Center for Complex Systems

and Enterprises at Stevens Institute of Technology. He is also professor emeritus, and former chair, of the School of Industrial and Systems Engineering at the Georgia Institute of Technology. His research focuses on understanding and managing complex public-private systems such as healthcare delivery, urban systems, and national security, with emphasis on mathematical and computational modeling of these systems for the purpose of policy design and analysis. Rouse has written hundreds of articles and book chapters, and has authored many books, including, most recently, *Modeling and Visualization of Complex Systems and Enterprises* (Wiley 2015), *Understanding and Managing the Complexity of Healthcare* (MIT Press 2014), *Economic Systems Analysis and Assessment* (Wiley 2011), *People and Organizations: Explorations of Human-Centered Design* (Wiley 2007), *Essential Challenges of Strategic Management* (Wiley 2001), and the award-winning *Don't Jump to Solutions* (Jossey-Bass 1998). He has edited or co-edited numerous books including *Engineering the System of Healthcare Delivery* (IOS Press 2010), *The Economics of Human Systems Integration* (Wiley 2010), *Enterprise Transformation: Understanding*

and Enabling Fundamental Change (Wiley 2006), *Organizational Simulation: From Modeling & Simulation to Games & Entertainment* (Wiley 2005), the best-selling *Handbook of Systems Engineering and Management* (Wiley 1999, 2009), and the eight-volume series *Human/Technology Interaction in Complex Systems* (Elsevier). Among many advisory roles, he has served as chair of the Committee on Human Factors of the National Research Council, a member of the U.S. Air Force Scientific Advisory Board, and a member of the DoD Senior Advisory Group on Modeling and Simulation. He has been designated a lifetime National Associate of the National Research Council and National Academies. Rouse is a member of the National Academy of Engineering and has been elected a fellow of four professional societies: Institute of Electrical and Electronics Engineers (IEEE), International Council on Systems Engineering (INCOSE), Institute for Operations Research and the Management Sciences (INFORMS), and Human Factors and Ergonomics Society (HFES). Rouse received his B.S. from the University of Rhode Island, and his S.M. and Ph.D. from Massachusetts Institute of Technology.

TUTORIALS^{IN} OPERATIONS RESEARCH

The Operations Research Revolution

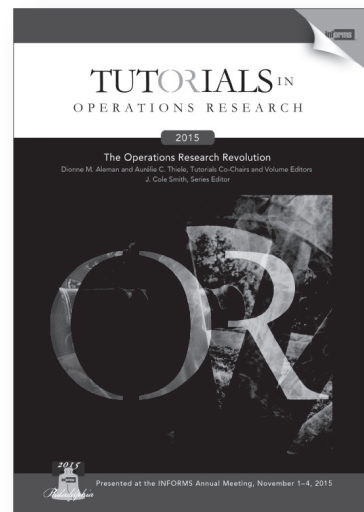
Dionne M. Aleman and Aurélie C. Thiele, Tutorials Co-Chairs and Volume Editors

J. Cole Smith, Series Editor

INFORMS 2015 edition of the *TutORials in Operations Research* series will be available online to registrants of the 2015 INFORMS Annual Meeting on November 1, 2015.

Access the 2015 *TutORials* at:

<http://pubsonline.informs.org/series/educ>



All tutorials are located in the Convention Center, 108A, 100 Level.

SUNDAY

Data-Driven Stochastic Programming using Phi-Divergences

SA54
8–9:30am

Guzin Bayraksan, Ohio State University & David K. Love, The American Express Company

Pricing Inspired by Data and Practice

SB54
11am–12:30pm

Georgia Perakis; Lennart Baardman; Maxime Cohen; Swati Gupta and Jeremy Kalas, Massachusetts Institute of Technology; Zachary Leung, Carnegie Mellon University; Kiran Panchangam, Oracle Retail Science R&D; Danny Segev, University of Haifa; Anthony Smith

Uncertainty in Demand Response-Identification, Estimation, and Learning

SC54
1:30–3pm

Josh Taylor, University of Toronto & Johanna Mathieu, University of Michigan

Robust Optimization, Risk Ambiguity

SD54
4:30–6pm

Erick Delage, HEC Montréal & Dan A. Iancu, Stanford University

MONDAY

A Practical Guide to Ranking and Selection Methods

MA54
8–9:30am

David Goldsman, Georgia Institute of Technology

Markov Decision Processes in Healthcare

MB54
11am–12:30pm

Andrew J. Schaefer, University of Pittsburgh

Equilibrium Routing and its Paradoxes

MC54
1:30–3pm

Asu Ozdaglar, Massachusetts Institute of Technology

Computational Optimization and Statistical Methods for Big Data Analytics: Applications in Neuroimaging

MD54
4:30–6pm

W. Art Chaovalitwongse & Shuai Huang, University of Washington

TUESDAY

Applying Machine Learning in Online Revenue Management

TA54
8–9:30am

David Simchi-Levi, Massachusetts Institute of Technology

Approximations of Queueing Performance for Rapid Systems Design

TB54
11am–12:30pm

Ton Dieker, Columbia University & Steve Hackman, Georgia Institute of Technology

Discrete Optimization Models for Homeland Security and Disaster Management

TC54
1:30–3pm

Laura A. McLay, University of Wisconsin–Madison

Meta-Algorithms: From Algorithm Tuning and Configuration to Algorithm Portfolios

TD54
4:30–6pm

Meinolf Sellmann, IBM Thomas J. Watson Research Center



All attendees receive free online access to the INFORMS 2015 **TutORials in Operations Research: The Operations Research Revolution** series volume concurrently with the meeting. The new TutORials volume will be available on November 1, 2015. Go to INFORMS PubsOnLine to access your content and view previous years' volumes. You will need your INFORMS customer account or your username and password. You can order the 2015 book or previous volumes through the TutORials website: <http://pubsonline.informs.org/series/educ>. For more information, visit the INFORMS Center in the Exhibit Hall.

2015 INFORMS Prize Presentation

Peter Buczkowski
Disney Parks & Resorts

Advanced Manufacturing

Yuan-Shin Lee
North Carolina State University

Auctions

Robert Day
University of Connecticut

Big Data Analytics in Computational Biology/Medicine

Kiavash Kianfar
Texas A&M University

Business Model Innovations

Jose Guajardo
University of California

Cloud Computing

Cathy Xia
Ohio State University

Data Envelopment Analysis

Andrew Johnson
Texas A&M University

Daniel H. Wagner Prize for Excellence in Operations Research Practice

C. Allen Butler
Daniel H. Wagner Associates, Inc.

Doing Good with Good OR

Lisa Maillart
University of Pittsburgh

Itai Ashlagi
Massachusetts Institute of Technology

Energy Systems: Design, Operation, Reliability and Maintenance

Bo Zeng
University of South Florida

Qianmei Feng
University of Houston

Funding Opportunities at NSF

Diwakar Gupta
National Science Foundation

George B. Dantzig Dissertation Award

Nils Rudi
INSEAD

Global and International Activities

Grace Lin
Institute for Information Industry

Homeland Security

Jeffrey Herrmann
University of Maryland

Hospitality, Tourism, and Healthcare

Alex Susskind
Cornell University

INFORMS Career Center

Neil Geismar
Texas A&M University

INFORMS Social Media Analytics

Les Servi
The Mitre Corporation

INFORMS Undergraduate Operations Research Prize

Aurelie Thiele
Lehigh University

Modeling and Methodologies in Big Data

Jiming Peng
University of Houston

W. Art Chaovalitwongse
University of Washington

New Product Development

Sanjiv Erat
University of California

Jurgen Mihm
INSEAD

Nicholson Student Paper Prize

Illya Hicks
Rice University

Mark Squillante
IBM Research

Operations/Marketing Interface

Kathy Steckle
University of Texas at Dallas

Xuying Zhao
University of Notre Dame

Risk Management

Agostino Capponi
Columbia University

Scheduling & Project Management

Nicholas G. Hall
Ohio State University

Marc Posner
Ohio State University

Stochastic Models: Theory and Applications

Ananth Krishnamurthy
University of Wisconsin-Madison

Strategy Science

Dan Levinthal
University of Pennsylvania

Tutorials

Dionne Aleman
University of Toronto

Aurelie Thiele
Lehigh University

Analytics

Tarun Mohan Lal
Mayo Clinic

Harrison Schramm, CAP
Navy Headquarters

Applied Probability

Tolga Telzcan
London Business School

Neil Walton
University of Amsterdam

Artificial Intelligence

Yilu Zhou
Fordham University

Aviation Application

Stephen Maher
Zuse Institute Berlin

Behavioral Operations Management

Tony Haitao Cui
University of Minnesota

Computing Society

Matthew Saltzman
Clemson University

CPMS

Yanni Papadakis
Dun & Bradstreet

Doug Samuelson
InfoLogix

Data Mining

Cynthia Rudin
Massachusetts Institute of Technology

Decision Analysis

Debarun Bhattacharjya
IBM T.J. Watson Research Center

Melissa Kenney
University of Maryland

Mazen Skaf
Strategic Decisions Group

Energy, Natural Resources & the Environment*Electricity*

Andy Sun
Georgia Institute of Technology

Policy, Natural Gas, Climate Change

Andrew Liu
Purdue University

Forestry

Matthew Thompson
U.S. Forest Service

Natural Resources I-Mining

Alexandra Newman
Colorado School of Mines

Natural Resources II-Petrochemicals and Petroleum

Marlize Meyer
Sasol

Sustainability & Environment

Sandra Eksiöglu
Clemson University

e-Business

Lin Hao
University of Notre Dame

Chris Parker
Pennsylvania State University

Mingfeng Lin
University of Arizona

Financial Services

Bo Zhang
IBM Research

Health Applications

Turgay Ayer
Georgia Institute of Technology

Information Systems

Anjana Susarla
Michigan State University

Param Vir Singh
Carnegie Mellon University

INFORM-ED

Susan Martonosi
Harvey Mudd College

INFORMS Practice

Stefan Karisch
Boeing

Manoj Chari
SAS

Junior Faculty Interest Group

Shengfan Zhang
University of Arkansas

KINFORMS (Korea Chapter INFORMS)

Chang Won Lee
Hanyang University

Location Analysis

Alan Murray
Drexel University

Manufacturing & Service Operations Management

Xuanming Su
University of Pennsylvania

Cheryl Druehl
George Mason University

Senthil Veeraraghavan
University of Pennsylvania

Healthcare Operations

Murat Kurt
Merck Research Labs

iForm

Yasin Alan
Vanderbilt University

Onur Boyabatli
Singapore Management University

Service Operations

Santiago Gallino
Tuck School of Business

Antonio Moreno-Garcia
Northwestern University

Supply Chain

Aydin Alptekinoglu
Pennsylvania State University

Vinayak Deshpande
University of North Carolina

Sustainable Operations

Gilvan Souza
Indiana University

Marketing Science

Olivier Toubia
Columbia Business School

Military Applications Society

Andrew Hall
U.S. Army

Minority Issues Forum

Emmett Lodree
University of Alabama

Multiple Criteria Decision Making

Matthias Ehrgott
Lancaster University

Optimization

Suvrajeet Sen
University of Southern California

Healthcare

Omid Nohadani
Northwestern University

Integer and Discrete Optimization

Juan Pablo Vielma
Massachusetts Institute of Technology

Mixed Integer Nonlinear Optimization and Global Optimization

Aida Khajavirad
University of Texas

Linear & Conic Optimization

John Mitchell
Rensselaer Polytechnic Institute

Network Optimization

Vladimir Boginski
University of Florida

Nonlinear Programming

Daniel Robinson
Johns Hopkins University

Optimization Under Uncertainty

Warren Powell
Princeton University

Mengdi Wang
Princeton University

Organization Science

Jared Harris
University of Virginia

Public Sector OR

Vedat Verter
McGill University

Burcu Balcik
Ozyegin University

Quality, Statistics & Reliability

Hui Yang
Pennsylvania State University

Ran Jin
Virginia Tech

Railway Applications

Jeremiah Dirnberger
CSX

Revenue Management & Pricing

Bora Keskin
Duke University

So Yeon Chun
Georgetown University

Service Science

Tor W. Andreassen
Norwegian School of Economics

Simulation

John Shortle
George Mason University

Technology, Innovation Management & Entrepreneurship

Gulru Ozkan-Seely
Georgia Institute of Technology

Telecommunications

Timothy Matis
Texas Tech University

Fabio D'Andreagiovanni
Konrad-Zuse-Zentrum

Stanko Dimitrov
University of Waterloo

Transportation Science & Logistics

Irina Dolinskaya
Northwestern University

Facility Logistics

Sadan Kulturel-Konak
Pennsylvania State University-Berks

Pratik Parikh
Wright State University

Freight Transportation & Logistics

Tom Van Woensel
Eindhoven University of Technology

Kevin Furman
ExxonMobil

Intelligent Transportation Systems (ITS)

Steve Boyles
University of Texas at Austin

Yingyan Lou
Arizona State University

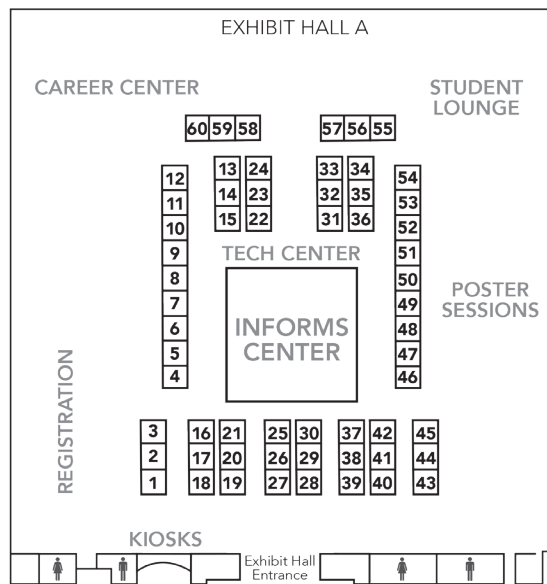
Urban Transportation

Song Gao
University of Massachusetts

Women in OR/MS

Renata Konrad
Worcester Polytechnic Institute

CONVENTION CENTER - EXHIBIT HALL - 200 LEVEL



INFORMS CENTER

New this year at the Annual Meeting, INFORMS Center will be located in the center of the Exhibit Hall. This dynamic space is the hub for your Annual Meeting activities. Be sure to stop by and see key INFORMS leadership and staff, and learn more about the many programs and activities taking place both at the Annual Meeting and throughout the year. Make sure to check the Mobile App or the website for an up-to-date schedule of INFORMS Center activities.

STUDENT LOUNGE

A space in the Exhibit Hall for our students to relax, hang out, meet other members, and take advantage of free Wi-Fi. Make sure to follow @INFORMS2015 for special pop-up events in the Student Lounge.

TECHNOLOGY CENTER

Free Wi-Fi

The Technology Center will be open during the following hours:

Sunday	12noon–5pm
Monday	9am–5pm
Tuesday	9am–5pm
Wednesday	9am–3pm

Free wireless internet and a Technology Center are located in the Exhibit Hall. There are a limited number of computers available in the Technology Center if you do not have your own computer. Name badges must be worn for admittance.

INFORMS CAREER CENTER

INFORMS Career Center (ICC) is the largest source of operations research and analytics jobs and resumes. It's where job seekers go to land the right job in academia or industry and where employers post their jobs and search our resume database for qualified candidates.

This service provides employers and applicants with a convenient venue for on-site interviews to explore opportunities in academia, industry, and government. In addition, the job placement service offers:

- Online access to job listings and applicant files
- Expanded information about jobs and applicants
- Daily updates of the database
- Improved database search capabilities
- Online data entry for applicants and employers
- Extended availability of the database at <http://careercenter.informs.org>

Career Fair

Sunday, 12noon–5pm
Exhibit Hall A, 200 Level, Convention Center

The Career Fair provides an opportunity for job seekers to meet the participating employers in an informal atmosphere and discuss employment opportunities within those organizations. Employers meet and collect resumes from many job seekers in a short period of time early in the meeting, giving them the chance to set up interviews during the Annual Meeting.

ICC On-site Interviews

Monday & Tuesday, 9am–5pm
Wednesday, 9am–3pm
Exhibit Hall A, 200 Level, Convention Center

ICC On-site Resume Review

(Must have previously scheduled appointment.)

Sunday, 12noon–5pm
Monday, 9am–5pm

Panel Discussions

Select panels will lead informal discussions about the industry and academic interview process.

Industry Job Search (SD26)

Sunday, 4:30–6pm
403, Level 4, Marriott

Academic Job Search (MC26)

Monday, 1:30–3pm
403, Level 4, Marriott

POSTER SESSIONS

Monday & Tuesday, 12:30–2:30pm
Exhibit Hall A, 200 Level, Convention Center

Researchers, practitioners, and students share their O.R. and analytics projects in these special sessions presented as poster displays, laptop demonstrations, and other creative formats.

Abstracts and authors for posters are listed in the chronological program under the day and time for each interactive session.

Monday, page 139
Tuesday, page 210

Competition

INFORMS places a special emphasis on high quality poster presentations. All poster session presenters were invited to submit their posters to the competition. In Round 1 of the process, submitters sent a PDF of their finished poster to the judging panel for review. The judges have evaluated these submissions and selected a group of semifinalists. The judging panel is made up of distinguished OR/MS professionals, both academics and practitioners, many of whom are INFORMS leaders.

In Round 2, the judging panel will review the semifinalist presentations during the Poster Sessions in Philadelphia. In Round 3, also held during the Poster Sessions, the judges will name the 1st, 2nd, and 3rd place winners. These winners will also be identified and awarded each day. Recognition includes a certificate, a monetary award, and announcements on the INFORMS website, newsletters, and in *OR/MS Today*.

EXHIBIT HOURS

Sunday	12noon–5pm (7:30–9pm Welcome Reception)
Monday	9am–5pm
Tuesday	9am–5pm
Wednesday	9am–3pm

All Software Demonstrations will take place in the Convention Center, 300 Level.

ACT Operations Research 46

<http://www.act-operationsresearch.com>

ACT OR is a company of mathematicians and engineers dedicated to improving customer businesses by creating Executive Decision Support Systems based on forecasting, mathematical optimization, and statistical models, and using “big data.” The purpose of our software toolsets and solutions are to assist customers in improving processes, assets, and labor – utilization by optimization or simulation models that can offer the most efficient policies or systems to help customers cut operating costs. Our tools are “prescriptive and predictive” analytical by design, for risk reduction capabilities for business investments.

http://www.act-operationsresearch.com/Products/Before_Predictive_Analytics.html

AIMMS 27

www.aimms.com

AIMMS is an innovative technology company with offices in Europe, United States, and Asia. Half of the global Fortune top 20 corporations rely on AIMMS because of its unique analytics, modeling, and optimization platform that supports complex business decision making at every organizational level. AIMMS customers can quickly create high business impact with optimization apps to support both strategic and daily operational challenges on a single platform that works seamlessly with your ERP system. AIMMS is trusted by companies like Alstom, BP, Kroger, Nike, Unilever, Shell, and many others. Visit www.aimms.com to learn more.

Software Tutorial:

Experience Optimization Modeling in Real Time, Deanne Zhang, Optimization Specialist, AIMMS, deanne.zhang@aimms.com

Monday, 1:30–2:15pm, Room 302 (MC79)

What can you do in 45 minutes? Attend a lecture? Watch a TED Talk online? Maybe go on a 5-mile run? There is a lot that can be accomplished in 45 minutes that can provide both a sense of achievement and generate new ideas. We invite you to experience this same kind of feeling in a 45-minute journey

with AIMMS! We are going to build an optimization model in real time and publish it on AIMMS PRO, an enterprise level app store. This 45-minute software demo will provide you with a fresh view of how AIMMS delivers broader usage and greater benefits for business users.

AMPL Optimization Inc. 28

www.ampl.com

AMPL's modeling language and system give you an exceptionally powerful and natural tool for developing and deploying the complex optimization models that arise in diverse business applications. AMPL lets you formulate problems the way you think of them, while providing access to the advanced algorithmic alternatives that you need to find good solutions fast. It features an integrated scripting language for automating analyses and building iterative optimization schemes; access to spreadsheet and database files; and application programming interfaces for embedding within larger systems. AMPL works with more than 30 powerful optimization engines including all of the most widely used large-scale solvers.

Software Tutorial: *Developing Optimization Applications Quickly and Reliably with Algebraic Modeling, Robert Fourer, President, AMPL Optimization Inc., 4er@ampl.com*

Monday, 11–11:45am, Room 302 (MB79)

Can you negotiate the complexities of the optimization modeling lifecycle, and deliver a working application before the problem owner loses interest? Algebraic languages were invented to streamline the key steps of model formulation, testing, and revision. Today, they are supported by powerful facilities for embedding models into larger systems and deploying them to users. This presentation introduces algebraic modeling for optimization through examples using classic and recently introduced features of the AMPL language and system.

AnyLogic North America, LLC 22-23

www.anylogic.com

The AnyLogic Company along with AnyLogic Software is a global organization with headquarters in Chicago, St. Petersburg, and Paris, comprising consulting, sales, and marketing professionals. Founded in 1992, the AnyLogic team that design, develop, and market AnyLogic Software – the first and only tool that brings together System Dynamics, process-centric (Discrete Event), and Agent-Based methods within one modeling language and one model development environment – have been the leading provider of dynamic simulation tools, technologies, and consulting services

for business applications. The language of AnyLogic has unmatched flexibility enabling modelers to capture the complexity of business, economy, and social systems at any level of detail to gain deeper insight into interdependent processes inside and around an organization.

Software Tutorial: *anyLogistix – Every Supply Chain is Unique, Capture Yours!, Timofey Popkov, Director of Business Development and Co-owner, AnyLogic North America, tim@anylogic.com*

Monday, 8:45–9:30am, Room 302 (MA79)
Supply chain optimization software must capture the uniqueness of your supply chain as well as produce fast results. The supply chain is the backbone of your business; it is what distinguishes you from competitors and enables you to win business. Experience a complete solution, anyLogistix, which allows you to carefully design, continuously analyze, and adjust to environmental changes. Learn how to maintain a competitive advantage in your industry through supply chain optimization.

Aptech Systems, Inc. 36

www.aptech.com

GAUSS is a powerful, highly adaptive suite of analytical software and tools that maximize the probability of success, giving analysts the ability to dig deeper into data to unlock actionable results. GAUSS is the product of decades of innovation and enhancement by Aptech Systems, a supportive team of experts dedicated to the success of the worldwide GAUSS user community. From physics to finance, Aptech is committed to helping people achieve their goals by offering flexible products and applications that define the leading edge of statistical analysis capabilities.

Artelys 21

www.artelys.com

Artelys is internationally known as an expert in the field of optimization and analytics and continues its growth with the recent acquisition of Ziena Optimization, author of KNITRO.

Dedicated to provide sound decision making through technology, operations research, and statistics with top international engineers, Artelys also develops, distributes, and supports a comprehensive portfolio of efficient and robust tools: Artelys Kalis, FICO® Xpress Optimization Suite, KNITRO, and AMPL. Relying on these tools and a high level of expertise in quantitative methods, Artelys has been successful in delivering 100+ efficient solutions to the most complex business problems. Located in France, United States, and Canada.

Software Tutorial: See the Artelys KNITRO 10.0 Optimization Solver in Action, Richard Waltz, Senior Scientist, Artelys Corp., waltz@ziena.com

Sunday, 4:30–6pm, Room 302 (SD79)

KNITRO is the premier solver for nonlinear optimization and recent winner of the GECCO 2015 Black Box Optimization Competition, finishing first among 28 solvers. This software demonstration will highlight the latest KNITRO features, including a new object-oriented interface and SQP algorithm for derivative-free optimization (DFO). The demo will also provide an overview of how to effectively use KNITRO in a variety of environments and applications, and present recent benchmarking results for DFO and nonlinear optimization.

Cambridge University Press 31
http://www.cambridge.org/us/academic

Cambridge publishes books and journals combining state-of-the-art content with the highest standards of scholarship, writing, and production. Visit our booth to browse new titles, available at a 20% discount, and to pick up sample issues of our journals. Visit our website to see everything we do: www.cambridge.org/us/academic.

COIN-OR 10
www.coin-or.org

The Computational Infrastructure for Operations Research publishes high quality, free, open-source tools for OR professionals and students, suitable for commercial, educational, and personal use. COIN-OR is the place to go when you need a “white box” for algorithm research and development. COIN-OR is a strategic partner of the INFORMS Computing Society.

Darden Business Publishing 15
http://store.darden.virginia.edu

Darden Business Publishing produces and markets case-based materials written by the renowned faculty at the University of Virginia Darden School of Business. Darden maintains a catalogue of student-centered learning materials that energize classrooms around the world with dynamic interactive multimedia cases, innovative simulations, and thought-provoking paper cases.

Do Analytics 12
www.doanalytics.net

OPTEx Mathematical Modeling System represents the new paradigm to make mathematical models. OPTEx separates the algebraic formulation from the source code of the models, and generates computer programs in multiple optimization technologies (C, GAMS, IBM-OPL, MOSEL, AIMMS, and

AMPL). It is based on its own unique database algebraic language that supports MS-EXCEL algebraic formulation. OPTEx supports every stage of mathematical modeling process (data model definition, data validation, SQL connection, graphic user interface generation, algebraic model formulation, numerical model generation, problem solution, and results visualization). Easy and fast, OPTEx represents the new generation to DO ANALYTICS. (http://www.doanalytics.net/Documents/OPTEx-Presentation.pdf)

Software Tutorial: OPTEx Mathematical Modeling System: The New Paradigm, Jesus Maria Velasquez, Chief Scientist, Do Analytics LLC, jesus.velasquez@decisionware.net

Monday, 5:15–6pm, Room 302 (MD79)

Do Analytics presents OPTEx Mathematical Modeling System, a powerful expert system that is changing the way to make large-scale mathematical programming models. OPTEx:

- Generates programming codes in the most powerful optimization technologies, including the SQL statements to connect any DBMS
- Mixes the power of an optimization technology with the ease of EXCEL
- Works as a client and as an optimization server in the cloud.

Dynamic Ideas, LLC 33
www.dynamic-ideas.com

Dynamic Ideas is a publisher of scientific books that have quality and originality in the areas of operations research and applied mathematics. The key objective of our titles is to “educate the next generation.” Many of our books are currently being used as the main textbook in academic courses in some of the finest universities and research institutions in the world.

Elsevier 13
www.elsevier.com

Elsevier is a leading publisher in the Operations Research and Decision Sciences fields, with over 25 high-quality peer-reviewed journals, including *European Journal of Operational Research*, *Omega*, and the newly launched *Operations Research Perspectives*. Elsevier’s OR/MS journals occupy 8 of the Top 10 positions in the Operations Research & Management Science category of Thomson Reuters’ Science Citation Index. Visit us to sign up for one-to-one feedback on your research from top journal editors.

FICO 55-56
www.fico.com

FICO is a leading analytics software company, helping businesses around the world make better decisions that accelerate growth,

profitability, and customer satisfaction. FICO’s optimization tools, which include FICO® Xpress Optimization Suite, feature high-performance solvers, flexible modeling, and application development tools. FICO’s optimization capabilities are now available on the FICO® Analytic Cloud and the FICO® Decision Management Suite, providing an easy, cost-effective way to evaluate, customize, deploy, and scale state-of-the-art analytics and decision management solutions.

Join us for the workshop to learn about the latest Xpress features and visit our exhibition area booth. Learn more at www.fico.com.

Software Tutorial: Turnkey Optimization on the Cloud, Oliver Bastert, Ph.D., oliver.bastert@fico.com

Wednesday, 11:45am–12:30pm, Room 302 (WB79)

In this workshop, we will demonstrate enhancements for modeling and solving linear, mixed integer and nonlinear optimization problems using the latest release of FICO® Xpress version 7.9. We will show how to rapidly turn optimization models into collaborative applications deployed on the FICO® Analytic Cloud. Also, learn how these capabilities can be combined with analytic modeling and decision rules to deliver powerful cloud-based or on-premises decision management solutions via the FICO® Decision Management Suite.

Forio Simulations 40
www.forio.com

Forio builds and hosts online business simulation games used by Harvard Business School, Wharton, MIT Sloan, and other universities and major corporations. Learners are actively engaged because they play a role, not just reading and analyzing. More than 60% of all MBAs currently enrolled at business schools worldwide will play a Forio simulation game before they graduate. We also build multiplayer collaborative or competitive simulation games with several Fortune 500 clients. Forio Epicenter, our simulation development software, allows for the rapid creation of simulation front-ends, as well as dashboards and data visualizations.

Software Tutorial: Publishing Interactive Analytics or Operations Research Models on the Web, Michael Bean, Co-Founder and President, Forio Simulations, mbean@forio.com

Sunday, 11:45am–12:30pm, Room 302 (SB79)

Forio’s Web platform makes your analytic model available to hundreds of people within your organization through the browser. We will start with an introduction to the platform and example analytics applications. Then we’ll divide the workshop into two parts. In the first part, we will teach you how to get your analysis on a server so it can be shared. In the second part, we will focus on creating a user interface for your model.

Frontline Systems, Inc.

www.solver.com

Frontline Systems is democratizing analytics, enabling business analysts and managers to get fast results—without expensive enterprise software and steep learning curves. See how easily you can solve optimization, simulation/risk analysis, and predictive analytics models in Excel Online, Google Sheets, and Apple's iPad—starting for free. See new Analytic Solver® Platform V2016 for desktop Excel, the easy-to-use integrated software that builds on Excel's Solver, Tableau, Power BI, and other tools. See our developer SDKs for data mining, simulation, and optimization, and our new RASON® modeling language and REST API. You'll be surprised by how little this costs, and how quickly you can get results.

Software Tutorial: *Analytic Solver® Platform: Integrated Data Mining, Simulation and Optimization in Microsoft Excel*

Tuesday, 2:15–3pm, Room 302 (TC79)

Analytic Solver Platform in Microsoft Excel has everything you need for forecasting and data mining, Monte Carlo simulation and risk analysis, conventional and stochastic optimization – with data from Apache Spark and visualization of results in Excel, Tableau, and Power BI. See how you can use it to build your own analytic expertise and teach others, leveraging what you already know, build and solve industrial-scale models with the world's best Solvers, and effectively communicate business results.

GAMS Development Corp.

www.gams.com

The General Algebraic Modeling System (GAMS) is a high-level modeling system for mathematical programming and optimization. It consists of a language compiler and a stable of integrated high-performance solvers. GAMS is tailored for complex, large-scale modeling applications, and allows you to build large, maintainable models that can quickly adapt to new situations.

Software Tutorial: *GAMS – An Introduction*, Steve Dirkse, Director of Optimization, GAMS Development Corp, sdirkse@gams.com

Sunday, 5:15–6pm, Room 302 (SD79)

This workshop will show you how to use the General Algebraic Modeling System (GAMS) in an efficient and productive way. There will be an introduction to the system and a presentation of the key concepts in GAMS. The largest part of the workshop consists of hands-on exercises. The workshop will demonstrate how GAMS interacts with

other applications and you will see how to analyze and debug problems using the tools available within GAMS.

Gurobi Optimization, Inc.

www.gurobi.com

Gurobi Optimization provides high performance math programming solvers using the most advanced implementations of the latest algorithms. We offer best-in-class performance, support a broad range of interfaces and modeling languages, and offer flexible licensing together with transparent, no surprises pricing, all backed by outstanding, easy-to-reach support.

Software Tutorial: *Modeling with the Gurobi Python Interface*, Dr. Renan Garcia, Optimization Support Engineer, Gurobi Optimization, garcia@gurobi.com

Monday, 11:45am–12:30pm, Room 302 (MB79)

Are you looking for an environment that combines the expressiveness of a modeling language with the power and flexibility of a programming language? The Gurobi Python interface allows you to build concise and efficient optimization models using high-level modeling constructs. Moreover, Python itself has a vast ecosystem of packages designed to increase your productivity, such as a notebook-style interface (iPython Notebook), data access capabilities, and Web development tools. This tutorial will provide an overview of these features, including detailed examples that show how to use the Python interface to build models that can be turned into full optimization applications.

Hong Kong Polytechnic University

www.polyu.edu.hk

The Department of Logistics and Maritime Studies is one of the three departments in the Faculty of Business, The Hong Kong Polytechnic University. We take a multidisciplinary approach to establishing an area of excellence in logistics, supply chain, and operations management. We would like to enhance and accelerate through the recruitment of ambitious, high-caliber candidates to join our academic team (<http://www.lms.polyu.edu.hk/en/footer/careeropportunities/>). You are welcome to join our tea reception, which will be held on November 2 from 5–6pm and November 3 from 11am–12pm in the Three Bay Hospitality Suite of Marriott Philadelphia.

IBM

www.ibm.com

IBM is paving the way to the next generation of analytics solutions and platforms, combining descriptive, predictive, and prescriptive analytics with the power of

cloud and cognitive insights. IBM Decision Optimization, which includes the market-leading IBM CPLEX Optimizer, has helped more organizations drive performance improvements from prescriptive analytics than any other company, including four times as many Edelman Award finalists. Visit the IBM Analytics booth to learn more about prescriptive analytics with IBM Decision Optimization, as well as the IBM Academic Initiative offering for all fields of analytics.

Software Tutorial: *IBM Decision Optimization for Python* (IBM Optimization group)

Sunday, 4:30–5:15pm, Room 204B (SD75)

In this tutorial, you will learn how to use the new CPLEX Modeling API for Python with standard development tools. You will learn how to install this open source library, configure your environment to use it, and write optimization models in a few minutes. At the end of the session, you will be able to write your own optimization model and solve them with the free IBM Decision Optimization offers (either with the DCloud trial or with the Community Edition of CPLEX Optimization Studio). The hands-on part of the tutorial requires a 64-bit machine (Windows, Linux, or Mac) and access to Wi-Fi, but all participants will be able to follow along. Follow us on Twitter @IBMOptimization

Software Tutorial: *IBM Academic Initiative for Cloud...Building Next-Generation Skills* (IBM Academic Initiative Group)

Wednesday, 11–11:45am, Room 302 (WB79)

Digital transformations are requiring students, no matter what their major, to understand how to leverage and build solutions on the cloud. With the new Academic Initiative for Cloud offering, faculty and students can have hands-on cloud-based experiences to propel radical ideas and innovation using IBM Watson, Internet of Things, big data, analytics, mobile, and more. Join us to collaborate on best practices to empower innovation in the classroom and beyond! <http://ibm.biz/aiforcloud>

IdeaConnection

www.ideaconnection.com

IdeaConnection provides a full suite of open innovation services to help accelerate your R&D initiatives and speed your products to market. Whether it's finding licensing opportunities, searching for collaboration partners, solving technical problems, crowdsourcing, or giving you the tools and help to make your open innovation portal successful, our model ensures that you are using the right tool for the job.

IdeaConnection uses multidisciplinary teams of highly qualified, hand-picked experts to solve your technical challenges. The result is an unparalleled level of confidentiality, lower burden on your technical staff, and highest success rate in the industry. Better yet, you only pay for success.

IEOM Society

www.iieom.org

IEOM Society promotes and encourages critical thinking in the field of Industrial Engineering (IE) and Operations Management (OM), provides means to communicate and network among people enthused with similar interests through conferences, seminars, workshops, membership, student and professional chapters across the globe, and illustrative research publications to disseminate the earned knowledge and experience. IEOM Global Engineering Education addresses challenges and opportunities for readiness of engineering graduates from various parts of the world. IEOM Society focuses on how to reduce the readiness gap around the world. IEOM Industry Solutions showcases industrial case studies and their impacts using IE/OM tools and techniques.

Lehigh University, ISE Department

<https://ise.lehigh.edu>

Recognized among the nation's premier research universities, Lehigh offers a rigorous academic community for nearly 7,000 students. Lehigh's SESQUICENTENNIAL celebrations are shining light on the people, places, breakthroughs, and traditions of the 150 years that made Lehigh a prime institution. The ISE Department pursues excellence and national prominence in OR, analytics, IT, and related fields through innovative teaching, distinguished research, and professional leadership. Building on its unique strength and reputation, ISE strives for leadership in educational innovation, multidisciplinary cutting edge research, and industrial partnership. Our ultimate mission is to produce leaders who have learned to think critically and analytically, have the skills to comprehend and create new knowledge, and are willing to serve and inspire others.

LINDO Systems, Inc.

www.lindo.com

LINDO Systems offers three products hooked to industrial strength solvers for linear, integer, stochastic, NLP, and global optimization. LINGO includes a powerful modeling language and convenient data options to make building models faster and easier. What'sBest! allows you to build large optimization models in Excel. Models are easy to build and understand for anyone comfortable with Excel. LINDO API allows

you to plug the power of the LINDO solvers right into customized applications that you have written. Find out about the latest solver enhancements and pick up a full capacity evaluation license to try or a free educational research license.

Software Tutorial: *Optimization Modeling Made Easy*, Mark Wiley, VP Marketing, LINDO, mwiley@lindo.com, and Gautier Laude, Software Development Manager, LINDO, glaude@lindo.com

Monday, 4:30–5:15pm, Room 302 (MD79)

Come and learn how easy it is to: quickly build linear, nonlinear, quadratic, conic, and integer optimization models; incorporate uncertainty into optimization models; access data from Excel and databases; and seamlessly embed a solver into your own application. Come see a demonstration of the power and flexibility of the new releases of LINDO API – a callable solver engine; LINGO – an integrated modeling language and solvers; and What'sBest! – a large-scale solver for Excel.

MathWorks

www.mathworks.com

The MATLAB and Simulink product families are fundamental applied math and computational tools adopted by more than 5000 universities and colleges. MathWorks products help prepare students for careers in industry, where the tools are widely used for data analysis, mathematical modeling, and algorithm development in collaborative research and new product development.

Software Tutorial: *MATLAB: An Environment for Operations Research and Data Analytics*, Seth DeLand, Data Analytics Product Manager, MathWorks, seth.deland@mathworks.com

Tuesday, 8:45–9:30am, Room 302 (TA79)

MATLAB is a platform for analysis, visualization, simulation, and optimization. You can access and analyze real-world data and develop customized algorithms that scale to your largest problems. Join us to see how MATLAB can help you explore data, develop algorithms, and integrate analytics into enterprise applications. You'll also learn about new features including mixed-integer linear programming, machine learning, and working with big data.

Maximal Software, Inc.

www.maximalsoftware.com

Maximal Software will be introducing the new release 5.0 of the MPL Modeling System and the OptiMax Component Library during the Annual Meeting. This new release represents a major milestone for MPL, and offers

numerous new features and enhancements. We will also be introducing both the MPL Academic Program and MPL Free Development Program, which provide access to free full-size development versions of the MPL software for academic faculty, students, and even commercial users and consultants. To sign up for your free copy of MPL, please visit us at our Exhibit Booth anytime during the conference, or attend our Software Demonstration session.

Software Tutorial: *Introducing New Release 5.0 of the MPL Modeling System and the OptiMax Component Library*, Bjarni Kristjansson, President, Maximal Software, Inc., Bjarni@maximalsoftware.com

Wednesday, 8–8:45am, Room 302 (WA79)

Maximal Software is introducing a new major release 5.0 of the MPL Modeling System, which represents a major milestone for MPL. We will be demonstrating the many new features and enhancements of MPL, including new directory structure, redesigned documentation, new solver updates, Reverse Hessian for nonlinear models, and enhanced Stochastic support. Major updates for the MPL OptiMax Library and the MPL Callable Library, include new callbacks, new exception handlers, and enhanced multithreaded support.

Microsoft Power BI

<https://powerbi.microsoft.com>

At Microsoft, our mission and values are to help people and businesses throughout the world realize their full potential. We are striving to empower a culture of data by visualizing any data, any place, in any way. Our Power BI solution allows everyone in an organization to become data-driven decision makers. Power BI simplifies complex analytics and provides proactive alerting on all kinds and sizes of data from structured and unstructured to real-time streaming data.

Software Tutorial: *Power BI: Bring Your Data to Life*, Jen Underwood, Microsoft Sr. Program Manager, Microsoft Power BI, jenunder@microsoft.com

Sunday 8:45–9:30am, Room 302 (SA79)

In this tutorial session, you will explore Power BI with Microsoft engineering product team members. Feel free to bring a sample of your own data to create your own personalized dashboards. You will learn:

- Data preparation: Discover, transform, and combine data from various sources
- Data models: Create relationships, categorize your data and author business calculations
- Interactive visual reports: Author professional reports to slice/dice data to discover insights

- Power BI Dashboards: Ask language questions, create real-time dashboards, and share insights
- Power BI Mobile Apps: Interact with dashboards from iOS, Android, or Windows devices

MOSEK ApS**37**www.mosek.com

MOSEK ApS provides optimization software that helps customers make better decisions. The customer base consists of financial institutions and companies, engineering and software vendors, among others. MOSEK ApS was established in 1997 by Erling D. Andersen and Knud D. Andersen and it specializes in creating advanced software for solution of mathematical optimization problems. In particular, the company focuses on solution of large-scale linear, quadratic, and conic optimization problems. For more details visit our website: www.mosek.com.

Software Tutorial: *Using MOSEK at Its Best*, Andrea Cassioli, Product Manager, MOSEK ApS, andrea.cassioli@mosek.com

Monday, 2:15–3pm, Room 302 (MC79)

MOSEK provides high-quality software for conic optimization. The software tutorial focuses on:

1. the key features and benefits of our objective-oriented API called FUSION API: speed, expressiveness, and simplicity;
2. modeling issues and best practices that may be helpful in many cases; and
3. insight on the upcoming new release will be presented.

Customer inspired examples will be used to show how to use MOSEK at its best.

North Carolina State University, Industrial and Systems Engineering**47**<http://www.ise.ncsu.edu>

The Edward P. Fitts Department of Industrial and Systems Engineering at NC State University is among the top-ranked programs in the country. The department features educational and research programs in optimization, stochastic processes, simulation, systems analysis and analytics, quality and reliability, logistics, and health systems. We offer Masters (resident and online) and Doctoral degrees in Industrial Engineering as well as a Master of Supply Chain Engineering and Management. With external from NSF, NIH, DoD, and industry and location near Research Triangle Park, the department provides a vibrant environment for more than 200 graduate students.

North Carolina State University, Engineering Online**48**<http://engineeringonline.ncsu.edu/>

The College of Engineering at North Carolina State University has 12 academic departments and more than 20 centers, institutes, and laboratories. Professional engineers and computer scientists can participate in the College's Engineering Online program and take classes for professional development or toward the completion of one of the 16 online master's degree programs available for distance students. For more information, visit these websites: www.engr.ncsu.edu and <http://engineeringonline.ncsu.edu>.

Optimization Direct Inc.**9**www.optimizationdirect.com

Optimization Direct Inc., co-founded by Dr. Robert Ashford, a pioneer in the field of optimization, and Dr. Alkis Vazacopoulos, a leader in the industry, markets IBM® ILOG® CPLEX Optimization Studio®, the world's leading software product for modeling and optimization. CPLEX Optimization Studio solves large-scale optimization problems and enables better business decisions and resulting financial benefits in areas such as supply chain management, operations, healthcare, retail, transportation, logistics, and asset management. It has been applied in sectors as diverse as manufacturing, processing, distribution, retailing, transport, finance, and investment.

Software Tutorial: *Solving Large-Scale Optimization Problems using CPLEX Optimization Studio*, Drs. Robert Ashford and Alkis Vazacopoulos, Optimization Direct, Inc, alkis@optimizationdirect.com

Wednesday, 8:45–9:30am, Room 302 (WA79)

Recent advancements in linear and mixed programming give us the capability to solve larger optimization problems. CPLEX Optimization Studio solves large-scale optimization problems and enables better business decisions and resulting financial benefits in areas such as supply chain management, operations, healthcare, retail, transportation, logistics, and asset management. In this tutorial using CPLEX Optimization Studio, we will discuss modeling practices, case studies, and demonstrate good practices for solving hard optimization problems. We will also discuss recent CPLEX performance improvements and recently added features.

Palisade Corporation**34**www.palisade.com

Maker of the world's leading risk and decision analysis software, @RISK & the DecisionTools Suite.

We're the difference between taking a guess and taking control. At Palisade, we turn the art of decision-making into a science that works for you. Our innovative software solutions create usable insights from uncertain situations. As the leading provider of risk and decision analysis software for three decades, Palisade enables companies and organizations to evaluate risk at any level and decide what step comes next. With offices around the world, Palisade offers a truly global presence. And, with over 150,000 decision makers using our products at top research universities and Fortune 500 companies, Palisade has a diverse client base that spans a broad range of industries and organizations.

Software Tutorial: *Introduction to Risk and Decision Analysis using Palisade @RISK and The DecisionTools Suite*, Jose Raul Castro, Palisade Corporation

Wednesday, 1:30–3pm, Room 302 (WC79)

This event is designed to provide an entry-level introduction into probabilistic analysis and will show how Monte Carlo simulation, decision trees, and optimization can be applied to your everyday business analyses. If you build models in Excel then Palisade solutions can almost certainly help you to make more informed decisions, right from your desktop.

The webinar will explore some of the ways in which organizations are applying Palisade tools. From oil and gas, insurance and finance to healthcare, defense and construction, the DecisionTools Suite improves decision making at many of the world's most successful companies.

Palgrave Macmillan**26**www.palgrave.com

Palgrave Macmillan is a cross-market publisher specializing in cutting edge academic and trade nonfiction, reference, and journals.

Provalis Research**19**www.provalisresearch.com

Provalis Research is a leading developer of text analytics software with groundbreaking qualitative and quantitative analysis programs, such as QDA Miner, an innovative mixed-methods qualitative data analysis software; WordStat, a powerful add-on module for computer-assisted content analysis and text mining; and Simstat, an easy, yet powerful statistical software. One of the most distinctive features of these tools

is their interoperability, allowing researchers to integrate numerical and textual data into a single project file and seamlessly move back and forth between quantitative and qualitative data analysis, as well as to easily explore relationships between numerical and textual data.

Software Tutorial: *How to Analyze Big Text Data with Provalis Text Analytics Tools*, Normand Peladeau, CEO, Provalis Research, peladeau@provalisresearch.com

Sunday, 1:30–2:15pm, Room 302 (SC79)

Provalis Research will showcase its integrated collection of text analytics software. QDA Miner is easy-to-use qualitative and mixed-methods software that meets the needs of researchers performing qualitative data analysis and would like to code more quickly and more consistently larger amounts of documents. It offers high-level computer assistance for qualitative coding with innovative text search tools that help users speed up the coding process as well as advanced statistical and visualization tools. Users with even bigger text data can take advantage of WordStat. This add-on module to QDA Miner can be used to analyze huge amounts of unstructured information, quickly extract themes, find trends over time, and automatically identify patterns and references to specific concepts using categorization dictionaries.

Responsive Learning Technologies 4
www.responsive.net

Responsive Learning Technologies develops online competitive exercises used to teach operations management and supply chain management in business and industrial engineering programs. Our games provide a dynamic context for teaching concepts like capacity management, lead time management, inventory control, supply network design, and logistics. Beginning with our first game, Littlefield Technologies developed at Stanford's Graduate School of Business in 1999, our simulation games have been widely used with all levels of students from undergraduate to post-graduate and executives. In addition, we offer Business Foundations, an online adaptive learning system designed to help students prepare for beginning their MBA studies.

Software Tutorial: *Online Games to Teach Operations and Supply Chain Management*, Sam Wood, President, Responsive Learning Technologies, wood@responsive.net

Tuesday, 5:15–6pm, Room 302 (TD79)

Learn about online competitive exercises that are used in operations management and supply chain management courses to

teach topics like capacity management, lead time management, inventory control, supply chain design, and logistics. These games are typically used as graded assignments

River Logic, Inc. 43
www.riverlogic.com

Founded in 2000, River Logic is a privately held technology firm with a mission to establish prescriptive analytics (optimization) as the leading scientific approach to business planning and decision support. Its focus is on helping customers and business partners increase their performance, decision-making agility, and ability to predict business outcomes. River Logic provides a prescriptive analytics platform, Enterprise Optimizer®, on a service-oriented architecture that supports SaaS and on-premises deployments. This is complemented by an Integrated Business Planning application that simplifies customer adoption of the solution and platform into their business. These solutions enable customers and partners to quickly configure scalable, high-ROI white space planning and decision support applications.

Software Tutorial: *Code-Free Modeling for Large-Scale LP and MIP Problems using Enterprise Optimizer*, Eric Kelso, VP Product Management, River Logic, Inc., ekelso@riverlogic.com

Tuesday, 11:45am–12:30pm, Room 302 (TB79)

Enterprise Optimizer is a code-free, visual LP and MIP optimization modeling platform. Using EO's intuitive drag-and-drop interface, learn how to rapidly create integrated process and financial models. Learn about EO's wizard-driven data integration, query designer, user-defined schema, dashboard builder, VBA integration, APIs, and job automation component. Outputs demonstrated include detailed unit costs and audit-quality P&L, balance sheet, and cash flow statements. The entire session will be spent discussing major features and showing real-world applications.

SAS 5
www.sas.com

Successful organizations today rely heavily on analytics to guide and support operational, tactical, and strategic decision making. Many of the most successful rely on SAS, which provides a full spectrum of coordinated analytic capabilities, including data integration, statistics, data and text mining, econometrics and forecasting, and operations research (optimization, simulation, and scheduling). SAS helps organizations around the world build analytic models, populate them with relevant data and insights, communicate recommended decisions effectively, and surface these

capabilities within accessible, business-oriented interfaces. Visit us to see how SAS can help you understand the past and present, anticipate the future, and make better decisions.

Software Tutorial: *Building and Solving Optimization Models with SAS*, Ed Hughes, Principal Product Manager, and Rob Pratt, Senior R&D Manager, SAS

Tuesday, 4:30–5:15pm, Room 302 (TD79)

SAS provides a broad spectrum of data and analytic capabilities, including statistics, data and text mining, econometrics and forecasting, and operations research—optimization, simulation, and scheduling. OPTMODEL from SAS provides a powerful and intuitive algebraic optimization modeling language and unified support for building and solving LP, MILP, QP, NLP, CLP, and network-oriented models. We'll demonstrate OPTMODEL for basic and advanced problems, highlighting its newer capabilities and its support for both standard and customized solution approaches.

SAS JMP Division 7
www.jmp.com

JMP is desktop statistical discovery software from SAS that links interactive graphs with deep statistics. In the classroom, its visual approach to data exploration and analysis promotes understanding and collaboration. JMP reveals context and insight not seen in a table of numbers. The academic version of the software includes the same comprehensive and extensible capabilities that are used in the industry version. JMP is available for both Macintosh and Windows systems.

Software Tutorial: *Interactive and Visual Data Analysis with JMP 12 Pro*, Darryl Revenew, JMP Academic Ambassador, SAS JMP Division, Darryl.revenew@jmp.com

Monday, 8–9:30am, Room 302 (MA79)

JMP Statistical Discovery Software is interactive and visual desktop software for Windows and Mac, with a complete array of integrated graphical and statistical procedures. We will demonstrate JMP tools for data analysis, visualization, and exploration, including, Graph Builder®, bubble plots, the data filter, and our popular mapping tools. In addition to interactive techniques for univariate and bivariate analysis, we will look at methods for multivariate analysis including clustering, principal components, and data mining.

SAS Education Practice

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www.sas.com/en_us/industry/higher-education.html

SAS is the leader in business analytics software and services, and the largest independent vendor in the business intelligence market. Through innovative solutions, SAS helps customers at more than 75,000 sites improve performance and deliver value by making better decisions faster. Since 1976, SAS has been giving customers around the world THE POWER TO KNOW®.

Software Tutorial: *Introduction to SAS Data Mining*, F. Michael Speed, Ph.D., Analytical Consultant, SAS, mike.speed@sas.com, and Tom Bohannon, Ph.D., Analytical Consultant, SAS, tom.bohannon@sas.com

Sunday, 2:15–3pm, Room 302 (SC79)

This introduction covers the skills required to assemble analysis flow diagrams using the rich tool set of SAS Enterprise Miner for both pattern discovery and predictive modeling. Participants will learn how to: define a SAS Enterprise Miner project; modify data for better analysis results; build and understand predictive models; and compare and explain complex models.

SIAM

8

www.siam.org

Visit the Society for Industrial and Applied Mathematics (SIAM, Booth #8) to check out our new publications, including recent titles in the MOS-SIAM Series on Optimization such as *Evaluating Gas Network Capacities* (Koch et al.), *Arc Routing: Problems, Methods, and Applications* (Corberán and Laporte), *Introduction to Nonlinear Optimization: Theory, Algorithms, and Applications with MATLAB* (Beck), and other bestselling SIAM books, all available at a conference discount. You'll also find sample issues of SIAM's renowned journals, including SIOPT, along with information and applications for anyone interested in becoming a SIAM member. And don't forget to pick up a copy of SIAM News for the road.

SigmaXL, Inc.

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www.sigmaxl.com

Established in 1998, SigmaXL, Inc. is a leading provider of user-friendly Excel Add-ins for Lean Six Sigma graphical and statistical tools and Monte Carlo simulation. Our customers include market leaders like FedEx, Microsoft, Motorola, and Shell. Our flagship product, SigmaXL®, was designed from the ground up to be a cost-effective, powerful, but easy-to-use tool for process improvement, quality, and statistics. DiscoverSim™ enables you to quantify your risk through Monte Carlo simulation and

minimize your risk with global optimization. Version 2 is now bundled with MIDACO-SOLVER, one of the world's strongest evolutionary solvers for mixed discrete-continuous-constrained optimization.

Software Tutorial: *What's New in SigmaXL® Version 7*, John Noguera, CTO & Co-founder, SigmaXL, Inc., jnoguera@sigmaxl.com

Tuesday, 8–8:45am, Room 302 (TA79)

SigmaXL is a user-friendly Excel Add-In tool for process improvement, Six Sigma quality, and statistics. We introduce SigmaXL and the new features in Version 7: "Traffic Light" Automatic Assumptions Check for T-tests and ANOVA, Automatic Normality Check for Pearson Correlation and Small Sample Exact Statistics for One-Way Chi-Square, Two-Way (Contingency) Table and Nonparametric Tests. Exact statistics are appropriate when the sample size is too small for a chi-square or normal approximation to be valid.

Simio Simulation and Scheduling Software

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www.simio.com

Simio Simulation and Scheduling Software is the most advanced solution on the market. With simulation, it is the only software that is fully object-oriented with process and objects being defined graphically with no programming. Unlike other scheduling software, Simio allows you to introduce risk into your production schedule with its patented Risk-based Planning and Scheduling. This dual function in Simio not only helps you improve your business performance from a facility design perspective, but also helps you maximize business results by optimizing the use of critical resources and assessing the risk associated with operational decisions.

Software Tutorial: *Introduction to Simio Simulation and Scheduling Software*, C. Dennis Pegden, CEO and Founder, Simio, cdpegden@simio.com, and Eric Howard, Director of Marketing, Simio, ehoward@simio.com

Sunday, 11–11:45am, Room 302 (SA79)

Simio is a premier simulation and scheduling software that allows you to expand traditional benefits of simulation to improve daily operations. In this tutorial, we will demonstrate Simio's 3D rapid modeling capability to effectively solve real problems. Explore how a single tool can be used to not only optimize your system design, but also provide effective planning and scheduling. Come explore the Simio difference and see why so many professional and novice simulationists are changing to Simio.

Springer

2-3

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Statistics.com

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The Institute for Statistics Education at Statistics.com offers 100+ courses in statistics, analytics, data mining, text mining, social network analysis, optimization, risk management, biostatistics, etc., plus courses that focus on tools like Python, R, SAS, SQL, and Hadoop. Our typical course is four weeks long and organized into weekly lessons that include readings, short videos, instant feedback exercises, homework due weekly, and a project. Courses are attended every day by an expert instructor, staffed by TAs who help the instructor with posting content and grading homework – participants do not need to be online at particular times.

Software Tutorial: *A Survey of Data Analytics Methods*, Peter Bruce, Founder and President, The Institute for Statistics Education at Statistics.com, peter.bruce@statistics.com

Tuesday, 11–11:45am, Room 302 (TB79)

This workshop will survey the field of data analytics, reviewing both traditional statistical methods and machine learning methods, including predictive modeling, unsupervised learning, text mining, statistical inference, time series forecasting, recommender systems, network analytics, and more. It will be a broad brush treatment aimed at newcomers, as well as those with knowledge in one area who wish to understand where other analytic methods fit into the picture.

Syncopation Software, Inc.

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www.syncopation.com

Syncopation Software is a leading provider of business analytic tools for decision and risk analysis, Monte Carlo simulation, real option valuation, and portfolio management. Our range of software solutions, backed by our responsive support and variety of efficient training courses, can help you tackle a wide variety of decision problems with inherent uncertainty. From quick risk assessments within a spreadsheet (DPL Direct), to complex decision support applications

(DPL Professional), to the prioritization of a demanding portfolio (DPL Portfolio and DPMX), Syncopation has robust tools grounded in solid management science principles that are sure to lead you to better outcomes and enhanced value creation.

Software Tutorial: DPL Portfolio and DPMX™: A Decision Analysis-based System for Better Portfolio Decisions, Chris Dalton, CEO, Syncopation Software, Inc., cdalton@syncopation.com

Tuesday, 1:30–2:15pm, Room 302 (TC79)

This demonstration will show how the DPMX™ system can serve as the analytical backbone for an effective portfolio analysis process. We'll start with an overview of DPL Professional, a proven modelling environment for decision analysis, risk analysis, and Monte Carlo simulation. Next, we'll cover DPL Portfolio, the modelling environment for portfolio analysis, visualization, and prioritization. Finally, we'll show DPMX, a Web-based system for managing project data and presenting portfolio results in attractive, management-friendly charts. The motivating examples will be drawn from the prioritization of an R&D portfolio in the pharmaceutical industry.

Taylor & Francis

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Taylor & Francis boasts an excellent portfolio of journals specializing in operations research and management science. Our journals are edited by leading academics and offer several accommodating options for prospective authors. Visit our booth to talk to us about your work and browse our Operations Research and Management Science journals.

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Wiley

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RENEW AT THE informs CENTER EXHIBIT HALL A

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How to Navigate the Technical Sessions

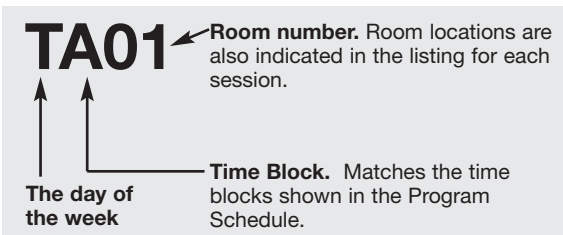
There are four primary resources to help you understand and navigate the Technical Sessions:

- This Technical Session listing, which provides the most detailed information. The listing is presented chronologically by day/time, showing each session and the papers/abstracts/authors within each session.
- The Author and Session indices provide cross-reference assistance (pages 510-553).

Quickest Way to Find Your Own Session

Use the Author Index (page 510) — the session code for your presentation will be shown along with the room location. You can also refer to the full session listing for the room location of your session.

The Session Codes



Time Blocks

Sunday - Tuesday

- A — 8:00am - 9:30am
- B — 11:00am - 12:30pm
- C — 1:30pm - 3:00pm
- D — 4:30pm - 6:00pm

Wednesday

- A — 8:00am - 9:30am
- B — 11:00am - 12:30pm
- C — 12:45pm - 2:15pm
- D — 2:45pm - 4:15pm
- E — 4:30pm - 6:00pm

Room Locations /Tracks

All tracks and technical sessions will be held in the Convention Center and Marriott. Room numbers are shown on the Track Schedule and in the technical session listing.

Sunday, 8:00am - 9:30am

■ SA01

01-Room 301, Marriott

Modeling and Combating Terrorism

Sponsor: Military Applications

Sponsored Session

Chair: Gary Kramlich, Orsa Team Leader, US Army INSCOM, 5837 New England Woods Dr, Burke, VA, 22015, United States of America, gary.r.kramlich.mil@mail.mil

1 - Combating Terrorism: How to Degrade a Terrorist Network by Strengthening a US Support Network

Chané Jackson, Instructor, United States Military Academy, Department of Mathematics, West Point, NY, 10996, United States of America, chane.jackson@usma.edu
Nedialko Dimitrov, Anthony Johnson

To combat terrorism abroad, the US Forces seek to degrade a terrorist support network and strengthen a US support network. We describe a general framework for the problem of influence maximization in a social network. Solutions identify key individuals to serve as a focus for US efforts to expand support. Our framework both captures previous work in the area and yields many novel problem formulations. We demonstrate the framework's applicability through insights gained on several examples.

2 - Countering Improvised Explosive Devices with Adaptive Sensor Networks

Jorge Buenfil, PhD Student, Stevens Institute of Technology, 1 Castle Point Rd, Hoboken, NJ, 07030, United States of America, jbuensfil@stevens.edu, Jose Emmanuel Ramirez-marquez

A combination of statistical analysis, artificial intelligence and human-machine interface with an adaptive system is presented as a way to infer the presence of IEDs in a dynamic environment. Specific algorithms, pattern recognition, and statistical data processing are applied to this problem to accurately indicate the presence of explosives with low probability of false alarms, high probability of detection, and the ability to automatically improve the sensor network's accuracy over time.

■ SA02

02-Room 302, Marriott

Interdiction and Fortification Models: Applications

Cluster: Homeland Security

Invited Session

Chair: Taofeek Biobaku, University of Houston, Houston, TX, United States of America, tobiobaku@uh.edu

1 - A Network Interdiction Approach to the Rural Postman Problem

Gokhan Karakose, University of Missouri, Lafferre Hall, Columbia, MO, United States of America, gkz7c@mail.missouri.edu, Ronald McGarvey

We consider a network where some required arcs need to be traversed by a manager who wishes to minimize his total distance traveled. Opposing this manager an interdicator seeks to disrupt arcs in order to impede the manager's travel. Given that the manager can invest limited resources to protect a subset of arcs from disruption, what investment strategy minimizes the maximum distance that the manager might need to travel?

2 - Allocating Resources to Enhance Resilience, with Application to Superstorm Sandy

Cameron MacKenzie, Assistant Professor, Iowa State University, 3004 Black Engineering, Ames, IA, 50011, United States of America, camacken@iastate.edu, Chris Zobel

We construct a framework to allocate resources to increase an organization's resilience to a system disruption. We first look at characterizing the optimal resource allocations associated with several standard allocation functions. Next, we apply the resource allocation model for resilience to uncertain disruptions. The optimization model is applied to an example of increasing the resilience of an electric power network to Superstorm Sandy.

3 - A Branch and Cut Method for Solving the Bilevel Clique Interdiction Problem

Timothy Becker, Rice University, 6100 Main Street, Houston, TX, 77005, United States of America, tjb5@rice.edu, Illya Hicks

I introduce an algorithm to solve the current formulation of the bilevel clique interdiction problem. The problem defines a defender who attempts to minimize the number of cliques removed by an attacker. The algorithm presented in this talk uses a branch and cut approach to solve the proposed problem and give preliminary results. This algorithm is expected to be usable on any social network, thereby improving the study of many network problems including terrorist cells or marketing strategies.

■ SA03

03-Room 303, Marriott

Scheduling and Optimization in Logistics, Energy, Manufacturing Industries

Cluster: Scheduling and Project Management

Invited Session

Chair: Lixin Tang, Professor, Northeastern University, Institute of Industrial Engineering and, Logistics Optimization, Shenyang, 110819, China, lixintang@mail.neu.edu.cn

1 - Integrated Production, Inventory and Delivery Problems: Complexity and Algorithms

Zhi-Long Chen, Professor, University of Maryland, Robert H. Smith School of Business, College Park, MD, 20742, United States of America, zchen@rhsmith.umd.edu, Feng Li, Lixin Tang

We consider integrated production, inventory and delivery scheduling problems that arise in practical settings where customer orders have delivery time windows, and are first processed in a plant and then delivered to the customers by transporters with fixed delivery departure times. We study their complexity by showing NP-hardness of a problem or giving polynomial-time algorithms. For two problems, we propose column generation based heuristics that can find near optimal solutions quickly.

2 - Smart Port Automation System

Loo Hay Lee, National University of Singapore, Department of Industrial & Systems, Engineering, Singapore, iseleelh@nus.edu.sg, Ek Peng Chew

In this talk we will present several innovative port automation concepts, which include the Frame-bridge system developed by ZPMC, Grid System developed by BEC, AGV system and the double storey container port system (SINGA port). SINGA port has won the grand prize of US\$ 1 million for the next generation container port challenge.

3 - Scheduling a Single Batching Machine with Makespan and Total Rejection Cost Objectives

Kangbok Lee, York College, CUNY, York College, The City University of New York, Jamaica, NY, 11451, United States of America, klee5@york.cuny.edu, Cheng He, Joseph Leung, Michael Pinedo

We consider a single batching machine scheduling problem with rejection being allowed. Two bi-criteria problems are considered: (a) minimize makespan with a given threshold of the total rejection cost, and (b) minimize the total rejection cost with a given threshold of makespan. For problem (a) we present an $O(n^2)$ -time 2-approximation algorithm and for both problems (a) and (b) we provide dynamic programming algorithms and fully polynomial-time approximation schemes.

4 - Production, Logistics and Energy Scheduling in the Steel Industry

Lixin Tang, Professor, Northeastern University, Institute of Industrial Engineering and, Logistics Optimization, Shenyang, 110819, China, lixintang@mail.neu.edu.cn

We discuss three scheduling problems in steel industry: 1) production scheduling in steel-making and hot/cold rolling operations; 2) logistics scheduling in storage/stowage, shuffling, transportation and (un)loading operations; 3) energy analytics and scheduling including energy consumption estimation, energy diagnosis and benchmarking, energy prediction and dynamic energy allocation. Some on-going interesting topics on coordinated scheduling of production, logistics and energy are discussed.

■ SA04

04-Room 304, Marriott

JFIG Paper Competition I

Sponsor: Junior Faculty Interest Group

Sponsored Session

Chair: Asoo Vakharia, Professor, University of Florida, Department of ISOM, Gainesville, FL, 32611, United States of America, asoov@ufl.edu

Co-Chair: Arda Yenipazarli, Assistant Professor of Operations Management, Georgia Southern University, COBA 2224, Statesboro, GA, 30460, United States of America, ayenipazarli@georgiasouthern.edu

1 - JFIG Paper Competition I

The 2015 JFIG paper competition features paper submissions from a diverse array of talented junior faculty members. The prize committee evaluated submissions based on the importance of the topic, appropriateness of the approach, and significance of the contribution. After careful review, the prize committee selected a group of finalists to present their research in one of the two JFIG sessions. For information on the finalists and their papers, please refer to the online program.

■ SA05

05-Room 305, Marriott

Scalable Business Analytics in Social Media

Cluster: Social Media Analytics

Invited Session

Chair: Kunpeng Zhang, Assistant Professor, University of Maryland, College Park, Maryland, College Park, United States of America, kpzhangs@gmail.com

1 - Assessing Factors that Drive People to Invest in Crowdfunding Projects

Yuheng Hu, Assistant Professor, University of Illinois at Chicago, 601 S Morgan St, Chicago, IL, United States of America, yuhenghu@gmail.com

Crowdfunding platforms have gained popularity in recent years. However, little is known about the factors driving people to invest in crowdfunding projects. In this paper, we examine factors associated with three different perspectives that drive people's investment in over 6K funded projects on Kickstarter: 1) founder's personality, 2) founder's social network, and 3) project-based factors. We find that people's personality and the project topics variously affect the investment choices.

2 - Production Diffusion and Identity Signaling on Social Shopping Platforms

De Liu, Associate Professor, University of Minnesota Twin Cities, deliu@umn.edu, Pei Xu

We study the diffusion of products on social shopping platforms, where consumers can endorse the products they discover and like and follow one another's endorsements. We find that the diffusion of product endorsements is consistent with the identity-signaling model. Consumers endorse products endorsed by their aspiration groups (whom they follow) but avoid products endorsed by the crowd.

3 - Winning Strategies in Dynamic Innovation Tournaments

Jie Zhang, Associate Professor, University of Texas, Arlington, 701 S West St. Box 19437, Arlington, TX, 76019, United States of America, jiezhang@uta.edu, Indika Dissanayake

Innovation tournaments have become a popular method of finding creative solutions. Using weekly contest data collected from an innovation tournament platform, we studied the winning strategies of solvers in a dynamic tournaments setting. Our analyses suggest that solvers strategically exert efforts over time to enhance their probability of winning. Furthermore, teams strategically merge with other team to enhance their chances of winning.

4 - On the Stormy Side of Twitter: The Role of the Network in Public Engagement with Climate Change

Lauren Rhue, Visiting Assistant Professor, Wake Forest University, 1834 Wake Forest Road, Farrell Hall 235, Building 60, Winston-Salem, NC, 27106, United States of America, rhuela@wfu.edu, Graham Gottlieb, Irina Feygina

Our study examines millions of tweets from TV meteorologists' accounts to understand the influence of meteorologists' network positions, the tweet sentiment, and major weather events on the public engagement with weather and climate change. We find that the effectiveness of their tweets, measured by retweets and favorites, is affected by all these drivers and that negativity and disasters sparks interest in the weather.

■ SA06

06-Room 306, Marriott

Financial Engineering

Sponsor: Financial Services

Sponsored Session

Chair: Abel Cadenillas, Professor, University of Alberta, Department of Mathematical Sciences, Central Academic Building 632, Edmonton, AB, T6G2G1, Canada, abel@ualberta.ca

1 - Robust Dynamic Optimization of Credit Portfolios

Agostino Capponi, Columbia, Mudd 313, New York, NY, 10027, United States of America, ac3827@columbia.edu

We introduce a dynamic credit portfolio framework where optimal investment strategies are robust against misspecifications of the reference credit model. We provide an explicit characterization of the optimal robust bond investment strategy, in terms of default state dependent value functions associated with the max-min robust optimization criterion. The value functions can be obtained as the solutions of a recursive system of HJB differential equations.

2 - Optimal Investment and Liability Ratio Policies in a Multidimensional Regime Switching Model

Abel Cadenillas, Professor, University of Alberta, Department of Mathematical Sciences, Central Academic Building 632, Edmonton, AB, T6G2G1, Canada, abel@ualberta.ca, Bin Zou

We consider an insurer who faces an external jump-diffusion risk that is negatively correlated with the capital returns in a multidimensional regime switching model. The insurer selects investment and liability ratio policies continuously to maximize her/his expected utility of terminal wealth. We obtain explicit solutions for optimal investment and liability ratio policies for logarithmic power, and exponential utility functions.

3 - Dynamic Programming in Mathematical Finance

Alain Bensoussan, Professor, The University of Texas at Dallas, United States of America, axb046100@utdallas.edu

Mathematical Finance has introduced new type of stochastic control problems. In this context, the martingale method has been used to solve them. This gives the impression that probabilistic techniques are the only way to obtain a solution. We show that purely analytical techniques can be used for the same result. Not only it is useful to have additional techniques, but also analytical techniques allow for more constructive solutions. We will discuss the main techniques, and give examples.

4 - A Data-driven Perspective on Transaction Costs in Portfolio Selection

Victor Demiguel, Professor, London Business School, Regent's Park, London, United Kingdom, avmiguel@london.edu, Alba V. Olivares-nadal

We show that a transaction cost term can result in portfolios that are robust with respect to estimation error. Theoretically, we show that the problem with transaction costs is equivalent to: a robust portfolio problem, a robust regression problem, and a Bayesian portfolio problem. Empirically, we propose a data-driven approach to portfolio selection with transaction costs. We demonstrate using five empirical datasets that the proposed data-driven portfolios perform well out of sample.

■ SA07

07-Room 307, Marriott

Quantitative Financial Risk Management

Cluster: Risk Management

Invited Session

Chair: Tim Leung, Professor, Columbia University, 116th Street, New York, NY, 10027, United States of America, tl2497@columbia.edu

1 - A Limit Order Book Model for Small-tick Stocks

Xinyun Chen, Stony Brook University, Math Tower, B148 #4, New York, United States of America, xinyun.chen@stonybrook.edu, Jose Blanchet, Yanan Pei

We construct a limit order book model to inform the joint evolution of the spread and the price processes for small-tick stocks. Under the multi-scale asymptotic regime suggested by empirical observations, we solve the price return distribution in terms of the order flow rates. We test our model using US stock market data. Under different scaling regimes, with respect to the autocorrelation of order flows, our results leads to different jump-diffusion models for the price dynamics.

2 - Optimal Static Quadratic Hedging

Tim Leung, Professor, Columbia University, 116th Street, New York, NY, 10027, United States of America, tl2497@columbia.edu

We propose a flexible framework for hedging European or path-dependent derivatives by holding static positions in vanilla European calls, puts, bonds, and forwards. A model-free expression is derived for the optimal static hedging strategy that minimizes the expected squared hedging error subject to a cost constraint. The versatility of our approach is illustrated through a series of examples.

3 - The Martingale Extraction Method with Applications to Long-term Cash Flows

Hyunbin Park, Worcester Polytechnic Institute, 100 Institute Road, Worcester, MA, 01609, United States of America, hpark@wpi.edu

The martingale extraction method is discussed with applications. We determine the exponential decay (or growth) rate of long-term cash flows and, as one of examples, long-dated leveraged ETFs are analyzed. We then explore a sensitivity analysis with respect to perturbations in the underlying process. The method of Fournie is combined with the martingale extraction to analyze the sensitivity.

4 - Drawdown-Based Measures of Risk

Olympia Hadjiladis, Professor, Brooklyn College and the Graduate Center CUNY, 32 Willow Place, Apt. 3, Brooklyn, NY, 11201, olympia.hadjiladis@gmail.com, Hongzhong Zhang, Tim Leung, Chris Knaplund

Common risk measures, such as value-at-risk and conditional value-at-risk, are based on the distribution of terminal returns, and do not incorporate path dependence of returns. The drawdown process can be used to describe the path-wise risk – it is defined as the difference between the running maximum and the current position of a process. We define and discuss the risk measures drawdown-at-risk, conditional drawdown-at-risk, maximum drawdown-at-risk and the co-drawdown-at-risk.

■ SA08

08-Room 308, Marriott

Node Location, Node Disruption and Routing

Sponsor: Telecommunications

Sponsored Session

Chair: Timothy Matis, Professor, Texas Tech University, 2500 Broadway, Texas, United States of America, Timothy.Matis@ttu.edu

1 - A Robust Optimization Approach for Identifying Disruptive Nodes in Networks

Joe Naoum-sawaya, IBM Research, Damastown Industrial Estate, Dublin 15, Ireland, jnaoumsa@uwaterloo.ca, Christoph Buchheim

The critical node selection problem (CNP) has important applications in telecommunication, supply chain design, and disease propagation prevention. In practice the weights on the connections are uncertain. Thus robust optimization approaches have been considered. In this presentation, we address general uncertainty sets and propose an exact approach based on Benders decomposition. In particular, we can deal with discrete scenario based uncertainty, gamma uncertainty, and ellipsoidal uncertainty.

2 - Location of Wireless Mobile Relays

David Shallcross, Applied Communication Sciences, 150 Mt Airy Road, Basking Ridge, NJ, 07920, United States of America, dfs@jhu.edu

We consider the placement of wireless mobile relays to enable communication between clients, focusing on minimizing the maximum link length in the resulting network. We present new bounds and complexity results for the centralized problem, and analysis of an algorithm distributed among the relays themselves.

3 - A Game-Theoretic Model of Network Routing under Strategic Link Disruptions

Mathieu Dahan, Master Student, Massachusetts Institute of Technology, 70 Pacific Street #648C, Cambridge, MA, 02139, United States of America, mdahan@mit.edu, Saurabh Amin

We consider a network security game where the defender routes flow through a network and the attacker disrupts one or more links. The defender (resp. attacker) faces disutility (resp. utility) of lost flow, and incurs transportation cost (resp. cost of attack). We show that, under certain conditions, Nash equilibria of this game can be characterized by max-flow and min-cut of the network. We study equilibrium structure in terms of the player valuations of effective flow and the incurred costs.

■ SA09

09-Room 309, Marriott

Global Value Chains and New Organizational Architectures

Sponsor: Technology, Innovation Management & Entrepreneurship
Sponsored Session

Chair: Saikat Chaudhuri, The Wharton School, University of Pennsylvania, 2000 Steinberg Hall-Dietrich Hall, 3620 Locust Walk, Philadelphia, PA, 19104, United States of America, saikatc@wharton.upenn.edu

1 - Collaboration Between Specialist Physicians in Multiple Countries Enabled by Information Technology

Ravi Aron, Johns Hopkins University, 100, International Drive, Room 1331, Baltimore, MD, 21202, United States of America, raviaron@jhu.edu, Praveen Pathak

Medical Tourism refers to patients that travel abroad for surgery. This involves collaboration between the doctor in the patient's home country that provides ongoing care and the specialist surgeon and hospital offshore that provides the surgical services. We look at how technology plays a role in enabling collaboration between physicians internationally. We disaggregate the different elements of IT and their impact on clinical outcomes and patient satisfaction levels.

2 - Operationalizing Enterprise Architecture and Evaluating Enterprise Flexibility

Alan MacCormack, Harvard Business School, Soldiers Field, Boston, MA, 02163, United States of America, amaccormack@hbs.edu

We develop a network-based methodology for analyzing a firm's enterprise architecture. We demonstrate the application of this method to the analysis of enterprise IT flexibility, using data from a large pharmaceutical firm. We show that measures of architecture derived from our methodology predict the cost of change for software applications within the firm. In particular, applications that are tightly coupled to other system components cost significantly more to change.

3 - The Voice of Ideas: Understanding Impact of Diverse Modes of Open Innovation

Natalia Levina, Stern School of Business, New York University, 44 W 4th Street., KMEC 8-78, New York, NY, United States of America, nlevina@stern.nyu.edu, Emmanouil Gkeredakis, Anne-laure Fayard

Organizations are increasingly engaging in open innovation by hiring consultants and using crowdsourcing platforms in the hopes of solving their long-standing R&D problems. Yet, the impact of these diverse modes of open innovation on organizations is not well understood. The talk builds on an in-depth field study of such engagements and argues that diverse modes of sourcing ideas have very different potential for enabling organizations to learn new perspectives on their long-standing problems.

4 - Global Sourcing of Key Resources: Emerging-market Firms' Acquisitions of Developed-Market Companies

Saikat Chaudhuri, The Wharton School, University of Pennsylvania, 2000 Steinberg Hall-Dietrich Hall, 3620 Locust Walk, Philadelphia, PA, 19104, United States of America, saikatc@wharton.upenn.edu

Emerging-market firms are increasingly acquiring developed-market companies to obtain high-value technology and market resources, challenging traditional paradigms. We offer a perspective that provides a more balanced focus on the role of both firm and location specific resources in the value creation of these acquisitions. Applying our conditional approach, we develop testable propositions on the distinct antecedents, processes, and outcomes of such acquisitions, as a basis for future work.

■ SA10

10-Room 310, Marriott

Mobile and Location-Based Services

Sponsor: E-Business
Sponsored Session

Chair: Lei Wang, Assistant Professor, Penn State University, 440 Business Building, University Park, PA, 16802, United States of America, luw21@psu.edu

1 - The Positive Spillover Effect of Mobile Social Games on App Literacy

Sang-Pil Han, Assistant Professor, Arizona State University, BA 301D, Tempe, AZ, 85287, United States of America, shan73@asu.edu, Wonseok Oh, Sungho Park, Mihyun Lee

Despite the massive influx of mobile apps into the market, not everyone is "mobile literate." This study uses an individual level mobile app usage dataset to examine the potential of mobile platform-based social games as training tools for mobile literacy. Results reveal that high social game app consumption increases the duration of app usage and the number of apps used. This positive spillover effect is more pronounced among users with limited mobile experiences or are in their 50s or older.

2 - Trajectory-based Mobile Advertising

Beibei Li, Assistant Professor, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, beibeili@andrew.cmu.edu, Siyuan Liu, Anindya Ghose

We propose a new mobile ad strategy that leverages full information on consumers' offline moving trajectories. To examine the effectiveness of this new mobile ad strategy, we design a large-scale randomized field experiment in a large shopping mall in Asia. We found that mobile trajectory-based ads can lead to the highest redemption probability and highest satisfaction rate from customers.

3 - Learning from your Friends' Check-Ins: An Empirical Study of Location-Based Social Networks

Liangfei Qiu, Assistant Professor, University of Florida, Department of ISOM, Gainesville, FL, United States of America, liangfeiqiu@ufl.edu, Zhan Shi, Andrew Whinston

Recently, mobile applications have offered users the option to share their location information with friends. Using data from a major location-based social networking app in China, we estimate a structural model of restaurant discovery and observational learning and conduct counterfactual analysis on seeding strategies. The unique feature of repeated customer visits in the data allows us to separate observational learning from non-informational confounding mechanisms.

4 - How Does the Taxi-hailing App Improve Driver's Efficiency? An Empirical Evidence from China's "UBER"

Kaiquan Xu, Nanjing University, 22#, Hankou Road, Nanjing, China, xukaiquan@nju.edu.cn

With the Uber's rapid development, there is no any study to assess the taxi-hailing app's advantages and disadvantages. Using the unique dataset from the large taxi-hailing app company in China, this study finds some interesting results. Drivers can earn more 1.249 RMB when the order is acquired from the app. Our study shows that the taxi-hailing app increases the time to pick up customers. This is the first study of using the driver-level objective data to examine the taxi-hailing app's impact.

■ SA11

11-Franklin 1, Marriott

Polynomial and Nonconvex Optimization

Sponsor: Optimization/Integer and Discrete Optimization
Sponsored Session

Chair: Daniel Bienstock, Columbia University, 500 W 120th St, New York, NY, 10027, United States of America, dano@columbia.edu

1 - Lifted Formulations for Optimization Problems with Small Width

Daniel Bienstock, Columbia University, 500 W 120th St, New York, NY, 10027, United States of America, dano@columbia.edu, Gonzalo Muñoz

We present polynomial-size lifted formulations for optimization problems where the intersection matrix of the constraints has bounded tree-width. For a binary problem with n variables and tree-width w , our formulation has $2wn$ constraints and variables, and is exact. We used this construction to obtain polynomial-size formulations for mixed-integer polynomial optimization problems of bounded width, which attain desired feasibility and optimality guarantees.

2 - Algebraic Decomposition of Polynomials by Linear and Second Order Cone Programming

Amir Ali Ahmadi, Princeton University, Department of ORFE, Princeton University, Sherrerd Hall, Charlton Street, Princeton, NJ, 08544, United States of America, a_a_a@princeton.edu

We present several LP/SOCP based algebraic decomposition algorithms for multivariate polynomials that can be used to solve polynomial optimization problems.

3 - Approximation Tools for Structured Nonconvex Optimization Problems

Fatma Kilinc Karzan, Assistant Professor Of Operations Research, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, fkilinc@andrew.cmu.edu, Levent Tuncel

We study the structured nonconvex optimization problem of maximizing a convex function over a convex domain. Such problems generalize computing matrix norms and often arise in applications in robust optimization and machine learning. In many cases, these problems are NP-Hard; and thus we establish a framework for building tractable convex relaxations. We study various properties, approximation quality, and exactness of these relaxations, and establish connections to existing results.

SA12

12-Franklin 2, Marriott

Surrogate-Based and Derivative-Free Optimization I

Sponsor: Optimization/Mixed Integer Nonlinear Optimization and Global Optimization

Sponsored Session

Chair: Rommel Regis, Saint Joseph's University, Mathematics Department, 5600 City Avenue, Philadelphia, 19131, United States of America, rregis@sju.edu

1 - A Swarm Intelligence Based Data-driven Optimizer using Adaptive Meta-modeling

Mengqi Hu, University of Illinois at Chicago, Chicago, IL, United States of America, mhu@uic.edu

Although many different meta-models are developed to reduce computational cost for time-intensive model, it is not conclusive that any meta-model performs better than others across diverse set of problems. To this end, we develop an adaptive model selection algorithm to adaptively select the most suited meta-model for different problems. This approach is integrated with a novel swarm intelligence algorithm for data-driven optimization which can achieve good result with less computational cost.

2 - Response Correction Techniques for Multifidelity Design Optimization

Leifur Leifsson, Iowa State University, Department of Aerospace Engineering, 2271 Howe Hall, Ames, IA, 50011, United States of America, leifur@iastate.edu

Simulations are widely used in engineering for analysis and design. A key challenge is the computational cost. Conventional design techniques typically require a large number of model evaluations. Thus, the use of simulations in the design process can be prohibitive. Physics-based surrogates, so-called multifidelity models, can be used to accelerate the optimization process. This talk describes several response correction techniques developed specifically for multifidelity design optimization.

3 - FALCON: A Function Approximation Algorithm for Large-scale Constrained Black-box Optimization

Rommel Regis, Saint Joseph's University, Mathematics Department, 5600 City Avenue, Philadelphia, PA, 19131, United States of America, rregis@sju.edu

This talk presents the FALCON algorithm for constrained expensive black-box optimization that uses surrogates to approximate the objective and constraint functions. Unlike previous methods, FALCON can handle infeasible start points and equality constraints. FALCON is implemented using an interpolating radial basis function surrogate and compared with alternatives on benchmark problems, including a large-scale automotive application with 124 decision variables and 68 black-box constraints.

SA13

13-Franklin 3, Marriott

Nonconvex Statistical Optimization

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Han Liu, Princeton University, Sherrerd Hall, Charlton Street, Princeton, NJ, United States of America, hanliu@princeton.edu

1 - Blessing of Massive Scale: Spatial Graphical Model Inference with a Total Cardinality Constraint

Ethan X. Fang, Princeton University, Sherrerd Hall ORFE, Charlton Street, Princeton, NJ, 08544, United States of America, ethanfangxy@gmail.com, Han Liu, Mengdi Wang

We propose a novel inferential framework for estimating large-scale spatial graphical models with a total cardinality constraint. This work has two major contributions. (i) From a computational perspective, we show that the computational accuracy increases when the problem scale increases. (ii) From a statistical perspective, we justify the obtained graph estimator achieves the minimax optimal rate of convergence under weak assumptions.

2 - A General Theory of Pathwise Coordinate Optimization

Tuo Zhao, Johns Hopkins University, 12124 East Run Drive, Lawrenceville, NJ, 08648, United States of America, touzhaot@gmail.com, Tong Zhang, Han Liu

The pathwise coordinate optimization achieves superior empirical performance for solving high dimensional nonconvex sparse learning problems, but at the same time poses significant challenge to theoretical analysis. To tackle this long lasting problem, we develop a new theory showing that the unique algorithmic structure of the pathwise coordinate optimization plays pivotal roles in guaranteeing its optimal statistical and computational performance.

SA14

14-Franklin 4, Marriott

Stochastic Optimization with Discrete Moments

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Anh Ninh, College of William and Mary, 200 Stadium Dr, Williamsburg, VA, 23186, United States of America, ninhantuanh@gmail.com

1 - Binomial Moments and Boolean Bounding for Functions in Random Variables

Jinwook Lee, Drexel University, 3220 Market Street, Philadelphia, PA, United States of America, jw78kr@gmail.com, Jongpil Kim, Andras Prekopa

For a desirable statistical precision level, it is often required to run a simulation more than million times. A new mathematical model is introduced for sharp bounds of a function of random variables. For the model construction we use the binomial moment scheme for systematic mathematical representation, and it's further developed by the use of Boolean logic over set algebra. Numerical examples of various probability distributions are presented.

2 - Improved Bounds on the Probability of the Union of Events Some of Whose Intersections are Empty

Kunikazu Yoda, Rutgers University, 100 Rockafeller Rd, Piscataway NJ 08854, United States of America, kunikazu.yoda@rutgers.edu, Andras Prekopa

We formulate a linear program whose optimal objective function value can be used in other formulations to yield improved upper and lower bounds on the probability of the union of events if we know some empty intersections of small numbers of events. The LP relaxation of an extension of the maximum independent set problem provides an upper bound on the largest number of events that have a nonempty intersection. We present numerical experiments demonstrating the effectiveness of our formulation.

3 - New Methods for Probabilistically Constrained Optimization Problem with Degenerate Distribution

Olga Myndyuk, Rutgers University, 100 Rockafeller Rd, Piscataway, NJ, 08854, United States of America, olik.myn@gmail.com

The problem under consideration is probabilistically constrained optimization problem with degenerate continuous probability distribution of the random variables in the constraints. Upper and lower bounds were obtained using the results of A.Prekopa and degeneracy of the distributions. Existing and new methods for solving are discussed: supporting hyperplane method, Prekopa-Vizvari-Badics hybrid algorithm and two derivative-free methods.

4 - Some Aspects of Discrete Moment Problem from the Linear Programming Perspective: Numerical Approach

Mariya Naumova, Rutgers University, Dept. of Mathematics, 110 Frelinghuysen Rd., Piscataway, NJ, 08854, United States of America, mariya.v.naumova@gmail.com

We present a brief survey of some of the basic results related to the discrete moment problems. We illustrate how piecewise polynomial lower and upper bounds on the function, created in connection with suitable dual feasible bases in the univariate discrete moment problem can be used to approximate definite integrals. Numerical illustrations of valuations of financial instruments are presented.

■ SA15

15-Franklin 5, Marriott

Nonlinear Optimization in Energy Systems

Sponsor: Optimization/Nonlinear Programming

Sponsored Session

Chair: Nai-Yuan Chiang, Argonne National Laboratory, 9700 South Cass Avenue, Lemont, IL, United States of America, nychiang@mcs.anl.gov

Co-chair: Yankai Cao, Ph.D. Student, Purdue University, FRNY G053B, 480 Stadium Mall Drive, West Lafayette IN 47907, United States of America, cao142@purdue.edu

1 - Clustering-Based Interior-Point Strategies for Convex Stochastic Programs

Yankai Cao, PhD Student, Purdue University, FRNY G053B, 480 Stadium Mall Drive, West Lafayette, IN, 47907, United States of America, cao142@purdue.edu, Victor M. Zavala, Carl Laird

We present a clustering-based interior-point strategy for two-stage stochastic programs. The key idea is to perform adaptive clustering of scenarios inside the solver. The resulting compressed KKT system is much smaller and is used as a preconditioner. We derive spectral and error properties for the preconditioner. We also describe our parallel implementation and demonstrate that high compression rates of 87% and speedups of 30 are achievable for electricity market clearing problems.

2 - Arc Search Methods for Linearly Constrained Optimization

Nick Henderson, Research Associate and Instructor, Stanford University, Stanford, CA, nwh@stanford.edu

We present an arc search algorithm for linearly constrained optimization. The method constructs and searches along smooth arcs that satisfy a small set of properties. When second derivatives are used, the method is shown to converge to a second-order critical point. We discuss use of arc search in Quasi-Newton methods and different strategies for handling constraints.

3 - A Progressive Method to Solve Large-scale AC Optimal Power Flow with Discrete Variables

Maxime Fender, Optimization Consultant, Artelys Canada Inc., 2001 Boulevard Robert-Bourassa, #1700, Montréal, QC, H3A 2A6, Canada, maxime.fender@artelys.com, Manuel Ruiz, Jean Maeght, Alexandre Marié, Patrick Panciatici

This study on power system networks aims to produce a dynamic simulation based security assessment taking into account uncertainties. An extended OPF without any guarantee on feasibility leads to the resolution of a Mixed-Integer NonLinear Problem, very challenging, and even harder to solve when the problem is not convex. A custom filtering method which tries to explain infeasibilities and uses the nonlinear solver KNITRO to reformulate discrete variables into nonlinear constraints is proposed.

4 - A Robust Approach to Chance Constrained Optimal Power Flow with Renewable Generation

Yury Dvorkin, PhD Student/Research Assistant, University of Washington, 185 Stevens Way NE, Paul Allen Center, Room AE104R, Seattle, WA, 98195, United States of America, iouridvorkin@gmail.com, Miles Lubin, Scott Backhaus

We formulate a Robust Chance Constrained (RCC) OPF that accounts for uncertainty in the parameters of these probability distributions by allowing them to be within an uncertainty set. The RCC OPF is solved using a scalable cutting-plane algorithm. We evaluate the RCC OPF on a modified BPA test system, which includes 2209 buses and 176 controllable generators. Deterministic, chance constrained (CC), and RCC OPF formulations are compared using several cost and reliability metrics.

■ SA16

16-Franklin 6, Marriott

Topics in Optimization

Sponsor: Optimization/Linear and Conic Optimization

Sponsored Session

Chair: John Mitchell, Professor, Rensselaer Polytechnic Institute, Mathematical Sciences Dept, Troy, NY, 12180, United States of America, mitchj@rpi.edu

1 - A Rounding Procedure for a Maximally Complementary Solution of Semidefinite Optimization Problems

Ali Mohammad Nezhad, PhD Student, Lehigh University, 200 West Packer Ave., Industrial and Systems Engineering Dept., Bethlehem, PA, 18015, United States of America, ali.mohammadnezhad@gmail.com, Tamás Terlaky

In this paper, we deal with the identification of optimal partitioning in semidefinite optimization. We derive some bounds on the condition numbers of the problem using the first order theory of reals and estimate the magnitude of the eigenvalues in the vicinity of the central path, which depends on the degree of singularity of the optimality conditions. We then present a rounding procedure for the solution of an interior point method to get a maximally complementary solution.

2 - Convex and Structured Nonconvex Stochastic Optimization with Stochastic Constraints

Zhiqiang Zhou, University of Florida, 2330 SW Williston RD, Apt3034, Gainesville, FL, 32608, United States of America, brianzhou1991@gmail.com, Guanghui Lan

We present a new stochastic approximation (SA) algorithm to minimize a class of convex or nonconvex objective functions subject to certain expectation constraints. We show that this algorithm exhibits the optimal rates of convergence in expectation and with high probability under different conditions. Some numerical results are provided for portfolio management and machine learning.

3 - Benders Decomposition for Discrete-constrained Problems with Complementarity Constraints

John Mitchell, Professor, Rensselaer Polytechnic Institute, Mathematical Sciences Dept, Troy, NY, 12180, United States of America, mitchj@rpi.edu, Jong-shi Pang, Andreas Waechter, Francisco Jara-Moroni

We discuss a logical Benders decomposition approach to discrete-constrained mathematical programs with complementarity constraints. This is an extension of our prior approach to linear and quadratic programs with complementarity constraints. The inclusion of discrete and binary constraints broadens the applicability of the approach.

■ SA17

17-Franklin 7, Marriott

Social Network Modeling and Optimization

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Alexander Nikolaev, Assistant Professor, University at Buffalo (SUNY), 312 Bell Hall, Buffalo, NY, 14260-2050, United States of America, anikola@buffalo.edu

1 - Seed Selection Scheduling for Long-term Campaign Planning on Large Social Networks

Mohammadreza Samadi, PhD Candidate, University at Buffalo SUNY, 327 Bell Hall, Buffalo, NY, 14260, United States of America, msamadi@buffalo.edu, Alexander Nikolaev, Naji Rakesh

The influence maximization problem lies in finding a set of seeds that can optimally initiate a diffusion-driven cascade. We explore flexible, time-dependent seed activation solutions for long-term intervention/campaign planning on networks. The Seed Selection Scheduling Problem (SSSP) is that of selecting an optimal policy for seed activation over a finite time horizon under knapsack constraints. The ideas from the wireless sensor scheduling domain are used to tackle SSSP on large networks.

2 - Critical Nodes in Network Cohesion

Alexander Veremyev, University of Florida, 1350 N Poquito Road, Shalimar, FL, United States of America, averemyev@ufl.edu, Oleg Prokopyev, Eduardo Pasiliao

We consider a class of critical nodes detection problems that involves minimization of a graph cohesion measure (e.g., graph efficiency or harmonic average geodesic distance, Harary index, characteristic path length, communication utility) that depends on the actual pairwise distances between nodes in the remaining graph after nodes removal. We derive linear integer programming formulations along with additional enhancements, and develop an exact iterative algorithm to solve this problem.

3 - Detecting Cliques of Maximum and Minimum Centrality: Methods and Applications

Chrysafis Vogiatzis, Assistant Professor, North Dakota State University, 1410 14th Avenue North, Room 202 Civil & Industrial Engineering, Fargo, ND, 58102, United States of America, chvogiat@ufl.edu, Alexander Veremyev

In this talk, we consider the problem of finding the most and least “influential” or “influenceable” cliques in graphs based on three classical centrality measures: degree, closeness, and betweenness. In addition to standard betweenness, we also consider its optimistic and pessimistic counterparts along with a new metric for cluster closeness, namely residual closeness centrality. Applications discussed include analysis of information and social networks, and results on the stock market graph.

4 - Social Structure Optimization in Nurse Scheduling Problem

Alireza Farasat, Graduate Research Assistant, University at Buffalo (SUNY), 327 Bell Hall, Department of Industrial and Systems Eng, Amherst, NY, 14260, United States of America, afarasat@buffalo.edu, Alexander Nikolaev

This paper presents a mathematical framework for treating the Nurse Scheduling Problem (NSP) explicitly incorporating Social Structure (NSP-SS). While traditional approaches generate a configuration of individual schedules, the presented framework introduces models that assign nurses to working shifts to achieve an optimal structure of individual attributes and social relations within the teams. For an NP-Hard instance of NSP-SS, an integer program is presented, followed by a LK-NSP heuristic.

SA18

18-Franklin 8, Marriott

Recent Advances on Support Vector Machines Research

Cluster: Modeling and Methodologies in Big Data

Invited Session

Chair: Shouyi Wang, Assistant Professor, University of Texas at Arlington, 3105 Birch Ave, Grapevine, TX, 76051, United States of America, shouyiw@uta.edu

1 - Fast Scalable Support Vector Machines for Big Bimodal Data Analytics

Talayeh Razzaghi, Postdoctoral Research Fellow, Clemson University, 221 McAdams Hall, Clemson University, Clemson, United States of America, trazzag@clemson.edu, Ilya Safro, Mark Wess

Solving the optimization model of support vector machines is often an expensive computational task for very large biomedical training sets. We propose an efficient, effective, multilevel algorithmic framework that scales to very large data sets. Our multilevel framework substantially improves the computational time without loosing the quality of classifiers for balanced and imbalanced datasets.

2 - Value-at-Risk Support Vector Machine (Var-SVM): MIP Representation and Equivalence of Formulations

Victoria Zdanovskaya, Research And Teaching Assistant At Industrial And Systems Engineering Department, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, ladyvi@ufl.edu, Konstantin Pavlikov

SVMs is a widely used data classification technique. A class of Var-SVMs is known to be robust to the outliers in the training dataset. Unfortunately Var-SVM is a nonconvex optimization problem. We consider MIP representations of Var-SVM, that can be solved by standard Branch & Bound algorithm. We also consider different techniques that help to dramatically improve computational performance of such formulations.

3 - A Comparison of Constraint Relaxation and Bagging Policies in Support Vector Classification

Petros Xanthopoulos, University of Central Florida, 12800 Pegasus Dr., Orlando, FL, 32816, United States of America, petrosx@ucf.edu, Onur Seref, Talayeh Razzaghi

In classification, when data are available in uneven proportions the problem becomes imbalanced and the performance of standard methods deteriorates. Imbalanced classification becomes a more challenging in the presence of outliers. In this presentation, we study several algorithmic modifications of support vector machines for such problems. We show that the combined used of cost sensitive learning with constraint relaxation performs better compared to approaches that involve bagging.

4 - Semi-supervised Proximal Support Vector Machine with Sparse Representation Regularization

Jiaxing Pi, University of Florida, 3800 SW 34th St. Apt. P138, Gainesville, FL, 32608, United States of America, jiaxing@ufl.edu, Panos Pardalos

Proximal Support Vector Machine has been an efficient technique to generate classifiers. Sparse representation can detect neighborhood for a signal by reconstructing it with the linear span of other data. We applied sparse representation to build a regularization which can achieved semi-supervised assumptions for unlabeled data. Experiment on standard datasets are performed to compare the proposed framework with PSVM with manifold regularization.

5 - Extending Relaxed Support Vector Machines

Orestis Panagopoulos, University of Central Florida, 12800 Pegasus Dr., Orlando, FL, 32816, United States of America, opanagopoulos@knights.ucf.edu, Onur Seref, Talayeh Razzaghi, Petros Xanthopoulos

In this work, we propose Relaxed Support Vector Regression (RSVR) and One-Class Relaxed Support Vector Machines (ORSVM). The methods constitute extensions of Relaxed Support Vector Machines (RSVM). They are formulated using both linear and quadratic loss functions and are solved with sequential minimal optimization. Numerical experiments on public datasets and computational comparisons with other popular classifiers depict the behavior of our proposed methods.

SA19

19-Franklin 9, Marriott

High-performance Computation for Optimization

Sponsor: Computing Society

Sponsored Session

Chair: Suresh Bolusani, Lehigh University, 524 Montclair Avenue, Bethlehem, United States of America, sub214@lehigh.edu

1 - Distributed Integer Programming

Ezgi Karabulut, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332-0205, United States of America, ezgi.karabulut@gatech.edu, George L. Nemhauser, Shabbir Ahmed

We want to find distributed solution algorithms for integer programming problems that allow only minimal interaction between the solvers.

2 - Scalable Communication in Parallel Optimizaiton

Oleg Shylo, University of Tennessee, 851 Neyland Drive, 523 John Tickle Building, Knoxville, TN, United States of America, oshylo@utk.edu

We establish theoretical models of algorithm portfolios to optimize communication patterns in algorithms, closely match empirical behavior of communicative algorithm portfolios, and predict computational performance for new and untested configurations.

3 - Solving Bilevel Linear Optimization Problems in Parallel

Suresh Bolusani, Lehigh University, 524 Montclair Avenue, Bethlehem, PA, United States of America, sub214@lehigh.edu, Ted Ralphs

Many real world applications involve multiple, independent decision makers with multiple, possibly conflicting objectives. Bilevel linear optimization provides a framework for modeling of such problems. With the growing number of applications, faster solution algorithms for bilevel optimization problems are needed. In this work, we present a parallel approach to solving bilevel optimization problems. Computational results will be presented.

SA20

20-Franklin 10, Marriott

Big Data in the Clouds

Cluster: Cloud Computing

Invited Session

Chair: Lydia Chen, IBM Zurich, yic@zurich.ibm.com

1 - Declarative Cloud Performance Analytics

Boon Thau Loo, Associate Professor, University of Pennsylvania, Philadelphia, PA, 19104, United States of America, boonloo@cis.upenn.edu

This talk presents Scalanytics, a declarative platform that supports high-performance cloud application performance monitoring. Scalanytics uses stateful network packet processing techniques for extracting application-layer data from network packets, a declarative rule-based language for compactly specifying analysis pipelines, and a parallel architecture for processing network packets at high throughput. I will next describe the commercialization of Scalanytics as Gencore (gencore.io).

2 - Event-driven Predictive Models for Socio-economic Indicators

Lakshminarayana Subramanian, Associate Professor, NY, NY,
United States of America, lakshmi@cs.nyu.edu,
Sunandan Chakraborty

I will describe how to extract real-world events using unstructured news streams to understand their impact on the volatility macro-economic indicators. The hypothesis is that the factors triggering sudden fluctuations in such indicators can be characterized by events. Given a news corpus, we describe how to build event-driven predictive models that can potentially predict fluctuations in specific indicators. We describe specific results about what triggers fluctuations in food prices in India.

3 - Efficient Coflow Scheduling in Data Center Networks

Yuan Zhong, Columbia University, 500 W. 120th Street,
New York, NY, 10027, United States of America,
yz2561@columbia.edu, Cliff Stein, Zhen Qiu

In this talk, we consider the efficient scheduling of coflows - an abstraction introduced in [Chowdhury and Stoica 2012] to capture communication patterns of large-scale data center jobs. We introduce the problem of minimizing the total weighted coflow completion times, show that it is strongly NP-hard, and develop the first polynomial-time approximation algorithms for this problem. We also evaluate the practical performances of a variety of algorithms through numerical experiments.

4 - Optimizing for Tail Response Times of Cloud Clusters

Lydia Chen, IBM Zurich, yic@zurich.ibm.com, Natarajan Gautam

Motivated by the volatile system dynamics in cloud cluster, we develop an approximation scheme that can capture the high performance variability caused by neighboring VMs, especially in terms of tail response times. The approximation of tail response times is based on the large deviation analysis. We evaluate the proposed analysis on simulation as well a wiki prototype cluster in the cloud.

SA21

21-Franklin 11, Marriott

Stochastic Models for Medical Decision Making and Healthcare Delivery

Sponsor: Health Applications

Sponsored Session

Chair: F. Safa Erenay, Assistant Professor, University of Waterloo, 200 University Ave. CPH 4323, Waterloo, Canada, ferenay@uwaterloo.ca

1 - The Impact of Optimization on the Allocation of Livers for Organ Transplantation

Mustafa Akan, Associate Professor, Carnegie Mellon University,
5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of
America, akan@andrew.cmu.edu, James Markmann, Heidi Yeh,
Zachary Leung, Sridhar Tayur

Patients on the waitlist for liver transplantation are prioritized according to their MELD scores, which reflects the severity of liver disease. Recent studies have shown that hepatocellular carcinoma (HCC) patients have significantly higher liver transplant rates than non-HCC patients. We recommend a family of alternative MELD score policies based on a fluid model approximation of the queueing system and an optimization model that achieves an optimal balance between efficiency and equity.

2 - Physician Staffing in the Emergency Department: Opening the Blackbox

Caglar Caglayan, Georgia Institute of Technology, Atlanta, GA,
United States of America, ccaglayan6@gatech.edu, Kalyan
Pasupathy, David Nestler, Mustafa Sir, Thomas Hellmich,
Turgay Ayer, Gomathi Marisamy, Thomas Roh

We propose an “intuitive”, “realistic” and “tractable” model of the emergency department (ED) by a multi-class multi-stage queueing network with multiple targeted service levels. Based on infinite-server approximation and offered load analysis, we employ square-root safety principle to determine the right number of physicians in the ED. Our model is detailed enough to capture the key dynamics of the ED but simple enough to understand, infer results and implement in a clinical setting.

3 - Deriving Better Strategies for Influenza Vaccines Allocation

F. Safa Erenay, Assistant Professor, University of Waterloo,
200 University Ave. CPH 4323, Waterloo, Canada,
ferenay@uwaterloo.ca, Osman Ozaltin, Onur Ozden Dalgic

In influenza pandemics, available vaccines are allocated considering individual risk profiles of the patients. Using a network based stochastic simulation model and mesh adaptive direct search, we derived effective age-specific vaccine allocation strategies for cost, health outcomes, and equity metrics. In most scenarios, the proposed method outperforms the current guidelines and policies developed based on deterministic compartmental models.

4 - Reliable Facility Location Model for Disaster Response

Abdelhalim Hiasat, PhD Student, University of Waterloo,
ahhiasa@uwaterloo.ca, Osman Ozaltin, F. Safa Erenay

We formulate a reliable facility location model for disaster response, and consider the problem of minimizing expected service cost. Candidate facility locations might become unavailable after the disaster, and victims patronize relief facilities based on their preferences. We propose a Lagrangian-decomposition-based branch-and-bound method for this problem. Our computational results show the efficiency of the solution approach and the significance of incorporating preferences into the model.

SA22

22-Franklin 12, Marriott

Matching Markets

Sponsor: Applied Probability

Sponsored Session

Chair: Itai Ashlagi, MIT, 100 Main St, Cambridge, MA, 02139,
United States of America, iashlagi@mit.edu

1 - Welfare-sensitive Assortment Optimization: An Application to School Choice

Peng Shi, MIT Operations Research Center, 1 Amherst Street,
E40-149, Cambridge, MA, 02139, United States of America,
pengshi@mit.edu

In many settings, a planner gives a set of options to agents who choose among them to maximize their own value, but agents' choices have externalities on system revenue/cost. Examples include school choice, public housing, and health insurance. Welfare-Sensitive Assortment Optimization is to find a set of options that maximize the sum of agents' values and system revenue. We give efficient algorithms under MNL utilities and various constraints, and apply this to improve school choice in Boston.

2 - Near Feasible Stable Matchings with Couples

Thanh Nguyen, Krannert School of Management, Purdue
University, West Lafayette, IN, United States of America,
nguye161@purdue.edu, Rakesh Vohra

The National Resident Matching program strives for a stable matching of medical students to teaching hospitals. With the presence of couples, stable matchings need not exist. For any student preferences, we show that each instance of a matching problem has a “nearby” instance with a stable matching. The nearby instance is obtained by perturbing the capacities of the hospitals.

3 - Matching with Externalities

Jacob Leshno, Columbia University, 3022 Broadway, Uris Hall,
406, New York, NY, 10027, United States of America,
jleshno@columbia.edu

We show existence of stable matching in markets with a continuum of students. Stable matchings are characterized as rational expectations market clearing cutoffs.

4 - What Matters in Tie-breaking Rules? How Competition Guides Design

Afshin Nikzad, Stanford University, 37 Angell Court, APT 116,
Stanford, Ca, 94305, United States of America,
afshin.nikzad@gmail.com, Assaf Romm, Itai Ashlagi

School districts that adopt the Deferred Acceptance (DA) mechanism to assign students to schools face the tradeoff between fairness and efficiency when selecting how to break ties among equivalent students. We analyze a model with with random generated preferences for students and compare two mechanisms differing by their tie-breaking rules: DA with one single lottery (DA-STB) and DA with a separate lottery for each school (DA-MTB). We identify that the balance between supply and demand in the market is a prominent factor when selecting a tie-breaking rule. When there is a surplus of seats, we show that neither random assignments under these mechanisms stochastically dominates each other, and, the variance of student's assignments is larger under DA-STB. However, we show that there is essentially no tradeoff between fairness and efficiency when there is a shortage of seats: not only that DA-STB (almost) stochastically dominates DA-MTB, it also results in a smaller variance in student's rankings. We further find that under DA-MTB many pairs of students would benefit from directly exchanging assignments ex post when there is a shortage of seats, while only few such pairs exist when there is a surplus of seats. Our findings suggest that it is more desirable that “popular” schools use a single lottery over a separate lottery in order to break ties, while in other schools there is a real tradeoff.

■ SA23

23-Franklin 13, Marriott

Queueing Models

Sponsor: Applied Probability

Sponsored Session

Chair: Alexander Stolyar, Lehigh University, 200 W. Packer Ave, Room 484, Bethlehem, United States of America, als714@lehigh.edu

1 - Diffusion Approximations for Large-scale Buffered Systems

Tonghoon Suk, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30305, United States of America, tonghoon.suk@gmail.com

Motivated by a desire to design stochastic systems satisfying certain quality of service, we establish mean-field limit theorems to approximate systems. We start with a simple model consisting of n buffers and a server, and develop diffusion approximations for the system with the randomized LQF scheduling algorithm. We achieve this by allowing the number of sampled buffers $d = d(n)$ to depend on the number of buffers n , which yields an asymptotic decoupling of the queue length processes.

2 - Stability Verification: A Monte-Carlo Approach

Neil Walton, University of Amsterdam, Science Park 904, Amsterdam, Netherlands, n.s.walton@uva.nl, Brendan Patch, Michel Mandjes

We implement a form of simulated-annealing as a method for detecting if a queueing system is unstable for a given set of loads.

3 - A Large-Scale Service System with Packing Constraints: Greedy-Random Algorithm with Sub-Linear Error

Alexander Stolyar, Lehigh University, 200 W. Packer Ave, Room 484, Bethlehem, PA, United States of America, als714@lehigh.edu, Yuan Zhong

There are multiple input flows of different customer types and infinite number of servers. Each server may simultaneously serve multiple customers, subject to general "packing constraints". Each customer leaves after an independent random service time. We consider a version of a Greedy-Random customer assignment (packing) algorithm, and prove that it has an asymptotic competitive ratio 1, as the input flow rates grow to infinity.

4 - Heavy-traffic Behavior of the Maxweight Algorithm in a Switch with Non-uniform Traffic

R. Srikant, University of Illinois Urbana-Champaign, CSL 107, Urbana, IL, United States of America, rsrikant@illinois.edu, Siva Theja Maguluri

We consider a switch operating under the MaxWeight scheduling algorithm. The traffic pattern is assumed to be such that all ports are saturated, but otherwise can be non-uniform. It is shown that the heavy-traffic scaled queue length under MaxWeight is within a factor of two compared to the smallest achievable queue length.

■ SA24

24-Room 401, Marriott

Data Mining for Decision Making

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Iljoo Kim, Assistant Professor, Saint Joseph's University, 347 Mandeville Hall, 5600 City Avenue, Philadelphia, PA, 19131, United States of America, ikim@sju.edu

1 - Rating Corporate Bonds using Deanfis Analysis – A Multi-modeling Approach

Rashmi Malhotra, Associate Professor, Saint Joseph's University, 5600 City Avenue, Philadelphia, PA, 19131, United States of America, rmalhotr@sju.edu, Davinder Malhotra

This paper illustrates the use of data envelopment analysis (DEA) and Adaptive Neuro-Fuzzy Inference Systems (ANFIS) to differentiate between bonds with credit ratings. This study measures the relative performance of corporate bonds using DEA. The ANFIS model creates a rule-based system that can aid the decision-maker in making decisions regarding the implications of a decision. This study proposes a modeling technique that jointly uses the two techniques to benefit from the two methodologies.

2 - Mining Hidden Organizational Structures from Meeting Records

Jiexun Li, Assistant Professor, Oregon State University, College of Business, Corvallis, OR, 97331, United States of America, jiexun.li@oregonstate.edu, Zhaohui Wu, Bin Zhu

Organizations often contain complex structures formed by social relationships. This study introduces an approach to finding hidden structures by mining meeting records. Using text-mining techniques, we extract information about persons and their opinions on topics. We conducted cluster analysis and network analysis to uncover hidden structures within the organization. Our preliminary study shows promising results. We are in the process of improving our approach and conducting more analyses.

3 - An Analytical Framework for Intelligent Reviewer Recommendation

Harry Wang, Association Professor, University of Delaware, 42 Amstel Ave, Newark, DE, 19716, United States of America, hjwang@udel.edu, Kunpeng Zhang, Sean Kilgallon

Recruiting reviewers for academic conferences and journals is a daunting task for conference organizers and journal editors. In this paper, we propose an intelligent approach for reviewer identification based on techniques such as text mining, social network analysis, and recommender system. We collect data from online paper repositories and research social network sites. We evaluate our approach by conducting user studies and experiments.

4 - Semi-supervised Article Selection for Medical Systematic Reviews

Jun Liu, Assistant Professor, Dakota State University, 422 SW 8th Street, Apt. 16, Madison, SD, 57042, United States of America, jun.liu@dsu.edu, Prem Timsina, Omar El-gayar

We developed a semi-supervised learning based classifier to identify articles that can be included in of medical systematic reviews. Through an empirical study, we demonstrated that semi-supervised approach is a viable technique for selecting articles for systematic reviews when only a few number of training samples are available, and a combination of semi-supervised and active learning can further optimize the article selection process.

■ SA25

25-Room 402, Marriott

Business Analytics and Innovation

Sponsor: Information Systems

Sponsored Session

Chair: Yan Huang, Assistant Professor, Stephen M. Ross School of Business, University of Michigan, 701 Tappan St. R5322, Ann Arbor, MI, 48109, United States of America, yphuang@umich.edu

1 - Who Hath the Crystal Ball? Antecedents of Advanced Analytics Adoption in Firms

Ajit Sharma, Ross School of Business, 701 Tappan Street, Ann Arbor, MI, United States of America, asharmaz@umich.edu, Mayuram Krishnan, Yan Huang

It is increasingly evident that the ability to gain forward-looking insight from advanced analytics will differentiate the winners from the losers. However, it is not clear what differentiates firms that are able to leverage these new technologies from those that do not. In this paper we attempt to answer this question by empirically investigating the antecedents of predictive analytics usage within firms. We present our findings and discuss managerial implications.

2 - Gain from Loss: Crowdsourcing Contests Bring Favorable Superstar Effect

Shunyuan Zhang, Tepper School of Business, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, shunyuanz@andrew.cmu.edu, Param Vir Singh, Anindya Ghose

We report favorable superstar effect, which contradicts with adverse superstar effect in Economic literature, and argue the unique crowdsourcing setting is the cause. Competing with superstars decreases one's chance of winning but leads to an improved performance in the next competition. Contestants are self-selected to solve the trade-off problem. Our work suggests a promising crowdsourcing practice that generates spill-over effects and identifies participants who are more capable of learning.

3 - Learning from the Offline Trace: A Case Study of the Taxi Industry

Yingjie Zhang, Carnegie Mellon University, 5000 Forbes Avenue,
Pittsburgh, PA, 15213, United States of America,
yingjie2@andrew.cmu.edu, Ramayya Krishnan,
Siyuan Liu, Beibei Li

The growth of mobile and sensor technologies leads to the digitization of individual's offline behavior. We instantiate our research by analyzing the digitized taxi tails to study the impact of different type and scale of information on driver behavior. We propose a Bayesian learning model and validate it on a unique data set containing complete information on 10.6M trip records from 11,196 taxis in a large Asian city in 2009. We find strong heterogeneity in individual learning behavior.

SA26

26-Room 403, Marriott

Biotechnology and Bioinformatics

Contributed Session

Chair: Kan Wang, Georgia Institute of Technology, 813 Ferst Drive NW,
Atlanta, GA, 30332, United States of America, kan.wang@gatech.edu

1 - Convex: De Novo Transcriptome Error Correction by Convexification

Meisam Razaviyayn, Stanford University, Packard Building,
Palo Alto, CA, 94305, United States of America,
meisamr@stanford.edu, David Tse, Elizabeth Tseng

De novo RNA sequencing with long reads requires accurate denoising as the first step. Unlike the initial combinatorial formulation, we propose an iterative convex reformulation which leads to a parallel algorithm for joint error correction and abundance estimation. The numerical experiments on the heart tissue PacBio samples show that, in addition to computational gain, the proposed algorithm results in 10% improvement in the number of denoised reads as compared to the existing software TOFU.

2 - Collection and Distribution of Cord Blood (CB) and Stem Cells (SC) by EU Blood Banks

Katrina Nordstrom, Professor, Aalto University School of
Chemical Technology, Department of Biotechnology, Kemistintie
1A, Espoo, 02150, Finland, katrina.nordstrom@aalto.fi,
Ari Vepsäläinen

Novel biomedical therapies call for expanding involvement of blood banks in collection, storage and distribution of cells. This study examines operations involving UB and SC in several EU countries. Wide variations are evident with major differences in amounts of cells collected and discarded. Most efficient operators are identified by minimized unnecessary collections.

3 - An Extended Formulation of the Convex Recoloring Problem on a Tree

Sangho Shim, Northwestern University, 2001 Sheridan Road
Suite 548, Kellogg School of Management, Evanston, IL, 60208,
United States of America, shim@kellogg.northwestern.edu,
Kangbok Lee, Minseok Ryu, Sunil Chopra

We introduce a strong extended formulation of the convex recoloring problem on a tree, which has an application in analyzing a phylogenetic tree. The extended formulation has only polynomial number of constraints, but dominates the conventional formulation and the exponentially many valid inequalities which are previously known. The extended formulation solves the problem instances from TreeBASE.org at the root node of the branch-and-bound tree without branching.

4 - Dual-material 3d Printed Metamaterials with Tunable Mechanical Property for Patient-Specific Phantom

Kan Wang, Georgia Institute of Technology, 813 Ferst Drive NW,
Atlanta, GA, 30332, United States of America,
kan.wang@gatech.edu, Mani Vannan, Changsheng Wu,
Zhen Qian, Chuck Zhang, Ben Wang

Patient-specific phantoms have a wide range of biomedical applications. Current 3D printed phantoms can only mimic Mechanical properties of soft tissues at small strain situations. This study investigated the feasibility of mimicking the strain-stiffening behavior of soft tissues using dual-material 3D printed metamaterials. Both FEA and tensile experiments indicated that those dual-material designs were able to exhibit strain-stiffening effects. Property tuning was also demonstrated.

SA27

27-Room 404, Marriott

Multi-objective Combinatorial Problems

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Banu Lokman, Assistant Professor, Middle East Technical
University, Department of Industrial Engineering, Cankaya, Ankara,
06800, Turkey, lbanu@metu.edu.tr

1 - A Line Rebalancing Problem with Disruption Cost and Production Rate Criteria

Ece Sanci, Research Assistant, Middle East Technical University
(1100004144), ODTU Endustri Muhendisligi 325, Ankara, 06800,
Turkey, esanci@metu.edu.tr, Meral Azizoglu

In this study, we consider a line rebalancing problem with two objectives. We assume that there is an initial set of assignments and a disruption on one or more workstations that could alter the initial assignments. Our stability objective is to minimize the disruption cost which is defined as the weighted distance between the original and new workstations. Our efficiency objective is to maximize the production rate. We develop some exact and heuristic procedures and report on the results.

2 - Optimizing a Linear Function over the Nondominated Set of Multi-objective Optimization Problems

Banu Lokman, Assistant Professor, Middle East Technical
University, Department of Industrial Engineering, Cankaya,
Ankara, 06800, Turkey, lbanu@metu.edu.tr

We present an algorithm to optimize a linear function over the nondominated set of multi-objective optimization problems. The algorithm iteratively generates nondominated points and converges to the optimal solution. We also develop a variation of this algorithm to approximate the optimal point with a desired level of accuracy. We conduct experiments on multi-objective combinatorial optimization problems and show that the algorithm works well.

3 - Representative Nondominated Sets in Multi-objective Integer Programs

Gokhan Ceyhan, Middle East Technical University,
Department of Industrial Engineering, Ankara, 06800, Turkey,
gceyhan@metu.edu.tr, Banu Lokman, Murat Koksalan

We develop an algorithm to generate a representative nondominated set for multi-objective integer programs. We define a density based representation measure that evaluates the representativeness of a nondominated set considering the estimated regional densities of the nondominated frontier. We also develop a web application that is available to researchers to generate all or a representative subset of nondominated points.

4 - Iterative Method for Finding Pareto-dominant Shift Schedules for a Pediatric Emergency Department

Young-chae Hong, University of Michigan, 1205 Beal Avenue,
Ann Arbor, MI, 48109, United States of America,
hongyc@umich.edu, Amy Cohn

Building resident shift schedules for the U-M Pediatric Emergency Department is a multi-objective combinatorial problem. Chiefs cannot provide a single objective function or weights to trade off metrics of patient safety, educational training requirements, and resident satisfaction. We have developed an algorithm for generating Pareto-dominant schedules to reduce the solution space for Chief Residents to review and to help elicit their preferences.

SA28

28-Room 405, Marriott

Combinatorial Auctions

Cluster: Auctions

Invited Session

Chair: Richard Steinberg, Chair In Operations Research, London School
of Economics, Department of Management, NAB 3.08, Houghton
Street, London, WC2A 2AE, United Kingdom, r.steinberg@lse.ac.uk

1 - The Performance of Deferred-acceptance Auctions

Vasilis Gkatzelis, Stanford University, 474 Gates Building,
353 Serra Mall, Stanford, CA, 94305, United States of America,
gkatz@cs.stanford.edu, Paul Duetting, Tim Roughgarden

Milgrom and Segal recently introduced deferred-acceptance auctions and proved that they satisfy a remarkable list of incentive guarantees. We study these auctions through the lens of two canonical welfare-maximization problems. For knapsack auctions, we show a strong separation between deferred-acceptance mechanisms and arbitrary strategyproof mechanisms. For single-minded combinatorial auctions, we design novel deferred-acceptance mechanisms with near-optimal approximation guarantees.

2 - Inapproximability of Truthful Mechanisms via Generalizations of the VC Dimension

Gal Shahaf, PhD Candidate, Hebrew University, Nataf 63, Nataf, 9080400, Israel, gal.shahaf@mail.huji.ac.il, Amit Daniely, Michael Schapira

Algorithmic mechanism design (AMD) studies the delicate interplay between computational efficiency, truthfulness, and optimality. We focus on AMD's paradigmatic problem: combinatorial auctions, and present new inapproximability results for truthful mechanisms in this scenario. Our main technique is a generalization of the classical VC dimension and the corresponding Sauer-Shelah Lemma. Joint work with Amit Daniely and Michael Schapira

3 - Efficient Procurement Auctions with Increasing Returns

Lawrence Ausubel, Professor of Economics, University of Maryland, Department of Economics, College Park, MD, 20742-7211, United States of America, ausubel@econ.umd.edu, Christina Aperjis, Oleg Baranov, Thayer Morrill

For procuring from sellers with decreasing returns (or selling to buyers with diminishing marginal values), there are known efficient dynamic auction formats. In this paper, we report progress in designing an efficient dynamic procurement auction for the case where bidders have increasing returns. The auctioneer names a price, and bidders report the minimum and maximum quantities that they would sell at that price. The process repeats with lower prices, until the efficient outcome is discovered.

4 - Competing Combinatorial Auctions

Marion Ott, RWTH Aachen University, Templergraben 64, Aachen, 52062, Germany, marion.ott@rwth-aachen.de, Thomas Kittsteiner, Richard Steinberg

What is the benefit of an auction format that allows for package bids for a seller who wants to sell a set of distinct items? We show that the answer depends on whether a seller faces competition from another seller. For a simple, tractable model we give conditions under which a seller with the choice between VCG mechanisms with or without package bidding prefers to disallow package bidding if another seller with the same options is present.

SA29

29-Room 406, Marriott

Analytics

Sponsor: Analytics

Sponsored Session

Chair: Harrison Schramm, Navy Headquarters Staff, 1507 22nd Street South, Arlington, VA, 22202, United States of America, Harrison.Schramm@gmail.com

1 - Identifying Shortfalls in Library Holdings through Analysis of References in Faculty Publications

Ziyi Kang, University of Pittsburgh, 1048 Benedum Hall, Department of Industrial Engineering, Pittsburgh, PA, 15261, United States of America, zik3@pitt.edu, Shi Tang, Louis Luangkesorn, Fan Zhang, Yunjie Zhang, Berenika Webster

University libraries measure their contribution to research in part through providing reference material cited by faculty in their publications. One difficulty is that article references are often abbreviated in non-standard ways. To compare references with library holdings we apply text processing methods such as normalization, string distances, and word splitting to determine if a reference is held by the library. We apply this to one subject area and validate the accuracy of the method.

2 - Assessing the Effects of Cross-Season Fairness Scheme on the Competitive Balance of NFL Schedules

Niraj Pandey, University at Buffalo, 342 Bell Hall, North Campus, Buffalo, NY, 14260, United States of America, npandey@buffalo.edu, Murat Kurt, Mark Karwan, Kyle Cunningham

The National Football League (NFL) is the highest revenue generating sports league in the world. Although the league's scheduling routine has evolved over the years to ensure fairness, recent schedules exhibit significant imbalances in several dimensions, particularly in teams' rest durations between games. We develop a two-phase MILP approach to create fairer schedules and evaluate the price of the league's practice of rotating venues of the games on a multi-year basis on their competitiveness.

SA30

30-Room 407, Marriott

Research from 2015 Richard E. Rosenthal Early Career Connection Program Participants

Sponsor: Analytics

Sponsored Session

Chair: Aurelie Thiele, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, aut204@lehigh.edu

1 - Overview of "The Richard E. Rosenthal Early Career Connection Program"

Aurelie Thiele, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, aut204@lehigh.edu

This short talk will provide an overview of the Richard E. Rosenthal Early Career Connecting Program, held in conjunction with the yearly Analytics conference in the spring. It will focus on the 2015 edition of the program, co-organized by Michelle Opp of SAS and myself.

2 - A Protein Scoring Function using Support Vector Machine

Shokoufeh Mirzaei, Cal Poly Pomona, 3801 West Temple Avenue, Pomona, CA, 91768, United States of America, smirzaei@cpp.edu, Silvia Crivelli

In this paper a knowledge-based scoring function for quality assessment of protein decoy models is developed. To this end, a benchmark data set from CASP 8, 9 and 10 is used. The dataset includes measurements of proteins structural features that are seemingly having significant impacts on the quality of predicted structures.

3 - Biologically-guided Radiotherapy Treatment Plan Optimization

Ehsan Salari, Wichita State University, 1845 Fairmount St, Wichita, KS, Ehsan.Salari@wichita.edu

Radiotherapy treatments are delivered in daily fractions over the course of one to several weeks. There is clinical evidence suggesting that patients with specific tumor sites may benefit from delivering larger radiation doses in fewer fractions. However, current treatment regimens use a fixed radiotherapy plan in all fractions. This research aims at developing a spatiotemporal planning approach that allows to investigate the potential benefit of temporal variation in the plan across fractions.

SA31

31-Room 408, Marriott

Mathematical Optimization Models for Data Science

Sponsor: Data Mining

Sponsored Session

Chair: Dolores Romero Morales, Copenhagen Business School, Porcelaenshaven 16 A, Frederiksberg, DK-2000, Denmark, drm.eco@cbs.dk

1 - Learning Tailored Risk Scores from Large Scale Datasets

Berk Ustun, PhD Candidate, MIT, 20 Highland Avenue Apt. 2, Cambridge, MA, 02139, United States of America, ustunb@mit.edu, Cynthia Rudin

Risk scores are simple models that let user assess risk by adding, subtracting and multiplying a few small numbers. These models are widely used in medicine and crime prediction but difficult to learn from data because they need to be accurate, sparse, and use integer coefficients. We formulate the risk score problem as a MINLP, and present a cutting-plane algorithm to solve it for datasets with large sample sizes. We use our approach to create tailored risk scores for recidivism prediction.

2 - A Multi-objective Approach to Visualize Proportions and a Binary Relation by Rectangular Maps

Dolores Romero Morales, Copenhagen Business School, Porcelaenshaven 16 A, Frederiksberg, DK-2000, Denmark, drm.eco@cbs.dk, Emilio Carrizosa, Vanesa Guerrero

We address the problem of representing individuals, to which there are proportions attached and a binary relationship, by means of a rectangular map, i.e., a subdivision of a rectangle into rectangular portions, so that each portion is associated with one individual, the areas of the portions reflect the proportions, and portions adjacencies reflect adjacencies in the binary relationship. We formulate this as a three-objective Mixed Integer Nonlinear Problem and numerical results are presented.

3 - Balanced Tree Partitioning with Compact Mathematical Programming Formulations

Onur Seref, Virginia Tech, 2060 Pamplin Hall (0235), Blacksburg, VA, 24061, United States of America, seref@vt.edu, J. Paul Brooks

In this paper, we study mathematical programming formulations for the balanced subtree partitioning problem, some variations of which are known to be NP-complete. We introduce compact exact mixed integer programming formulations for different variations of the problem. We explore the effect of different sets of constraints on our formulations and provide comparative computational results among our formulations as well as other exact formulations and approximation algorithms.

■ SA32

32-Room 409, Marriott

Data Mining in Medical and Brain Informatics

Sponsor: Data Mining

Sponsored Session

Chair: Sina Khanmohammadi, SUNY Binghamton, 4400 Vestal Parkway East, Binghamton, NY, 13902, United States of America, skhanmo1@binghamton.edu

Co-Chair: Chou-An Chou, Binghamton University, 4400 Vestal Parkway, Vestal, NY, United States of America, cachou@binghamton.edu

1 - Nonlinear Dimensionality Reduction for Analysis of Electroencephalography Records

Anton Kocheturov, Research Assistant, Department of Industrial and Systems Engineering, University of Florida, 303 Weil Hall, Gainesville, FL, 32611-6595, United States of America, antrubler@gmail.com

We suggest using nonlinear dimensionality reduction technique called the Local Linear Embedding for analysis of EEG records. This approach enabled us to distinguish between different states of the brain in a more efficient way comparing to the existing machine learning techniques since it is faster and doesn't require training of the algorithm. We also detected evidence for local linearity of the brain in the resting state and introduced a new model of the brain based on it.

2 - The Gap Statistics for Determining the Number of Linear Autoregressive Modes in a Multimode Model

Vahid Tarokh, Professor, Harvard University, 33 Oxford Street, MD347, Cambridge, MA, 02138, United States of America, vahid@seas.harvard.edu, Jie Ding, Mohammad Noshad

We consider modeling of non-stationary stochastic-processes using a multi-mode linear autoregressive (AR) model. Each process is modeled as a mixture of unknown AR components (modes) with an unknown number of modes. We are interested in online determination of the number of modes, and also in identification of each mode. A new model selection approach based on GAP statistics for this purpose is introduced with applications in modeling and prediction of financial and biological data, etc.

3 - Online Machine Learning Framework for Detecting EEG Abnormalities

Sina Khanmohammadi, SUNY Binghamton, 4400 Vestal Parkway East, Binghamton, NY, 13902, United States of America, skhanmo1@binghamton.edu, Chou-An Chou

Electroencephalogram (EEG) signals provide insight about human brain function. EEG signal abnormalities can be a sign of mental disorders such as depression, epilepsy, etc. Hence, detecting EEG abnormalities can be beneficial for diagnosis, prognosis, and overall improvement of patient's quality of life. In this work, we present a new online classification framework to detect EEG signal abnormalities in real time. The proposed framework is validated using public EEG datasets.

■ SA33

33-Room 410, Marriott

Health Policy/ Public Health

Sponsor: Health Applications

Sponsored Session

Chair: Ozge Karanfil, PhD Candidate, MIT Sloan School of Management, 100 Main Street, E62-379, Cambridge, MA, 02142, United States of America, karanfil@mit.edu

1 - Multi-Criteria, Multi-Place, Multi-Time: Evaluating System Strategies with the Rethink Health Model

Jack Homer, Owner, Homer Consulting, 72 Station Hill Rd., Barrytown, NY, 12507, United States of America, jhomer609@gmail.com, Gary Hirsch, Bobby Milstein

The ReThink Health Dynamics Model simulates many possible interventions to improve a local health system by lowering costs and deaths and boosting equity and productivity through 2040. It has been carefully calibrated to represent several localities across the U.S. A multi-criteria weighting scheme reflecting local values helps to select a single "best" intervention strategy. The best strategy may also depend upon a locality's room for improvement with regard to health care and health risks.

2 - Systems Models of Post-traumatic Stress Disorder

Navid Ghaffarzadegan, Professor, Virginia Tech, 231 Durham Hall, 1185 Perry Street, Blacksburg, VA, 24060, United States of America, navidg@vt.edu, Richard Larson

Little agreement exists about effective methods of screening for PTSD, optimal cutoff values, and even the number of PTSD patients. In a series of modeling efforts, we uncover five vicious cycles that inhibit PTSD treatment, and investigate characteristics of an optimal cutoff value for screening. We then show a population level model of PTSD patients in a military/post-military system. The models represent different levels of complexities of PTSD at individual and societal levels.

3 - Patient Flows in Mental Health Clinics

Anne Claire Collin, Graduate Student, MIT, 235 Albany Street, Ashdown House #5052, Cambridge, MA, 02139, United States of America, acollin@mit.edu

There are different factors that can hinder access and quality of care for veterans in a mental health clinic, many of which are not related to the treatment itself. The purpose of this research is to analyse the flows of patients in Veterans Affairs' Mental Health clinics in order to improve access. After a thorough work of understanding patients' conditions and paths through the different services, simulation is used to find a configuration which improves wait times.

4 - Cost Escalation in Health Systems Dominated by Private Health Insurance

Nisa Onsel, Research Assistant, Bogazici University, Bogazici University, Industrial Engineering Dept, Bebek, Istanbul, 34342, Turkey, nisa.guler@boun.edu.tr, Yaman Barlas, Güneş Yöcel

Adverse selection and moral hazard are effective in individuals' health insurance plan choice and healthcare service utilization. The inefficient behaviors have a potential impact on increasing insurance premiums. In the existence of increasing healthcare costs due to advanced health technologies, cost escalation in health systems is a complex problem. A system dynamics model is constructed and analyzed for understanding financial sustainability of health systems dominated by private insurance.

■ SA34

34-Room 411, Marriott

Health-care Decision Making

Sponsor: Health Applications

Sponsored Session

Chair: Ebru Bish, Associate Professor, Virginia Tech, Dept of Industrial and Systems Eng, 250 Durham Hall, Blacksburg, VA, 24061-0118, United States of America, ebru@vt.edu

1 - The Management of Mass Casualty Incident Response

Behrooz Kamali, PhD Candidate, Virginia Tech, 250 Durham Hall (MC 0118), Blacksburg, VA, 24061, United States of America, kamali@vt.edu, Douglas Bish

In this research we seek to systematically investigate triage and transport of casualties in the aftermath of a mass-casualty incident. We study the structure of the optimal policies using novel models that incorporate available resources, quantity, and mix of casualties. Insights gained allow us to derive special cases that can be solved to optimality with simple heuristics. We compare results from our models to that of other models in the literature and the current practices.

2 - A Study on the Spatial Spread and Optimal Control of the 2014-2015 Ebola Outbreak in West Africa

Esra Buyuktahtakin, Assistant Professor, Wichita State University, 1845 N Fairmount, Wichita, KS, 67260, Wichita, United States of America, Esra.Buyuktahtakin@wichita.edu, Eyyub Kibis, Emmanuel Des-bordes

We develop an optimization approach to capture the disease dynamics of the deadly Ebola virus. We illustrate our model on a case study from Guinea, Liberia, and Sierra Leone. Numerical results demonstrate the accuracy of our predictions and suggest that the model can be used as a decision-making tool to optimally allocate resources for epidemic prevention and control.

3 - Multi-Server Queues with Impatient Customers as Level-Dependent QBDs with Applications in Healthcare

Amir Rastpour, University of Alberta, Alberta School of Business, PhD office, Edmonton, AB, T6G 2R6, Canada, amir.rastpour@ualberta.ca, Burhaneddin Sandikci, Armann Ingolfsson

We investigate the use of level-dependent quasi-birth-death (QBD) processes to analyze priority queues with impatient customers, such as emergency departments where patients are triaged into priority classes and some patients leave without being seen. We report numerical results and discuss algorithm performance (accuracy and speed).

4 - Optimal Cut-off Points for RNA-based Testing to Minimize the Transfusion-transmitted Infection Risk

Hrayr Aprahamian, PhD Student, Virginia Tech, Dept of ISE, Blacksburg, VA, 24061-0118, United States of America, ahrayer@vt.edu, Ebru Bish, Douglas Bish

The safety of blood products, in terms of being free of infectious agents (e.g., human immunodeficiency virus, hepatitis viruses), is essential. We develop a novel mathematical model to determine the optimal cut-off points for RNA-based individual and pooled screening tests, considering all recognized and emerging infections that can be transmitted through the use of blood products. Using real data, we show that our model improves upon current practices.

■ SA35

35-Room 412, Marriott

Joint Session HAS/MSOM-Healthcare: Health Care Operations

Sponsor: Health Applications & MSOM

Sponsored Session

Chair: Nilay Argon, University of North Carolina, Department of Statistics and Operations, Chapel Hill, NC, 27599, United States of America, nilay@unc.edu

Co-Chair: Serhan Ziya, Associate Professor, UNC Department of Statistics & Operations Research, 356 Hanes Hall, CB#3260, Chapel Hill, NC, 27599 - 32, United States of America, ziya@unc.edu

1 - Scale and Skill Mix Efficiencies in Nursing Home Staffing

Ger Koole, VU University Amsterdam, De Boelelaan 1081a, Amsterdam, Netherlands, ger.koole@vu.nl, Dennis Moeke, Lineke Verkooijen

Care workers account for a significant proportion of the total health expenditure in nursing homes and are by far the largest controllable resource. Therefore determining the appropriate number and type of care workers required plays an important role in the search for more efficiency. This study provides insights in how and why scale of scheduling and blending tasks of different qualification levels effect the number and type of staff required to meet the preferences of nursing home residents.

2 - Myopic Scheduling of Jobs with Decaying Value with Applications in Patient Scheduling

Neal Master, Stanford University, 350 Serra Mall, Stanford, CA, 94305, United States of America, nmaster@stanford.edu, Carri Chan, Nicholas Bambos

In healthcare settings, delays in receiving treatment can result in worse outcomes for patients. We introduce a clearing model in which the reward generated by completing service for an individual job decays over time. Because computing an optimal policy for such a model is computationally intractable, we focus on a number of myopic heuristics. We provide performance guarantees for each heuristic and use simulation to gain further insight into patient scheduling problems.

3 - Wait Time Announcements at Hospital Emergency Departments

Zhankun Sun, Haskayne school of business, University of Calgary, 2500 University Drive NW, Calgary, AB, Canada, zhankun.sun@haskayne.ucalgary.ca, Marco Bijvank

We study a multiclass multiserver priority queue with delayed feedback to predict the wait time for low-priority patients to be seen by a physician for the first time after triage in ED. We model the patients reassess process and develop a procedure to predict the state-dependent wait time based on an busy-period analysis. With a case study at the four major hospitals in the Calgary area we illustrate the performance of our wait time predictions.

4 - Evaluating Different Policies: A Real Life Operating Room Scheduling Problem

Elvin Coban, Ozyegin University, Cekmekoy, Istanbul, Turkey, elvin.coban@ozyegin.edu.tr, Gulsah Alper

We study a real life operating room scheduling problem using a dataset from a leading hospital in Turkey. We solve the daily and weekly scheduling problems by a mixed integer linear programming model. Various objective functions and performance metrics are analyzed including minimizing the waiting time of patients while maximizing fairness. We examine surgery delays and incorporate possible delays in surgery durations. We also propose a method to compute robust operating room schedules.

■ SA36

36-Room 413, Marriott

Humanitarian Applications I

Sponsor: Public Sector OR

Sponsored Session

Chair: Burcu Balcik, Ozyegin University, Nisantepi Mah. Orman Sok. Cekmekoy, Istanbul, Turkey, burcu.balcik@ozyegin.edu.tr

1 - The Needs Assessment Routing Problem in Humanitarian Relief

Burcu Balcik, Ozyegin University, Nisantepi Mah. Orman Sok. Cekmekoy, Istanbul, Turkey, burcu.balcik@ozyegin.edu.tr

In the immediate aftermath of a disaster, it is important for relief agencies to develop accurate estimates about the effects of the disaster in the affected region. Since assessments must be completed quickly, it may not be possible to visit each site in the affected region to collect information. We present mathematical models and solution approaches to support site selection and routing decisions of the rapid needs assessment teams. We present a case study to illustrate our approach.

2 - Effective Response to Disable and Elderly Populations in Short-notice Disasters

Jacqueline Griffin, Assistant Professor, Northeastern University, 334 Snell Engineering Center, 360 Huntington Ave, Boston, MA, 02125, United States of America, ja.griffin@neu.edu, Rana Azghandi

We develop a mixed integer programming model to simultaneously account for the different protection strategies for the elderly and disabled population in short-notice disasters. The modeling poses a split-delivery vehicle routing problem with time windows and multiple uses of heterogeneous vehicles. We examine the effect of multiple objectives for this disaster response application. Moreover, the value of cooperation among neighboring jurisdictions as compared with greedy policies is examined.

3 - A Dynamic Model for Disaster Response Considering Prioritized Demand Points

Gina Galindo, Dr., Universidad del Norte, Km 5 Antigua Via a Puerto Colombia, Barranquilla, Colombia, ggalindo@uninorte.edu.co, Daniel Rivera

This research addresses the problem of distributing relief supplies after the occurrence of a natural disaster. We develop a dynamic model to define an action plan to serve demand, while prioritizing the response according to the level of urgency of demand points. Our model considers capacity constraints and dynamic priorities. To evaluate its applicability, we use a case study of a flood occurred in Colombia. We also test the solvability of our model for large instances of our problem.

4 - The Role of Media Exposure on Humanitarian Donation and Coordination

Mahyar Eftekhari, Arizona State University, P.O. Box 874706, Tempe, AZ, 85287, United States of America, eftekhari@asu.edu, Luk Van Wassenhove, Hongmin Li, Scott Webster

Despite their resource and financial limitations and despite the considerable level of demand uncertainty they face, Humanitarian Organizations (HOs) do not typically share resources. Considering the impact of media exposure, our study unveils the conditions in which humanitarians will coordinate. This paper contains both empirical and analytical modeling.

■ SA37

37-Room 414, Marriott

Health Care Modeling and Optimization I

Contributed Session

Chair: Michal Jakubczyk, Warsaw School of Economics, Al. Niepodleglosci 162, Warsaw, 02-554, Poland, michal.jakubczyk@sgh.waw.pl

1 - The Optimal Timing of Medical Tests

Thomas Weber, Associate Professor, EPFL, CDM-ODY 3.01, Station 5, Lausanne, VD, 1015, Switzerland, thomas.weber@epfl.ch

This paper considers the optimal timing of tests based on a known law of motion for the statistical evolution of a random population prevalence. In a Bayesian setting, we find for a given imperfect binary disease diagnostic and action thresholds the optimal time to test and retest a potentially ill individual, conditional on past test outcomes. The framework allows for complex disease dynamics, including multiple populations, contagion, and stochastic lifetimes.

2 - A Fuzzy Approach to Modeling the Willingness-to-Pay for Health and Supporting Decision Making

Michal Jakubczyk, Warsaw School of Economics, Al. Niepodleglosci 162, Warsaw, 02-554, Poland, michal.jakubczyk@sgh.waw.pl

Choosing between health technologies involves multiple criteria (e.g., effects & cost), uncertainty, and often multiple alternatives. I advocate that, due to peculiarity of health, fuzziness additionally needs to be introduced to model the willingness-to-pay/accept (WTP/WTa). I show how to do that by redefining notions typically used in health technology assessment. Properties of new approach are discussed. Accounting for fuzziness additionally explains the WTP-WTA disparity in this context.

3 - Emergency Department Length-of-stay Estimation using Time-variant Predictors

Seung Yup Lee, Graduate Research Assistant, Wayne State University, 4815 4th St., Detroit, MI, 48202, United States of America, seung.lee@wayne.edu, Ratna Babu Chinnam, Alper Murat, Evrim Dalkiran

The accurate length-of-stay (LOS) estimation for patients in emergency departments (ED) is a pre-requisite for quality resource coordination between ED and inpatient wards. We investigate how time-variant levels of crowding in ED can be captured and incorporated in LOS estimation models by using vector autoregression (VAR). We will also report results and insights from testing the models on data from VA Medical Centers.

4 - An Integrated Framework to Model the Trajectories of Chronic Conditions

Adel Alaeddini, University of Texas at San Antonio (UTSA), One UTSA Circle, San Antonio, United States of America, adel.alaeddini@utsa.edu

Any medical condition that requires long term monitoring and management to control symptoms and shape the course of the disease is known as chronic conditions. Nearly 45% of the general population has 1 chronic condition or more. This accounts for more than 75% percent of health care expenditures. We present an integrated probabilistic framework for modeling the trajectories of chronic conditions. The proposed methodology will be validated using a large dataset from a medical center in Texas.

■ SA38

38-Room 415, Marriott

Big Data I

Contributed Session

Chair: Ellick Chan, Exponent, 149 Commonwealth Dr., Menlo Park, CA, 94025, United States of America, echan@exponent.com

1 - A Structural Service Model for Describing and Designing Services with Data

Chie-Hyeon Lim, Post-doc, POSTECH, Engineering Building #4-316, Pohang, 790-784, Korea, Republic of, arachon@postech.ac.kr, Min-Jun Kim, Kwang-jae Kim, Paul Maglio

Using big data effectively in service design requires having a model that describes the service in question along with the data in use. In this talk, we propose a generic structural service model to describe a service with a set of predefined variables, facilitating design of services that use big data. The variables include service objective, indicators, customer and context variables, and delivery contents. We discuss the model in the context of several case studies of service design.

2 - Increasing Productivity and Minimizing Errors in Spreadsheet Analytics

Larry LeBlanc, Professor, Owen Graduate School of Management, Vanderbilt University, 401 21st Avenue South, Nashville, TN, 37203, United States of America, larry.leblanc@owen.vanderbilt.edu, Thomas Grossman, Michael Bartolacci

Spreadsheets have proliferated for business analytics, and spreadsheet errors can result in poor supply chain, manufacturing, or investment decisions, including the failure to identify good opportunities. We examine potential problem areas for spreadsheet design and suggest alternative design approaches that seek to increase productivity and reduce the likelihood of errors. Even careful analysts might send their spreadsheet to assistants for updating, and s/he might need these guidelines

3 - A Practical Big Data Precision Marketing – Cross-Selling Mobile Bank to Internet Bank

Jian Xu, IBM, Diamond Bld, ZGC Software Park, Beijing, China, xujianx@cn.ibm.com, Ming Xie, Yuhang Liu, Zhen Huang, Tianzhi Zhao, Yuhui Fu

The bank wants improve mobile bank users and transform customers from online bank channel to mobile bank. Mobile bank represents the future E-channel. Large amount of data is integrated and analyzed on E-channel users' behavior. The users' online behaviors are also considered. We build the cross-selling model to identify the potential customers who are more likely to become mobile bank users, and improve the marketing success rate significantly.

4 - Forecasting Unemployment Rate by using Ensemble Hybrid Ann- Bayesian Model Combination

Farzad Radmehr, West Virginia University, 900 Willowdale Road, Morgantown, WV, United States of America, fradmehr@mix.wvu.edu

The goal of this paper is to predict the future data by using ensemble Bayesian model. Our dataset is UK unemployment rate from Floros C. paper in 2005 (Floros, 2005). In this paper, the Bayesian Ensemble Model Combination (BMC) will be proposed. For this purpose, we run ANN multiple times and these results will be the initial values for BMC. Then by giving the weight to each value, we predict the new value. The goal is to compare the values in BMC and ANN.

5 - Deep Learning Approaches to Digging Data Out of Digitized Paper Documents

Ellick Chan, Exponent, 149 Commonwealth Dr., Menlo Park, CA, 94025, United States of America, echan@exponent.com, Glen Depalma

Many organizations scan paper documents for fast search, however, existing search approaches generally require carefully crafted search terms to find documents. In this talk, we discuss deep learning approaches for OCR and search. We use computer vision to improve OCR accuracy and apply deep learning using Google's Word2Vec natural language processing (NLP) to identify topics of interest automatically. We've processed more than 300 boxes of documents with our techniques.

■ SA39

39-Room 100, CC

Game Theoretic Models in Operations and Marketing Interface

Cluster: Operations/Marketing Interface

Invited Session

Chair: Tao Li, Santa Clara University, 500 El Camino Real, Santa Clara, CA, 95053, United States of America, tli1@scu.edu

1 - Online Manufacturer Referral to Heterogeneous Retailers

Gangshu Cai, Santa Clara University, OMIS Department, Lucas Hall 216N, Santa Clara, CA, 95053, United States of America, gcai@scu.edu, Hao Wu, Chwen Sheu, Jian Chen

Since the development of the Internet, thousands of manufacturers have been referring consumers visiting their websites to some or all of their retailers. Through a model with one manufacturer and two heterogeneous retailers, we investigate whether it is an equilibrium for the manufacturer to refer consumers exclusively to a retailer or nonexclusively to both retailers.

2 - Strategic Risk Management in Spot Market for Supply Chains under Competition

Xuan Zhao, Associate Professor, Wilfrid Laurier University, 75 University Avenue West, Waterloo, ON, Waterloo, Canada, xzhao@wlu.ca, Shanshan Ma, Wei Xing

This paper studies two risk management strategies related to spot market to mitigate firms' exposure to demand uncertainty, namely, operational hedging and financial hedging. We provide insights on the dynamics of each hedging strategy under competition.

3 - Overconfident Competing Newsvendors

Meng Li, University of Illinois, Wohlers Hall, 1206 S Sixth St.,
Champaign, IL, 61820, United States of America,
mengli@illinois.edu, Jun Zhang, Nicholas Petruzzi

In this paper, we study the effects and implications of overconfidence in a competitive newsvendor setting. This bias unequivocally leads to a lower expected profit for a newsvendor that does not compete on inventory availability. Nevertheless, it can be a positive force for competing newsvendors. In a similar vein, we also show that the more biased of two competing newsvendors is not necessarily destined to a smaller expected profit than its less biased competitor.

4 - Transshipment in a Supply Chain with Competing Retailers

Tao Li, Santa Clara University, 500 El Camino Real, Santa Clara,
CA, 95053, United States of America, tli1@scu.edu, Meng Li

We study a supply chain with one manufacturer and two retailers who transship inventory between each other. We show the manufacturer's profit increases in customer search probability. We study the effect of bargaining power over the transshipment decision. We show the manufacturer always prefers to control the transshipment price rather than to control whether to transship, while the retailer can prefer both. We find bargaining power always benefits the manufacturer but could hurt the retailer.

SA40

40- Room 101, CC

Organization Theory I

Contributed Session

Chair: Robert Ryan, Doctoral Candidate, University of Pittsburgh, 6 Hillstream Rd, Newark, DE, 19711, United States of America, ryanrc111@gmail.com

1 - On Dynamics of Mirroring Hypothesis: How Product's Architecture Influences Social Network of Developers

Mahdi Ebrahim, PhD Candidate, Bocconi University, Via Rontgen
1, Milan, MI, 20138, Italy, mahdi.ebrahim@phd.unibocconi.it

Organization literature implies that product architecture and organizational structure mirror each other. Recent studies, though, show cases of mismatch between the two. Adverse effect of mismatch on product is well documented. Yet, its drivers are still unclear. We hypothesize that design elements with different complexity levels cause various forms of mismatch, the most harmful of which caused by Core elements. A dataset of elements' dependencies & developers' communications used to test hypotheses.

2 - Behavioral Motivation for Diversification: A Linkage Between Aspiration and Environment

Christine Choi, Seoul National University, 1 Gwanak-ro,
Gwanak-gu, Seoul, Korea, Republic of, kiky1001@snu.ac.kr,
Taewoo Roh

We explore how performance relative to aspiration level influences firms' choice of diversification strategy contingent upon task environment. Using sample of U.S. manufacturing firms, we propose that motivation to pursue specific diversification strategy is simultaneously affected by individual performance feedback condition and environmental dimensions. The study contributes both to the behavioral theory and diversification literatures by identifying antecedents for diversification strategy.

3 - Balancing of Exploration and Exploitation: from Punctuated Equilibrium to Dynamic Ambidexterity

Julio Pertuze, Assistant Professor, Pontificia Universidad Catolica de Chile, Av. Vicuña Mackenna 4860, Macul, Santiago, RM,
Chile, jpertuze@ing.puc.cl, Stephen X. Zhang

We clarify the process through which firms balance exploration, exploitation, and the origins of ambidexterity. Based on inductive case studies of academic startups, we found that firms initially balance exploration and exploitation sequentially and later develop ambidexterity. High-frequency switching between exploration and exploitation enhanced the fitness of routine assembly. We contribute to the understanding of the assembly of routines and to the nascent dynamic view on ambidexterity.

4 - Routines, Frictions, and Parenthetical "MAN": The Model of Managerial Rationality

Robert Ryan, Doctoral Candidate, University of Pittsburgh, 6 Hillstream Rd, Newark, DE, 19711, United States of America, ryanrc111@gmail.com, Barry Mitnick

The question of "what managers do" is an abandoned line of research, but shouldn't be. For studies of managed organizations, we still lack a model of how managerial actions and routines interact to create value for the firm. We address this gap. We call the logic of managerial actions, "managerial rationality" with three necessary conditions: "I break it" "I own it" "I fix it". This model includes four meta-cognitive action types: problematizing, objectivizing, planning, and committing.

SA41

41-Room 102A, CC

Joint Session MSOM-Health/HAS/Analytics: Data-driven Modeling in Healthcare I

Sponsor: Manufacturing & Service Oper Mgmt/Healthcare Operations, HAS & Analytics

Sponsored Session

Chair: Nan Liu, Columbia University, 722 W. 168th. St., New York, United States of America, nl2320@columbia.edu

Co-Chair: Yichuan Ding, UBC, 2053 Main Mall, Sauder School of Business, Vancouver, BC, V6T1Z2, Canada, daniel.ding@sauder.ubc.ca

1 - Effective Mechanisms for Reducing Hospital Readmissions

Jon Stauffer, Indiana University, 1309 E. Tenth Street,
Bloomington, IN, 47405, United States of America,
stauffer@indiana.edu, Kurt Bretthauer, Jonathan Helm

In this work we consider the problem of optimal design and capacity allocation for monitoring and treatment mechanisms to reduce patient readmissions. Using actual data, we analyze how groups in the healthcare provider system (hospitals, physicians, post-discharge follow-up care) would adjust their approach to readmission reduction in terms of what monitoring approaches / interventions to employ and when to employ them.

2 - Admission Control in a Network of ICUS and PCU/IMC Units Based on Patient Mortality Risk

Amirhossein Meisami, PhD Student, University of Michigan,
1205 Beal Avenue, Ann Arbor, MI, 48109, United States of
America, meisami@umich.edu, Jivan Deglise-hawkinson,
Mark Cowen, Jennifer Czerwi, Mark Van Oyen

Traditional admission to ICU and step-down/intermediate care units emphasizes acuity and specific treatment needs for "mandatory" placement. This revised work optimizes the selective admission of highest risk "non-mandatory" patients to the higher care unit network. The MIP models the queuing network dynamics to avoid excessive blocking of mandatory patients.

3 - Mitigating the Effect of Schedule Dependent No-show

Zhenzhen Yan, National University of Singapore, NUS, Business
School 1 Business Lin, PhD Program Deans Office Biz2,
Singapore, 117592, Singapore, a0109727@u.nus.edu,
Qingxia Kong, Shan Li, Chung Piau Teo, Nan Liu

Based on empirical study of two sets of data from US and Chile, we observe patient's no show probability is related to the appointment schedule. We develop a conic programming approach to study the effect of schedule dependent no-show on the design of the optimal schedule, and its impact on the choice of overbooking strategy. Our method is able to overcome the deficiency of standard stochastic LP approach, which is not able to handle this problem.

4 - Managing Appointment-based Health Services under Patient Choices

Nan Liu, Columbia University, 722 W. 168th. St., New York, NY,
United States of America, nl2320@columbia.edu,
Peter Van De Ven, Bo Zhang

This talk provides a framework to critique two main scheduling paradigms currently used in the healthcare market: non-sequential (online) appointment scheduling and sequential (similar to over-the-phone) scheduling. We develop dynamic programming models and approximate algorithms to solve them. We show that a significant efficiency improvement can be achieved by carefully modeling the scheduling process and explicitly accounting for patient choice.

■ SA42

42-Room 102B, CC

Joint Session HAS/MSOM-Health-Practice: Operations Management of Emergency Services I

Sponsor: Health Applications/MSOM

Sponsored Session

Chair: Maria Mayorga, Associate Professor, University of North Carolina, Dept. of Industrial & Systems Engineering, Campus Box 7906, Raleigh, NC, 27695-7906, United States of America, memayorg@ncsu.edu

1 - Two-stage Stochastic Programming to Redeploy and Dispatch Ambulances with Restricted Workload

Shakiba Enayati, Research Assistant- PhD Candidate, North Carolina state university, NC State University 373 Daniels Hall, Raleigh, NC, 27695-79, senayat@ncsu.edu, Osman Ozaltin, Maria Mayorga

EMS system is responsible to dispatch ambulances to arriving emergency calls. Redeployment strategy potentially improves the EMS performance as ambulances becoming busy erratically. This study proposes a stochastic approach comprising two steps. Each step is a two-stage stochastic programming in which the redeployment occurs only for idle ambulances in the first stage. Dispatching decisions are made in the second stage. Numerical results are provided based on simulation for a large real dataset.

2 - Assessing the Impact of Flexible use of Observations Units

Gabriel Zayas-Caban, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, gzayasca@umich.edu

We assess tradeoffs that result from flexible use of Observation Units (OUs). A potential solution to reduce delays to care is to relocate boarding patients to an OU, which offer an alternative to discharging or admitting ED patients by allowing doctors to observe patients for an extended time. This allows ED beds to become available, resulting in decreased times to first treatment for patients. However, this has the potential to block the OU for patients needing observation.

3 - Dynamic Ambulance Management: Theory and Practice

Rob Van Der Mei, CWI, Kruislaan 123, Netherlands, R.D.van.der.Mei@cwi.nl, Thijs Van Barneveld, Sandjai Bhulai, Martin van Buuren, Caroline Jagtenberg

Dynamic Ambulance Management (DAM) is a powerful means to reduce response times for ambulance services, and the use of DAM is rapidly gaining momentum. Over the past few years, we have developed a variety of DAM-algorithms, each with their pros and cons. Recently, we have started a real-life pilot to evaluate the different algorithms in practice. In this talk I will give an overview of the algorithms developed, and discuss the lessons learned from the DAM-pilot.

4 - Modeling Ambulance Dispatch Systems During Extreme Weather Events

Eric Dubois, PhD Student, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, edubois2@wisc.edu, Laura Mclay

Ambulance dispatch models traditionally focus on steady state systems operating under normal conditions. We develop a Markov decision process to model the system during extreme weather events where patient queueing and patient health deterioration is relevant. We determine that under certain situations with high ambulance utilization, average patient survival can be increased by withholding ambulances from less serious patients in the expectation of more emergent future calls.

■ SA43

43-Room 103A, CC

Revenue Management and Learning I

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: He Wang, MIT, 77 Mass Ave, E40-149, Cambridge, MA, 02139, United States of America, wanghe@mit.edu

1 - Learning via External Sales Networks

Ankur Mani, NYU, 44 W 4th St, New York, NY, United States of America, amani@stern.nyu.edu, Josh Reed, Ilan Lobel

We consider the problem of demand learning faced by a firm selling through an external sales network. The firm is not able to control its product experimentation and needs to rely on the decisions made by its sales agents. The only control available to the firm is to remove products from its lineup. We show that if the firm utilizes a well designed policy, it is able to obtain near-optimal experimentation when the sales force is sufficiently large.

2 - Learning and Pricing using Thompson Sampling

He Wang, MIT, 77 Mass Ave, E40-149, Cambridge, MA, 02139, United States of America, wanghe@mit.edu, Kris Johnson Ferreira, David Simchi-levi

We consider a network revenue management problem where a retailer aims to maximize revenue from multiple products with limited inventory. As common in practice, the retailer does not know the expected demand at each price and must learn the demand information from sales data. We propose an efficient and effective dynamic pricing algorithm, which builds upon the Thompson sampling algorithm used for multi-armed bandit problems by incorporating inventory constraints into the pricing decisions.

3 - Nonparametric Self-adjusting Price Control

Stefanus Jasin, Stephen M. Ross School of Business, University of Michigan, Ann Arbor, MI, United States of America, sjasin@umich.edu, George Chen, Izak Duenyas

We consider dynamic pricing of multiple products with limited inventories. The functional form of demand is not known. We devise a nonparametric heuristic that consists of four elements: Spline approximation of the unknown demand during the exploration stage, linear approximation of the estimated demand, quadratic approximation of the estimated revenue, and self-adjusting control during the exploitation stage. Our heuristic significantly improves the theoretical bound of existing heuristics.

4 - Incomplete Learning and Certainty-equivalence Control

Bora Keskin, Duke University, Fuqua School of Business, 100 Fuqua Drive, Durham, NC, 27708-0120, United States of America, bora.keskin@duke.edu, Assaf Zeevi

Motivated by dynamic pricing applications, we consider a dynamic control and estimation problem where a system manager sequentially chooses controls and makes observations on a response variable that depends on chosen controls and an unknown sensitivity parameter. The system manager uses a certainty-equivalence decision rule to determine subsequent controls based on estimates, and we characterize the asymptotic accuracy performance of this policy.

■ SA44

44-Room 103B, CC

Pricing and Consumer Behavior

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Mikhail Nediak, Queen's University, 143 Union Str., Kingston, ON, K7L3N6, Canada, mnediak@business.queensu.ca

Co-Chair: Yuri Levin, Queen's School of Business, 143 Union St. West, Kingston, Canada, ylevin@business.queensu.ca

1 - A Non-parametric Approach to Dynamic Pricing with Demand Learning

Guyves Achtari, Queen's School of Business, 143 Union Str., Kingston, ON, Canada, 11ga10@queensu.ca, Mikhail Nediak

In many industries, firms have the capability of observing both sales and the refusal to buy from their customers. In situations where demand is unknown, firms may use early sales data to forecast demand. We consider a situation where the firm does not know demand, but can observe arriving customers refuse or accept to buy a product at a given price. We formulate a dynamic program which aims to dynamically adjust the price of the product in order to maximize the firm's total expected revenue.

2 - Turnpike Equilibrium for Oligopolistic Dynamic Pricing Competition with Strategic Consumers

Jue Wang, Post-doctoral Fellow, Queen's School of Business, 143 Union St. West, Kingston, ON, K7L 3N6, Canada, jw171@queensu.ca, Yuri Levin, Mikhail Nediak

We consider the oligopolistic price competition when the prices are dynamic and the customers are strategic. We formulate the problem as a fluid model in the optimal control framework, and show that the equilibrium has a turnpike property. We characterize the structure of turnpike for symmetric oligopoly and asymmetric duopoly. The impact of non-stationary demand is also examined.

3 - Quantity Competition in a Multi-product Exchange Market with Strategic Consumers and Dynamic Preference

Samuel Kirshner, UNSW Business School, Kensington, NSW, Australia, skirshner@business.queensu.ca, Mikhail Nediak, Yuri Levin

We study a general multi-product multi-period exchange market for gross substitute products. Consumers maximize surplus under the uncertainty of their future product preferences deciding the quantity of products to purchase and sell in each period. Under mild assumptions, the equilibrium trades and price path is unique. The model is used to explore how strategic behavior of consumers and preference dynamics impact the equilibrium and aggregate welfare.

4 - Capacity and Price-matching Competition with Strategic Consumers

Mikhail Nediak, Queen's University, 143 Union Str., Kingston, ON, K7L3N6, Canada, mnediak@business.queensu.ca, Yossi Aviv, Andrei Bazhanov, Yuri Levin

Price matching (PM) is important to all market participants since PM can not only mitigate the loss from strategic customer behavior but even lead to gains from higher levels of this behavior under competition. Retailer profit with PM can be less than the worst profit without PM. Manufacturer never benefits from PM except for branded products when the sales at reduced prices are undesirable. On the other hand, policymakers may encourage PM since it can improve the aggregate welfare.

■ SA45

45-Room 103C, CC

Networks: Games and Control

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Kimon Drakopoulos, Massachusetts Institute of Technology, Cambridge, MA, United States of America, kimondr@mit.edu

Co-Chair: Asu Ozdaglar, Massachusetts Institute of Technology, 32 Vassar St, Cambridge, MA, United States of America, asuman@mit.edu

1 - Controlling Epidemics on Networks

Kimon Drakopoulos, Massachusetts Institute of Technology, Cambridge, MA, United States of America, kimondr@mit.edu, Asu Ozdaglar, John Tsitsiklis

We study the problem of optimally allocating curing resources to cure an epidemic on a graph. We assume a curing budget constraint at each time instant. We prove that for graphs with large CutWidth efficient curing is impossible while for graphs with small CutWidth, efficient curing is possible and provide a near optimal policy.

2 - Privacy Constrained Network Formation

Ali Makhdoumi, Massachusetts Institute of Technology, 32 Vassar St, Cambridge, MA, 02139, United States of America, makhdoum@mit.edu, Daron Acemoglu, Asu Ozdaglar, Azarakhsh Malekian

With the increasing ease with which information can be shared in social media, the issue of privacy has become central for the functioning of various online platforms. In this talk, we consider how privacy concerns affect individual choices in the context of a network formation game.

3 - Consensus Expectations and Conventions

Ben Golub, Assistant Professor, Harvard University, 1805 Cambridge St, Cambridge, MA, 02144, United States of America, ben.golub@gmail.com, Stephen Morris

Players have uncertainty over both an external random variable and each other's beliefs. We study the iteration of an operator that takes a network-weighted average of others' expectations. By relating this process to a Markov chain, we characterize its limit, generalizing prior results on games with common priors and on complete-information network games. As applications, we study coordination games, over-the-counter financial markets, and the robustness of equilibrium.

4 - On the Efficiency of Networked Stackelberg Competition

Adam Wierman, California Institute of Technology, 1200 E California Blvd, Pasadena, CA, 91125, adamw@caltech.edu, Desmond Cai, Yunjian Xu, Subhonmesh Bose

We study the impact of strategic anticipative behavior in networked markets. We focus on the case of electricity markets and model the market as a game between a system operator (market maker) and generators at different nodes of the network. We compare the efficiency of a networked Stackelberg equilibrium, where generators anticipate the market clearing actions of the system operator, with a networked Cournot equilibrium, where generators are not anticipative.

■ SA46

46-Room 104A, CC

Empirical Research in Services and Retail

Sponsor: Manufacturing & Service Oper Mgmt/Service Operations
Sponsored Session

Chair: Santiago Gallino, Tuck School of Business, 100 Tuck Hall, Hanover, NH, United States of America, santiago.gallino@tuck.dartmouth.edu

Co-Chair: Antonio Moreno-Garcia, Northwestern University, 2001 Sheridan Rd, Evanston, IL, 60208, United States of America, a-morenogarcia@kellogg.northwestern.edu

1 - The Reference Effect of Delay Announcements

Qiuping Yu, Assistant Professor, Indiana University, 1309 E. 10th Street, Bloomington, IN, 47405, United States of America, qiupyu@indiana.edu, Gad Allon, Achal Bassamboo, Pengfei Guo

We study whether delay announcements induce the reference effect using data from a call center. Our empirical results show that customers are loss averse in response to the delay announcements. We then provide insights on whether and how we should provide announcements to the customers accounting for their loss averse behavior.

2 - The Operational Value of Social Media Information

Dennis Zhang, Kellogg School of Management, Northwestern University, 2001 Sheridan Road, Evanston, IL, 60201, United States of America, j-zhang@kellogg.northwestern.edu, Antonio Moreno-Garcia, Santiago Gallino, Ruomeng Cui

We study how social media information can be used to improve forecasting and discuss the implications of this relation for operations management.

3 - The Value of Rapid Delivery in Online Retailing

Santiago Gallino, Tuck School of Business, 100 Tuck Hall, Hanover, NH, United States of America, santiago.gallino@tuck.dartmouth.edu, Marshall Fisher, Joseph (Jiaqi) Xu

For online retailers who sell physical goods, every transaction has two main components: the physical product a customer buys and the services by which the retailer facilitates the customer's purchase. Delivery speed is arguably the most important service component for online retailers. We use a quasi-natural experiment to assess the impact of faster delivery on revenue.

4 - A Holistic Perspective to Shrinkage: Antecedents and Consequences

Daniel Corsten, IE Business School, Calle Maria de Moina 12 Bajo, Madrid, 28006, Spain, daniel.corsten@ie.edu, Shivom Aggarwal

Vendor-side fraud has been overlooked in literature due to intractability, but poses to be significant antecedent of shrinkage. Using multi-store longitudinal data from a US retailer, we investigate holistic antecedents of shrinkage and how they affect store performance. The unified framework will contribute to extant literature on efficient retail operations.

■ SA47

47-Room 104B, CC

Emerging Topics in Healthcare Operations

Sponsor: Manufacturing & Service Oper Mgmt/Service Operations
Sponsored Session

Chair: Mor Armony, NYU Stern, 44 West 4th Street, New York, NY, 10012, United States of America, marmony@stern.nyu.edu

1 - An Examination of Early ICU Admissions based on a Physiologic Risk Score

Wenqi Hu, Columbia Business School, 3022 Broadway, Ur 4V, New York, NY, 10027, United States of America, whu17@gsb.columbia.edu, Gabriel Escobar, Carri Chan, José Zubizarreta

Unplanned transfers of patients from the ward to the Intensive Care Unit (ICU) can occur due to rapid deterioration and may increase the patients' risk of death. This work examines the potential costs and benefits of preventive ICU admissions based on a new dynamic warning system. We find that preventive ICU admissions have the potential to improve patient outcomes, and physicians' fears of needlessly clogging the ICU may not be as dire as initially assumed.

2 - The Impact of Online Reviews on Demand for Outpatient Care: An Empirical Study

Yuqian Xu, NYU Stern School of Business, 44 West 4th Street, New York, NY, 10002, United States of America, yxu@stern.nyu.edu, Anindya Ghose, Mor Armony

New platforms for online patient reviews and appointment scheduling provide an unprecedented opportunity to examine the relationship between patient reported satisfaction and demand for outpatient care. We study data from a leading online appointment booking site and use structural estimation and data mining to determine the influence of patient reviews on physician demand. We pay special attention to operational factors in patient care such as service time, waiting time and ease of appointment.

3 - Process Information in Healthcare Systems: Applications to Delay Estimations and Management

Galit Yom-tov, Technion, IE&M Faculty, Technion, Haifa, Israel, gality@tx.technion.ac.il, Chen Shapira, Sarah Kadish, Shoshi Levavi, Avi Mandelbaum, Nitzan Carmeli, Arik Senderovich, Craig Bunnell

Extracting process information data for healthcare services is a challenge due to the combination of multiple non-integrated IT systems. In this talk we consider an (open traditional) emergency department and an (appointment-driven) outpatient hospital. We discuss operational benefits of information processing efforts and the theoretical challenges they present. We then focus on the evolution of delays through these service networks, and the use of process (and RTLS) data to estimate delays.

4 - Optimal Emergency Department Wait Time Prediction

Sara Kwasnick, Stanford Graduate School of Business, 655 Knight Way, Stanford, United States of America, kwasnick@stanford.edu, Erica Plambeck, Mohsen Bayati

We implement a real-time wait time prediction system at a partner hospital, and explore how the accuracy and format of wait time estimates affects patient behavior. In particular, we find that accurate provision of wait time information appears to improve satisfaction and decrease the rate at which patients leave without being seen. We propose a new wait time prediction objective based on these results.

SA48

48-Room 105A, CC

Sustainable Operations Management and the Environment

Sponsor: Manufacturing & Service Oper Mgmt/Sustainable Operations
Sponsored Session

Chair: Michael Lim, University of Illinois, 1206 S. 6th street, Champaign, IL, 61822, United States of America, mlim@illinois.edu

Co-Chair: Nicholas Petruzzi, The Pennsylvania State University, 210 Business Building, University Park, PA, 16802, United States of America, ncp12@psu.edu

1 - On the Formation of Farmer Producer Organizations in Developing Economies

Qiao-Chu He, PhD Candidate, University of California, Berkeley, 1117 Etcheverry Hall, Berkeley, United States of America, heqc0425@berkeley.edu, Ying-ju Chen, Zuo-jun Max Shen

We study the incentives for small and marginal farmers in developing economies to form farmer producer organizations (FPOs). We shall focus on the FPOs' institutionalized efforts in linking small farmers by integrating market information. By a stylized Cournot competition model endowed with endogenous information acquisition and sharing decisions, we offer insights on the governments or NGOs' dual roles in providing market information as well as mobilizing farmers to build FPOs.

2 - The State of Scope 3 Carbon Emissions Reporting

Christian Blanco, christian.noel.blanco@gmail.com, Charles Corbett, Felipe Caro

We compare upstream supply chain carbon emissions (scope 3) reported to CDP to estimates from Economic Input-output Life Cycle Assessment (EIO-LCA) models. We find that several opportunities remain in measuring and reporting upstream carbon emissions reported to CDP relative to EIO-LCA estimates.

3 - Design Implications of Extended Producer Responsibility: Durable or Recyclable Products?

Ximin (Natalie) Huang, Scheller College of Business, Georgia Institute of Technology, 800 West Peachtree, NW Atlanta, GA, United States of America, ximin.huang@scheller.gatech.edu, Beril Toktay, Atalay Atasu

We consider a monopolist who has two product design options to manage the end-of-life costs/revenues associated with its products: making products more durable or recyclable. We explore how the recyclability and durability choices are affected by the requirements of take-back legislation.

4 - The Impact of Ecolabeling on the Green Product Line

Karthik Murali, kmurali4@illinois.edu, Michael Lim, Nicholas Petruzzi

The use of ecolabels allows firms to convey credible information about environmental attributes in their products to consumers. In a competitive setting, we study the role of a firm's credibility and certification from external agencies with differing objectives on a firm's ecolabeling choices and ensuing consequences from a triple bottom line perspective using game-theoretic models.

SA49

49-Room 105B, CC

Frontiers of Supply Chain Research

Sponsor: Manufacturing & Service Oper Mgmt/Supply Chain
Sponsored Session

Chair: Karen Zheng, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, yanchong@mit.edu

1 - Impact of Technology Adoption on Product Assortment Planning

Duo Shi, Washington University in St. Louis, St. Louis, United States of America, dshi@wustl.edu, Fuqiang Zhang, Lingxiu Dong

This paper studies the impact of technology adoption on firms' product assortment planning. Consider two types of production technologies, dedicated technology and flexible technology. We aim to address the following questions that may arise when the firm contemplates the adoption of the flexible technology: What is the optimal product assortment under different technology choices? How does the adoption of flexible technology affect the firm's assortment decision?

2 - Omnichannel Retail Operations

Fei Gao, The Wharton School, University of Pennsylvania, 3730 Walnut Street, 500 Jon M. Huntsman Hall, Philadelphia, United States of America, feigao@wharton.upenn.edu, Xuanming Su

Omnichannel consumers strategically make use of online and offline channels to gather information and purchase products. We study different omnichannel information strategies and their profit implications for firms.

3 - Quality in Supply Chain Encroachment

Xiaoyang Long, PhD Student, Hong Kong University of Science and Technology, Hong Kong - PRC, xlongaa@connect.ust.hk, Albert Ha, Javad Nasiry

We study a supply chain with manufacturer encroachment in which product quality is endogenous and customers have heterogeneous preferences for quality. We find that encroachment always makes the retailer worse-off. In addition, we show that a manufacturer offering differentiated products through two channels prefers to sell its high-quality product directly. Contrary to conventional wisdom, quality differentiation does not always benefit either manufacturer or retailer.

4 - Measuring the Bullwhip Effect with Material Flow Data: Biases and Remedies

Wei Luo, IESE Business School, Av. Pearson 21, Barcelona, Spain, wluo@iese.edu, Li Chen, Kevin Shang

This paper focuses on understanding the bullwhip measurement and providing methods to infer demand and order variance from available material flow data. We derive conditions under which estimation bias occurs and characterize the driving factors. We also propose a debiasing method that helps the practitioners and empirical researchers to further improve their estimation and assessment of the magnitude of the bullwhip effect.

■ SA50

50-Room 106A, CC

Emerging Issues and Recent Trends in Sourcing

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Eda Kemahilioglu-Ziya, NC State, Poole College of Management, Raleigh, United States of America, ekemahl@ncsu.edu

Co-Chair: Olga Perdikaki, Texas A&M University, College Station, TX, United States of America, operdikaki@mays.tamu.edu

1 - Cooperation in Assembly Systems: The Role of Knowledge Sharing Networks

Fernando Bernstein, Duke University, 100 Fuqua Drive, Durham, NC, United States of America, fernando.bernstein@duke.edu, Ana Meca, Gurhan Kok

Process improvement plays a significant role in reducing production costs over the life cycle of a product. We consider the role of process improvement in a decentralized assembly system in which a buyer purchases components from first-tier suppliers. Suppliers make investments in process improvement. The assembler establishes a knowledge sharing network among suppliers. We investigate the benefits and challenges associated with establishing a knowledge sharing network.

2 - Managing Dependent Random Supply Capacities in Dynamic Inventory-pricing Problems

Qi Annabelle Feng, Professor, Purdue University, 100 S. Grant St., West Lafayette, IN, United States of America, annabelle.feng@purdue.edu, Justin Zheng Jia, J. George Shanthikumar

Most work on multi-sourcing assumes independent supplies, though dependence among different sources is commonly observed. This is mainly due to the difficulty in analyzing models with dependent supplies. Extending the notion of stochastic linearity via transform the problem into one defined on a function space, we show that the dynamic inventory-pricing problem with dependent supply capacities is concave. This observation allows us to derive the optimal policy and generate interesting insights.

3 - Allocation of Greenhouse Gas Emissions in Supply Chains

Greys Sosis, University of Southern California, Marshall School of Business, Bridge Hall 401, Los Angeles, Ca, 90089, United States of America, sosis@marshall.usc.edu, Daniel Granot, Hailong Cui, Sanjith Gopalakrishnan, Frieda Granot

We formulate the greenhouse gas (GHG) emission responsibility problem as a cooperative game, referred to as the GREEN game, and suggest allocations of GHG responsibility among supply chain members. We prove that the GREEN game has a nonempty core and identify some allocations that are extreme core points and are used in practice. We derive an expression for the Shapley value of this game, which has a simple and intuitive interpretation, and provide its three distinct axiomatic characterizations.

4 - Outsourcing under Competition: When to Choose a Competitor as a Supplier?

Olga Perdikaki, Texas A&M University, College Station, TX, United States of America, operdikaki@mays.tamu.edu, Eda Kemahilioglu-Ziya

Motivated by several examples of sourcing from direct competitors in different industries, we study a stylized supply chain model with a single OEM that could outsource either to an independent supplier or to an integrated firm that carries out manufacturing in-house and competes with the OEM. We model different contractual relationships between the OEM and the firm it sources from and aim to identify whether and how the bargaining power of the OEM affects its supplier choice.

■ SA51

51-Room 106B, CC

Service Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Masha Shunko, Assistant Professor, Purdue University, 403 W State St., West Lafayette, IN, 47907, United States of America, mshunko@purdue.edu

1 - Understanding Customers Retrials in Call Centers: An Empirical Study

Gad Allon, Professor, Kellogg School of Management, Northwestern University, 2001 Sheridan Road, Evanston, IL, 60201, United States of America, g-allon@kellogg.northwestern.edu, Kejia Hu, Achal Bassamboo

We study the impact of waiting times and service quality on the retrieval behavior of customers in a call center.

2 - Humans are not Machines: How Server Behavior Affects Queueing Systems

Masha Shunko, Assistant Professor, Purdue University, 403 W State St., West Lafayette, IN, 47907, United States of America, mshunko@purdue.edu, Julie Niederhoff, Yaroslav Rosokha

Using behavioral experiments, we examine the impact of queueing system design on server productivity. We manipulate queue layout (parallel or single) and load visibility. Our results provide the following insights: 1) behavioral factors may slow down the single-queue system, which makes this design choice less attractive than predicted theoretically, and 2) providing good visibility of the queue length may speed up the servers and thus improve service performance.

3 - Operations in the On-demand Economy: Staffing Services with Self-scheduling Capacity

Martin Lariviere, Northwestern University, 2001 Sheridan Rd, Evanston, IL, 60208, United States of America, m-lariviere@kellogg.northwestern.edu, Itai Gurvich, Antonio Moreno-Garcia

Under self scheduling, agents choose for themselves whether or not to work in each period. The firm thus controls its service level only indirectly. Relative to when the firm sets the schedule, the firm has lower profits and the customers have a higher chance of not being served. An unconstrained firm recruits a large pool of agents to reduce compensation. If the firm is constrained to offer a minimum wage, it limits the pool of size and agent scheduling flexibility.

4 - E-commerce, the On-demand Economy and Sustainability

Ekaterina Astashkina, INSEAD, Boulevard de Constance, Fontainebleau, 77305, France, ekaterina.astashkina@insead.edu, Karan Girotra, Elena Belavina

On-demand services are heralding the next era of the e-commerce revolution. This talk examines the sustainability of using these on-demand services in certain high impact categories.

■ SA52

52-Room 107A, CC

Models of Service Systems

Sponsor: Service Science

Sponsored Session

Chair: Ralph Badinelli, Professor, Virginia Tech, Dept. of Business Information Technology, Virginia Tech 0235, Blacksburg, VA, 24061, United States of America, ralphb@vt.edu

1 - A Big Data Approach to Assessing the Quality of Higher Education Services

Robin Qiu, Professor, Penn State, 1025 Braxington Dr, Collegeville, PA, 19426, United States of America, robinqiu@psu.edu

This talk introduces a real-time, scalable, and model-driven higher education ranking system with the support of big data technologies. Text sentiment analysis is included in the developed ranking service system. The proposed approach has promising potential of wide application across the service industry.

2 - Impact of Top Service Designers on Experience Service Performance

Gregory Heim, Associate Professor, Mays Business School at Texas A&M University, Wehner Hall 320, College Station, TX, 77843-4217, United States of America, GHeim@mays.tamu.edu

Service firms today leverage many designers known for design excellence. Despite expanding use of top designers, no research examines practical implications of top designers as compared to mainstream designers. In considering whether to use top designers, service managers must consider benefits from investment in high quality designs. Using data on golf courses and golf course designers, we study how top designers influence performance of Texas golf courses.

3 - Applying Normalized Systems Theory to Service System Design

Ralph Badinelli, Professor, Virginia Tech, Dept. of Business Information Technology, Virginia Tech 0235, Blacksburg, VA, 24061, United States of America, ralphb@vt.edu

This paper applies Normalized Systems Theory (NST) as a new framework for the modular design of service systems. We synthesize a prescription for service system design from principles of NST and principles of the Viable Systems Approach (VSA). A mathematical model of the effects of system coupling on evolvability and entropy is derived. Evolvability and entropy are related to autopoiesis, homeostasis and viability. An example of an NST-inspired service system design is provided.

SA53

53-Room 107B, CC

Experiments in Supply Chains

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Andrew Davis, Cornell University, 401J Sage Hall, Ithaca, NY, 14850, United States of America, adavis@cornell.edu

1 - Inventory Decisions under Epistemic and Aleatory Demand Uncertainty

John Aloysius, University of Arkansas, WCOB 475d University of Arkansas, Fayetteville, AR, 72701, United States of America, JAloysius@walton.uark.edu, Siqi Ma

Research on inventory decisions under uncertainty has primarily focused on aleatory uncertainty due to stochastic variability. Epistemic uncertainty due to a lack of confidence in knowledge however routinely features in such decisions. Our experiment orthogonally manipulates the two forms of uncertainty in a newsvendor task. We partial out biases due to each form of uncertainty and also report on learning as well as interaction effects.

2 - Bargaining and the Allocation of Risk in Supply Chains: An Experimental Study

Kyle Hyndman, University of Texas at Dallas, 800 W Campbell Rd (SM 31), Richardson, TX, 75080, United States of America, KyleB.Hyndman@utdallas.edu, Andrew Davis

We study the impact of bargaining and inventory risk location in a supply chain. We conduct a human-subjects experiment where a retailer and supplier engage in free-form bargaining over wholesale price, order quantity and inventory location. We show: (1) our bargaining environment leads to higher efficiency than in past studies; (2) the party incurring the inventory risk always earns a substantially lower profit than the other party; (3) more restrictive environments lead to lower efficiency.

3 - Sharing in the Benefits of Learning-by-doing: A Laboratory Study of Procurement Auction Mechanisms

Blair Flicker, PhD Candidate, The University of Texas at Dallas, 800 W Campbell Road, Mailstop AD23, Richardson, TX, 75208, United States of America, bflicker@utdallas.edu, Wedad Elmaghaby, Elena Katok

Buyers looking to share in suppliers' learning-by-doing savings can either (i) draft long-term contracts with payment reduction schedules or (ii) encourage competition via sequential short-term contracts. Theoretically, there is minimal cost difference between the two approaches, but behavioral findings suggest that humans do respond differentially to the two mechanisms.

4 - Supply Base Diversification in the Presence of High Impact, Low Probability Supply Disruptions

Doug Thomas, Penn State, 463 Business Building, University Park, PA, 16802, United States of America, dthomas@psu.edu, Mirko Kremer, Kyle Goldschmidt, Chris Craighead

We investigate sourcing decisions in the presence of high impact, low probability supply disruptions. We develop a model that captures a key sourcing tradeoff: A consolidated (diversified) supply base reduces (increases) transaction costs but increases (reduces) the exposure to disruptions. We predict, and using a laboratory experiment, find evidence for, an oscillating pattern - decision makers diversify immediately after a severe disruption and consolidate during stretches without disruptions.

SA54

54-Room 108A, CC

Data-Driven Stochastic Programming using Phi-Divergences

Cluster: Tutorials

Invited Session

Chair: Guzin Bayraksan, Associate Professor, The Ohio State University, Integrated Systems Engineering, Columbus, OH, 43209, United States of America, bayraksan.1@osu.edu

1 - Data-Driven Stochastic Programming using Phi-Divergences

Guzin Bayraksan, Associate Professor, The Ohio State University, Integrated Systems Engineering, Columbus, OH, 43209, United States of America, bayraksan.1@osu.edu, David K. Love

Phi-divergences provide a measure of distance between two probability distributions. They can be used in data-driven stochastic optimization to create an ambiguity set of distributions centered around a nominal distribution and hedge against distributional uncertainty. In this tutorial, we present two-stage models with distributional uncertainty using phi-divergences and tie them to risk-averse optimization. We examine the value of collecting additional data and discuss convergence properties.

SA55

55-Room 108B, CC

Airline Economics: Competition and Collaboration

Sponsor: Aviation Applications

Sponsored Session

Chair: Yi Liu, UC Berkeley, 107 McLaughlin Hall, Berkeley, Ca, 94720, United States of America, liuyi.feier@gmail.com

1 - Airline Competition and Market Frequency: A Comparison of the S-curve and Schedule Delay Models

Yi Liu, UC Berkeley, 107 McLaughlin Hall, Berkeley, CA, 94720, United States of America, liuyi.feier@gmail.com, Mark Hansen

We compare two models for an airline market served by identical carriers who compete on fare and frequency: s-curve model and schedule delay model. They only differ structurally with respect to how they handle frequency competition. The demand side of our model is an approximation of a nested logit model which yields endogenous travel demand by including not travelling in the choice set. The results of our comparison support the schedule delay model over the s-curve model.

2 - Game-theoretic and Empirical Models for Airline Capacity and Fare Decisions under Competition

Vikrant Vaze, Assistant Professor, Dartmouth, 14 Engineering Drive, Hanover, NH, 03755, United States of America, Vikrant.S.Vaze@dartmouth.edu, Reed Harder

Airline capacity and fare decisions under competition affect passenger choice and the overall efficiency of airline networks. We develop Nash equilibrium models as well as empirical models to characterize these interactions. We analytically prove desirable properties of the resulting games and describe numerical experiments that extend our theoretical results to more complicated competition settings. Our results, validated against real-world data, provide new insights into airline competition.

3 - An Equitable and Collaborative Mechanism for Scheduling Interventions at Congested Airports

Alexandre Jacquillat, PhD Candidate, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Building E40-240, Cambridge, MA, 02136, United States of America, alexandre.jacquillat@gmail.com, Vikrant Vaze

Flight scheduling interventions can mitigate airport congestion by controlling the imbalances between peak-hour demand and capacity. We design, optimize and assess non-monetary congestion-mitigating scheduling mechanisms that ensure inter-airline equity and enable airline collaboration. Theoretical and computational results suggest that large equity gains can be achieved at small efficiency losses and that accounting for airline preferences can improve the outcome of scheduling interventions.

4 - A Majority-judgment-based Multi-criteria Consensus Building Method

Chiwei Yan, Massachusetts Institute of Technology,
77 Massachusetts Avenue, E40-130, Cambridge,
United States of America, chiwei@mit.edu, Michael Ball,
Vikrant Vaze, Prem Swaroop, Cynthia Barnhart

We propose a multi-criteria consensus building method based on Majority Judgment proposed by Balinski and Laraki recently. This problem setting originally stems from strategic air traffic flow management, but is applicable to a wide range of social choice problems. We propose two methods: 1) a multi-round estimation approach and 2) a single-shot robust approach to find majority winner under this setting. Case studies from real-world applications demonstrate the effectiveness of our approach.

■ SA56

56-Room 109A, CC

Hub Location

Sponsor: Location Analysis

Sponsored Session

Chair: Sibel Alumur, University of Waterloo, 200 University Avenue West, Waterloo, ON, N2L 3G1, Canada, sibel.alumur@uwaterloo.ca

1 - Models and Algorithms for Robust Hub Location

Ivan Contreras, Concordia University and Interuniversity
Research Center on Enterprise Networks, Logistics and
Transportation (CIRRELT), H3G 1M8, MONTREAL, Qu, Canada,
ivan.contreras@cirrelt.ca, Jean - Francois Cordeau, Carlos Zetina

In this talk we present robust hub location problems in which uncertainty is associated with demands and flow costs. We study three robust counterparts of the uncapacitated hub location problem with multiple assignments. The first focuses on demand uncertainty, the second one deals with flow cost uncertainty and the third one considers both demand and flow cost uncertainty. We present mathematical models and exact algorithms for each one of these variants. Computational experiments are reported.

2 - On Single-allocation P-hub Median Location Problems with Flow Thresholds-based Discounts

Armin Luer Villagra, Universidad Andres Bello, Engineering
Sciences Department, Antonio Varas 880, Piso 6, Providencia,
Santiago, Chile, armin.luer@unab.cl, H A Eiselt,
Vladimir Marianov

Appropriate modeling of economies of scale on hub and spoke networks is an active research trend. We present a single allocation p-hub location problem where a fixed discount is applied to the flow in an arc if it exceeds a fixed threshold, and the inter-hub network can be incomplete. We solve using standard software and literature instances. Aggregated performance indicators are used to analyze and compare solutions. The results show the appropriateness of our model.

3 - Hub Network Design in Air Transportation

Armaghan Alibeyg, Concordia University and Interuniversity
Research Center on Enterprise Networks, Logistics and
Transportation (CIRRELT), 1455 de Maisonneuve Blvd. West,
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Elena Fernández, Ivan Contreras

We present a class of hub network design problems that consider a profit-oriented objective. Potential application arise in the design of air transportation networks, where companies need to determine not only the location of hub facilities but also the design of the hub network. This class of problems considers the simultaneous optimization of the collected profit, the setup cost of the hub network and the transportation cost.

4 - The Design of Capacitated Intermodal Hub Networks with Different Vehicle Types

Sibel Alumur, University of Waterloo, 200 University Avenue
West, Waterloo, ON, N2L 3G1, Canada,
sibel.alumur@uwaterloo.ca, Elif Zeynep Serper

We determine the locations and capacities of hubs, which transportation modes to serve at hubs, allocation of non-hub nodes to hubs, and the number of vehicles of each type to operate on the hub network to route the demand between origin-destination pairs with minimum total cost. A mixed-integer programming model is developed and a local search heuristic is proposed. Computational analyses are conducted on the Turkish network and CAB data sets.

■ SA57

57-Room 109B, CC

Real Options in the Energy Sector

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Afzal Siddiqui, University College London, Department of
Statistical Science, Gower Street, London, UK, WC1E 6BT,
United Kingdom, afzal.siddiqui@ucl.ac.uk

1 - Structural Estimation of Real Switching Options in Peak Power Plants

Stein-erik Fleten, NTNU, Industrial Economics and Technology
mana, Trondheim, Norway, Stein-Erik.Fleten@iot.ntnu.no,
Carl J. Ullrich, Erik Haugom, Alois Pichler

Peak power plants have high operating and maintenance costs when kept ready to operate. Therefore, plant managers sometimes put their plants in a standby state, or retire them. Using structural estimation, we estimate the maintenance cost for the operating states (operating ready, standby) and switching costs for startup, shutdown and retirement actions. Our approach extends recent contributions in structural estimation, combining nonparametric statistics with nonlinear programming.

2 - Real Options Analysis of Investments in Flexibility Measures for Gas-fired Power Plants

Reinhard Madlener, RMadlener@eonerc.rwth-aachen.de,
Barbara Glensk, Christiane Rosen

Conventional power generation will remain important for quite some time for balancing electricity demand and supply. We propose a real options model for the flexible operation of existing gas-fired power plants, enabling to study the optimal timing of investment and valuation of alternative flexibility measures. We use the spark spread for valuing the flexible plant operation in light of different load levels and corresponding efficiency factors. The proposed model is applied to a case study.

3 - Capacity Mechanisms and Investment Decisions in Electricity Market

Ryuta Takashima, Tokyo University of Science, 2641 Yamazaki,
Noda-shi, Chiba, Japan, takashima@rs.tus.ac.jp, Yuto Takano,
Naoki Makimoto, Yuji Yamada

The power producers can sell their generating capacities kWe in a market of the capacity or via a bilateral contract by means of a capacity mechanism. In this paper, we consider an investment problem of capacity expansion taking into account a scheme of the capacity mechanisms. We analyze an investment timing for different ratios of selling the capacity. In addition, we compare the investment timing for the standard energy-only market with that for the capacity market.

4 - Transmission and Power Generation Capacity Investment under Uncertainty

Verena Hagspiel, Norwegian University of Science and
Technology, Alfred Getz vei 3, Trondheim, Norway,
verena.hagspiel@iot.ntnu.no, Afzal Siddiqui, Jannicke Sletten,
Nora Midttun

In a decentralized electricity market transmission system operators must anticipate the investment behaviour of power companies when deciding on investment transmission-capacity expansion. We propose a novel RO model that captures both the investment decisions of a TSO and power companies allowing to account for the conflicting objectives of the distinct agents and study how potential generation expansion affects the optimal timing and sizing of transmission expansion.

■ SA58

58-Room 110A, CC

Multi-Agent Decision-Making for Smart Grids Operation I

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Amin Kargarian, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15232, United States of America, amin.kargarian@gmail.com

1 - A Fast Distributed Algorithm for Power Optimization Problems

Ramtin Madani, Columbia University, 116th St. & Broadway, New York, NY, 10027, United States of America, madani@ee.columbia.edu, Abdulrahman Kalbat, Javad Lavaei

This talk aims to develop an efficient numerical algorithm for power optimization problems by leveraging the small treewidth of real-world power grids. To this end, a distributed algorithm is proposed for arbitrary conic programs with a low treewidth, based on the alternating direction method of multipliers (ADMM). The iterations of this algorithm consist of two subproblems, which are highly parallelizable and enjoy closed-form solutions. The algorithm is tested on several power systems.

2 - Demand Response using Supply Function Bidding

Na Li, Assistant Professor, Harvard University, 33 Oxford St, MD 147, Cambridge, Ma, 02138, United States of America, nali@seas.harvard.edu, Lijun Chen, Munther Dahleh

An abstract market model based on supply function bidding is proposed for demand response to match power supply fluctuations. We characterize the resulting equilibria in competitive and oligopolistic markets and analyze the efficiency of the equilibria. The equilibrium in competitive market maximizes social welfare, and the equilibrium in oligopolistic market has bounded efficiency loss under certain mild assumptions. We also propose distributed algorithms to achieve the equilibria.

3 - Community Storage for Firming

Chenye Wu, Postdoctoral Fellow, UC Berkeley, 60 Panoram Way, Berkeley, CA, 94704, United States of America, wcy@ieee.org, Kameshwar Poolla

We analyze the benefit of storage capacity sharing for a set of residential consumers in a community. Each consumer has its own choice of either installing its own storage system or investing in a shared storage system. In the latter case, they must also decide on a scheme to allocate the costs. We formulate the problem as a cooperative game and identify an efficient and stable cost allocation rule. We further show this cost allocation rule induces a weakly incentive compatible mechanism.

4 - Fully Distributed Approach for Optimal Power Flow Calculations

Javad Mohammadi, Carnegie Mellon University, Electrical and Computer Engineering, CMU, Pittsburgh, PA, 15232, United States of America, jmohamma@andrew.cmu.edu

In this talk, we propose a method which enables a fully distributed solution of the DC Optimal Power Flow problem. The approach consists of an iterative procedure that aims at solving the first order optimality conditions in fully distributed manner at both nodal and regional level.

■ SA59

59-Room 110B, CC

Open Pit Mining

Sponsor: ENRE – Natural Resources I – Mining

Sponsored Session

Chair: Alexandra Newman, Professor, Colorado School of Mines, Mechanical Engineering, Golden, CO, 80401, United States of America, anewman@mines.edu

1 - Open Pit Mine Scheduling with Variants on Inventory Considerations

Mojtaba Rezakhah, PhD Student, Colorado School of Mines, Golden, CO, 80401, United States of America, mrezakha@mymail.mines.edu

We present several ways of modeling stockpiling (with and without considering degradation) in open pit mine production scheduling, including (i) individual stockpiles for each block and (ii) binned stockpiles with pessimistic grade estimates. These models are formulated for a currently operational mine and compared to results without stockpiling in order to assess the benefits of stockpiling and to analyze the relationship between milling capacity and stockpiling value.

2 - Models for Inventory Allocation of Erratic-demand Spare Parts in a Multi-echelon System

Andrea Arias, PhD Student, Universidad Catolica de Valparaiso, Avda Brasil 2241, Piso 6, Valparaiso, V, 2362807, Chile, andari20@gmail.com, Jimena Pascual, Timothy Matis

Mining industry has processes that are carried out by complex machines with many parts, which are repairable upon failure. We consider a two-level supply chain inventory system for high cost/low demand repairable items. The aim is to determine inventory levels for each item at every warehouse in order to maximize system availability. We will present a comparative study between two approaches used for addressing this problem from which some interesting ideas for further research are proposed.

3 - Operational Flexibility in the Gold Mining Industry

Panos Markou, IE Business School, Calle Maria de Moina 12 Bajo, Madrid, 28006, Spain, pmarkou.phd2016@student.ie.edu, Daniel Corsten

Gold mining companies are highly exposed to commodity price risks. We examine the effects of using “high-grading” (to combat these risks) on the operational and financial performance of the miners. We find that although high-grading can increase gross margin and profitability, it also increases profit variance and inventory levels. Further, we show that these undesirable effects can be reduced through financial hedging strategies.

4 - Using The Bienstock-Zuckerberg Algorithm for Large-scale, Real-world Mine Planning Problems

Alexandra Newman, Professor, Colorado School of Mines, Mechanical Engineering, Golden, CO, 80401, United States of America, anewman@mines.edu, Marcos Goycoolea, Eduardo Moreno, Daniel Espinoza, Andrea Brickey

We apply an algorithm that solves the LP relaxation of precedence-constrained knapsack problems to mine planning models which determine when to extract a notional three-dimensional block of ore or waste, or when to commence an activity (e.g., development, extraction) so as to maximize net present value, subject to spatial precedence constraints and resource bounds. A simple heuristic provides good integer-feasible solutions. Real-world instances from various settings provide compelling results.

■ SA60

60-Room 111A, CC

Evaluating Student Learning

Sponsor: INFORM-ED

Sponsored Session

Chair: Sadan Kulturel-Konak, Professor, Pennsylvania State University, Berks Campus, Reading, PA, 19609, United States of America, sadan@psu.edu

1 - Assessing Students' Global Awareness

Sadan Kulturel-Konak, Professor, Pennsylvania State University, Berks Campus, Reading, PA, 19609, United States of America, sadan@psu.edu

Students are expected to become increasingly globally aware in order to be better prepared for a career in an international knowledge-based society. We define global awareness knowledge, skills and abilities (KSA) that need to be met for a student to be proficient in global awareness and define an assessment framework based on the Model of Domain Learning (MDL). The preliminary findings for the effectiveness of the proposed global awareness interest assessment will be presented.

2 - A Web-based Peer Evaluation Tool for Professional Skills Assessment

Abdullah Konak, Professor, Penn State Berks, Tulpehocken Road, P.O. Box 7009, Reading, PA, 19610, United States of America, konak@psu.edu

We introduce the Peer Evaluation & Assessment Resource (PEAR), which is a web-based solution that was created to efficiently assess the teamwork skills of students through peer and self-evaluations. The PEAR application allows instructors to form teams and choose a rubric to assess their teamwork skills and contributions. In addition to built-in PEAR rubrics, instructors can also create custom rubrics based on the Model of Domain Learning to better suit their specific courses.

3 - Use of Pretesting to Assess Retention of Prerequisite Knowledge

Jill Wilson, Northwestern University, 2145 Sheridan Rd.,
Room C211, Evanston, IL, 60208, United States of America,
jill.wilson@northwestern.edu, Karen Smilowitz, Barry Nelson

We describe a pretest assessment scheme designed to test student retention of knowledge obtained in prerequisite courses. Although useful in documenting continuous improvement for ABET accreditation, pretests most importantly help identify students who are unprepared for the current course and help faculty to identify course-wide deficiencies that need remediation. We describe content of pretests, details of implementation, and insights gleaned from data collected in the first two years.

4 - Georgia Tech's Systematic Approach to Improving PhD Students' Academic Job Talks and Interviews

Judith Norback, judith.norback@isye.gatech.edu, Alan Erera

Our goal is improving the academic job talks and interviews of IE/OR PhD candidates currently on the job market. We describe the systematic work done to identify instructional activities for the students. The seven steps we took were: 1) observing PhD student INFORMS talks, 2) interviewing faculty to identify what they expect in an excellent talk, 3) conducting a workshop where each student gives a brief presentation and receives feedback from a presentation expert, 4) holding oral skills meetings for instruction and practice, and 5) having a faculty panel discussion of how to conduct interviews. 6) Finally, once a student has arranged an interview, they give a practice talk to their advisers and the presentation expert, and 7) the expert joins them in a final oral skills meeting. Preliminary feedback from students and faculty, and instructional materials, will be shared.

■ SA61

61-Room 111B, CC

Electricity Markets and Renewable Power

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Nur Sunar, Assistant Professor, University of North Carolina, Kenan-Flagler School of Business, Chapel Hill, NC,
United States of America, Nur_Sunar@kenan-flagler.unc.edu

1 - Stochastic Co-Optimization Framework for Renewable Power Generation

Shijie Deng, Georgia Inst of Tech, 755 Ferst Dr, Atlanta, GA,
United States of America, sd111@gatech.edu,
Anthony Papavasiliou

We propose a stochastic programming framework for solving the optimal scheduling problem faced by a renewable power producer that simultaneously participates in multiple markets. Specifically, the renewable-generator participates in both the electricity spot market and the ancillary services market as a price taker. Numerical case studies on the advantages of the proposed strategy for a wind-generator to hedge market uncertainties are carried out with a set of realistic parameters.

2 - Lessons from Large Scale Transmission Planning using Stochastic Programming in WECC

Qingyu Xu, Johns Hopkins University, 3400 North Charles Street,
Baltimore, MD, 21218, United States of America, qxu25@jhu.edu,
Saamrat Kasina, Jonathan Ho, Pearl Donohoo-vallett,
Yueying Ouyang, Benjamin Hobbs

A 21-zone model and a 300-bus model of the western North America interconnection are used to optimize transmission and generation investment and production, facing uncertain economic, regulatory and climate scenarios. The stochastic optima show very different patterns of transmission/generation investment compared to deterministic solutions. The economic impacts of various model simplifications are compared, including the network, number of scenarios, and generator unit commitment.

3 - Supply Function Bidding with Uncertain Supply and Demand: Electricity Markets and Renewable Power

Nur Sunar, Assistant Professor, University of North Carolina, Kenan-Flagler School of Business, Chapel Hill, NC, United States of America, Nur_Sunar@kenan-flagler.unc.edu, John Birge

Motivated by high penetration of renewables into electricity generation mix, we introduce and analyze a supply function competition model with both supply and demand uncertainty. Using the ODE theory, we characterize a supply function equilibrium, and analyze the implications of different penalty schemes and subsidy for equilibrium day-ahead market clearing price, production schedules and actual production quantities of generators. We also calibrate our model based on MISO's data.

■ SA62

62-Room 112A, CC

Optimization Models for Bioenergy Production and Delivery

Sponsor: ENRE – Environment I – Environment and Sustainability

Sponsored Session

Chair: Mohammad Roni, Computational Energy Analyst, Idaho National Laboratory, P.O. Box 1625,, Idaho Falls, ID, 83401,
United States of America, mohammad.roni@inl.gov

1 - Economic, Environmental and Social Optimization of an Integrated Bioenergy and Biofuel Supply Chain

Taraneh Sowlati, University of British Columbia, 2931-2424 Main
Mall, Vancouver, BC, V6T1Z4, Canada, taraneh.sowlati@ubc.ca,
Claudia Cambero

A multi-objective optimization model is proposed for the network design and strategic planning of integrated bioenergy and biofuel supply chains using forestry by-products as feedstock. The objectives of the model are to maximize the NPV, maximize the GHG emissions savings, and maximize the number of direct jobs created. The model was applied to a case study in British Columbia, and a set of Pareto-optimal solutions was obtained using the augmented ϵ -constraint (AUGMECON) method.

2 - Analyzing Stranded Biomass Resource: Regional Case Study in the United States of America

Mohammad Roni, Computational Energy Analyst, Idaho National Laboratory, P.O. Box 1625,, Idaho Falls, ID, 83401, United States of America, mohammad.roni@inl.gov, Ross Hays, Damon Hartley, Erin Searcy

National assessment such as Billion Ton Study has projected biomass resources to meet biofuel production targets. But resources are often inaccessible because of unfavorable economics—labeled as “stranded resources”. This study quantifies stranded resources under conventional and proposed distributed depot based supply design. A mixed integer, linear programming is formulated to quantify the stranded resource. We perform a regional case study based on agricultural residues and energy crops.

3 - Potential Savings and Cost Allocations for Forest Fuel Transportation in Sweden

Mario Guajardo, Assistant Professor, NHH Norwegian School of Economics, Helleveien 30, Bergen, 5045, Norway,
Mario.Guajardo@nhh.no, Patrik Flisberg, Mikael Frisk, Mikael Ronnqvist

Efficient logistics is crucial to make forest fuels a competitive source of bioenergy. By using optimization models and a decision support system, we study alternatives to lower the costs in a case that accounts for all forest fuel transport operations in Sweden. This involves 200,000 transports of about 6.1 million tons of forest biomass. We identify potential savings of about 22%. As one of the alternatives is collaboration, we test cost allocation methods based on cooperative game theory.

4 - GIS-Based Allocation of Lignocellulosic Biorefineries and Depots

Daniela S. Gonzales, Texas A&M University, College Station, TX,
United States of America, anielasofia Gonzales@gmail.com,
Stephen W. Searcy

Our objective was to determine the structure of the likely biomass feedstock supply chain that will develop in the US based on the DOE concept of an advanced uniform feedstock format; the predicted availability of biomass (presented in the 2011 Billion Ton Study Update), the geographic location of suitable lands for biomass (based on the 2011 National Land Cover Data), and the transportation infrastructure. We use ArcGIS tools to identify the location of biorefineries and depots in the US.

■ SA63

63-Room 112B, CC

Nicholson Student Paper Competition

Cluster: Nicholson Student Paper Competition

Invited Session

Chair: Illya Hicks, Rice University, 6100 Main MS-134, Houston, TX, 77005, United States of America, ivhicks@rice.edu

1 - Nicholson Student Paper Competition

Illya Hicks, Rice University, 6100 Main MS-134, Houston, TX, 77005, United States of America, ivhicks@rice.edu

This session highlights the finalists for the 2015 George Nicholson Student Paper Competition.

■ SA64

64-Room 113A, CC

Experts & Algorithms

Sponsor: Decision Analysis

Sponsored Session

Chair: Jason Merrick, Professor, Virginia Commonwealth University, P.O. Box 843083, 1015 Floyd Avenue, Richmond, VA, 23284, United States of America, jrmerrick@vcu.edu

1 - Experts & Algorithms: Lessons in Blending Analytics with Subjective Judgment

Cade Massey, Practice Professor, University of Pennsylvania, 3730 Walnut St., Huntsman 554, Philadelphia, PA, 19104, United States of America, cadem@wharton.upenn.edu, Jason Merrick

We share insights and tools gleaned from an 18-month project implementing an analytics-based decision model for the admissions process at a large graduate school. Issues include preference elicitation, forecasting, optimization and group decision-making. We address both the theoretical and practical challenges involved.

2 - Technology Implementation Decisions: A Multi-objective, Multi-Stakeholder Case Study

Ed Cook, Capital One, ed.cook@capitalone.com, Jason Merrick

Major corporate technology adoption decisions are based on the financial case and take an organization-wide viewpoint. However, technology implementation decisions are different in nature and affect various stakeholders across the organization with multiple, conflicting objectives. Our case study examines how to implement a major technology change across a thousand branches of a national bank and to avoid the costly delays and problems that afflicted other banks implementing this technology.

3 - Overcoming Algorithm Aversion

Berkeley Dietvorst, Doctoral Student, The Wharton School, 3730 Walnut St, Suite 500, Philadelphia, PA, 19104, United States of America, diet@wharton.upenn.edu, Joe Simmons, Cade Massey

How can we get forecasters to use algorithms instead of human judgment? In four experiments, participants decided whether to use an algorithm's forecasts or their own to complete a forecasting task. In the treatment conditions we gave participants the option to modify the algorithm's forecasts if they chose to use it. Participants chose to use the algorithm much more often when they could modify its forecasts, even when the amount that they could modify its forecasts was severely restricted.

4 - Failure to Replicate Hyperbolic Discounting in Large-scale Studies

Yael Grushka-Cockayne, Assistant Professor, Darden School of Business, University of Virginia, FOB 163, 100 Darden Blvd, Charlottesville, VA, United States of America, grushkay@arden.virginia.edu, Daniel Read, Casey Lichtendahl

We propose a simple model in which future income risk can explain hyperbolic and anti-hyperbolic discounting. We present results from multiple experimental studies involving thousands of participants, some of whom were asked Gallup-type questions about future income. Overall, we fail to replicate hyperbolic discounting. Instead, we find that anti-hyperbolic discounting effects are large and reliable across studies, with little dependency on income expectations.

■ SA65

65-Room 113B, CC

Joint Session DAS/ENRE: Panel Discussion: Climate Assessment and Decision Analysis

Sponsor: Decision Analysis & ENRE

Sponsored Session

Moderator: Melissa Kenney, Research Assistant Professor, University of Maryland, 5825 University Research Court, Suite 4001, College Park, MD, 20740, United States of America, kenney@umd.edu

1 - Decision Analysis in the IPCC and National Climate Assessment

Robert Lempert, Senior Scientist, RAND, 1776 Main St, Santa Monica, CA, 90407, United States of America, lempert@rand.org

Decision and risk analysis is playing an increasingly important role in scientific assessments of climate change. This talk will describe this role, drawing on the speaker's experience as a lead author of the decision support chapters of both the US National Climate Assessment and Intergovernmental Panel on Climate Change (IPCC) Working Group II Fifth Assessment Report.

2 - Climate Change Decision Support Systems: Validation Required

Richard Moss, Senior Scientist, Pacific Northwest National Lab, Joint Global Change Research Institute, 5825 University Research Ct. Ste. 3500, College Park, MD, 20740, United States of America, rhm@pnnl.gov

An increasing number of climate change decision support systems are being offered for use. Overall, little is known about the effectiveness of many of these tools. Failure to assess existing tools and practices is setting the research community up for a loss of trust. This paper describes aspects of climate-related decision support that require evaluation and argues that the decision analysis community has a leadership role to play in this process through the US National Climate Assessment.

3 - Climate Indicators: Do They Help or Hinder Decision Processes?

Melissa Kenney, Research Assistant Professor, University of Maryland, 5825 University Research Court, Suite 4001, College Park, MD, 20740, United States of America, kenney@umd.edu

Though in Decision Analysis indicators measure objectives, in practice indicators may not be linked to specific decision contexts. I will describe an effort to develop recommendations to the U.S. Global Change Research Program for a wide-reaching indicator system to inform decision about climate changes and impacts. I will discuss preliminary work to determine if these kinds of indicators are useful for decision structuring or as attributes in different decision processes.

4 - Discussant

Robert O'Connor, roconnor@nsf.gov

5 - Risk and Resilience for Climate Change

Igor Linkov, Risk and Decision Science Team Lead, US Army Corps of Engineers, Engineer R&D Center, 696 Virginia Rd, Concord, MA, United States of America, Igor.Linkov@usace.army.mil, Catherine Fox-lennt

An urgent need exists to complement the existing knowledge-base of climate change risk by further developing frameworks enabling system-wide analysis. A promising lens is resilience, a system property that can be planned for and managed irrespective of adverse impact or system vulnerability. This presentation will summarize our ideas and case study on the use of risk-based decision making and decision-driven resilience management.

■ SA66

66-Room 113C, CC

Airlines Network Planning and Scheduling Applications

Sponsor: Aviation Applications

Sponsored Session

Chair: Ahmed Abdelghany, Associate Professor, Embry-Riddle Aeronautical University, 600 S. Clyde Morris blvd, Daytona Beach, United States of America, abdel776@erau.edu

1 - Stochastic Fleeting with Itinerary Attractiveness in MapReduce

Diego Klabjan, Professor, Northwestern University, Evanston IL, United States of America, d-klabjan@northwestern.edu

Stochastic fleeting models with discrete choice based on attractiveness are computationally challenging. Parallel computing via Hadoop and MapReduce have become ubiquitous. We study algorithms under the MapReduce parallel framework for stochastic fleeting with attractiveness.

2 - Airline Trip Segmentation

Manini Madireddy, Sabre, 3150 Sabre Dr, Southlake, TX, 76092,
United States of America, Manini.Madireddy@sabre.com,
Aditya Kothari, Goda Doreswamy, Sergey Shebalov,
Ramasubramanian Sundararajan

We consider the problem of recommending customized product bundles to airline customers based on their behavior and preferences. We present an approach to correlate candidate product designs to traveler behavior, based on historical evidence of travel and purchase patterns. We use clustering algorithms to segment travelers and further demonstrate how the goodness of a clustering result can be measured through the extent to which it enables good product design.

3 - Predicting Operational Performance for Airline Schedules through Simulation

Mahmood Zangui, Senior Systems Engineer, Optym, 7600 NW
5th Place, Gainesville, FL, 32607, United States of America,
mahmood.zangui@optym.com, Eric Camacho, Yu-shiu Lin,
Pranav Gupta, Jeff Borges, Lonny Hurwitz

An airline schedule is a highly interconnected network; where one disruption can propagate through the network and delay several flights. Airlines are interested in measuring the robustness of their schedules against such disruptions, and in forecasting their operational performance. We have built a simulation model that can predict key performance indices for given schedules. We will share our modeling approach, challenges we faced, and lessons learned during development of this model.

4 - A Hybrid Model for Airline Flight Frequency and Scheduling Optimization

Ahmed Abdelghany, Associate Professor, Embry-Riddle
Aeronautical University, 600 S. Clyde Morris Blvd, Daytona
Beach, FL, United States of America, abdel776@erau.edu,
Khaled Abdelghany, Farshid Azadian

An optimization model that considers the joint optimization of airline flight frequency and flight scheduling decisions is presented. The model takes into consideration the schedule of other competing airlines. Several experiments are presented to illustrate the model capabilities.

SA67

67-Room 201A, CC

City Logistics and Sustainable Urban Freight Systems - I

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Johanna Amaya, Rensselaer Polytechnic Institute, 110 8th St.
JEC 4037, Troy, NY, 12180, United States of America, amayaj@rpi.edu

1 - Public Sector Initiatives Sustainable Urban Freight Systems Part I

Jeffrey Wojtowicz, RPI, United States of America, wojtoj@rpi.edu,
Cara (xiaokun) Wang, Johanna Amaya, Jose Holguin-Veras,
Miguel Jaller, Carlos A. Gonzalez-Calderon, Ivan Sanchez-Diaz,
Stacey Hodge, Michael Browne, Daniel Haake

Transportation policy should ensure freight is moved efficiently as it is a physical manifestation of the economy. From this study, planners are provided with guidelines to implement initiatives addressing freight issues. Initiatives were organized as part of a continuum, from supply to demand side; underpinned by stakeholder engagement. This paper focuses on supply side and covers infrastructure management, parking and loading, vehicles, and traffic management along with stakeholder engagement.

2 - Toward a Freight-friendly Built Environment: A Mixed Method Approach

Kazuya Kawamura, Associate Professor, University of Illinois at
Chicago, MC348, 412 S. Peoria St., Chicago, IL, 60607,
United States of America, kazuya@uic.edu, Takanori Sakai

This study uses both parking violation data for quantitative analysis and video images collected from pole-mounted portable video recorders for qualitative contextual assessment to shed light on the relationship between delivery vehicle activities and the built environment including streetscape in Chicago.

3 - Electric Vehicle Routing Problem

Jane Lin, University of Illinois at Chicago, 842 W. Taylor Street
(M/C 246), Chicago, IL, 60607, United States of America,
janelin@uic.edu, Wei Zhou

This paper presents a general Electric Vehicle Routing Problem (EVRP) that finds the optimal routing strategy with minimal travel time cost and energy cost as well as number of EVs dispatched. As demonstrated with a case study in Austin TX, the effect of vehicle load on routing strategy cannot be ignored. Compared to diesel truck VRP, EVRP has comparable travel time and distance but long en-route re-charging time. Lastly, the network topology greatly affects the routing strategies.

4 - A Plugin Hybrid Electric Vehicle Routing Problem with Recharging and Refueling

Matthew Roorda, Associate Professor, University of Toronto, Civil
Engineering Department, University of Toronto, Toronto, On,
M5S 1A4, Canada, roordam@ecf.utoronto.ca, Mehdi Nourinejad,
Sina Bahrami, Glareh Amirjamshidi

This paper presents a Hybrid Electric Vehicle Routing Problem which specifically considers Electric Vehicles and Plugin Hybrid Electric Vehicles. A modified Clarke Wright algorithm is proposed. The model is applied to the City of Toronto. The results of the model provide managerial insight. For instance, the analysis shows the total number of Electric Vehicles is insensitive to the battery capacity but sensitive to the fuel tank capacity of Plugin Hybrid Electric Vehicles.

SA68

68-Room 201B, CC

Geospatial Analysis in Transportation and Logistics

Sponsor: Transportation, Science and Logistics

Sponsored Session

Chair: Eunsu Lee, Assistant Professor, New Jersey City University, 2039
John F. Kennedy Blvd, Jersey City, NJ, 07305, United States of
America, elee3@njcu.edu

1 - Spatial Matching Models: Freight Demand Analyses Considering Partner Selection and Joint Decision

Dapeng Zhang, Doctoral Student, Rensselaer Polytechnic
Institute, zhangd9@rpi.edu, Cara (xiaokun) Wang

Freight demand has not been understood comprehensively due to unique features: the freight activity is a result of collaboration of multiple agents. In specific, the collaboration can be observed by partner selection and joint decision making processes. As existing models cannot capture such features, this research develops an innovative model, spatial matching model, to fill the void. The proposed model is specified based on freight behavior, validated by experiments, and explained by examples.

2 - Stochastic Market Boundaries and Fertilizer Plants

Sumadur Shakyia, Assistant Professor, California State Univ.
Monterey Bay, 100 Campus Center, Seaside, CA, 93955,
United States of America, sshakyia@csumb.edu, William Wilson,
Bruce Dahl

The study analyzes spatial competition among nitrogen-based fertilizer plants in United States, to gain insight on viability of newly announced fertilizer plants and structure of supply chain, now and in future, at a macro level using locational information; linear and mixed-integer based optimization techniques and geographical information systems methods are applied to arrive at current spatial equilibrium and most likely future cases for structure of supply chain in United States.

3 - An Agent-based Modeling for Remotely Piloted Aircraft (RPAS) Package Delivery in Rural Area

Ali Rahim Taleqani, Research Assistant, Upper Great Plains
Transportation Institute, Dept. 2880, P.O. Box 6050, Fargo, ND,
58108-6050, United States of America,
ali.rahimtaleqani@ndsu.edu, Eunsu Lee

The purpose of this paper is to examine the agent-based modeling concept in the context of urgently-needed package delivery system by means of Remotely Piloted Aircraft (RPA). The target market is assumed to be in rural area in Cass County North Dakota where travelling distance to major markets are longer and accessibility is not well developed. The implementation is constructed over Agent Analyst simulation platform in ArcGIS software.

4 - Analysis of Alabama Statewide Freight Flow after the International Capacity Expansion

Jaehoon Kim, University of Alabama in Huntsville, 301
Sparkman Dr., Technology Hall S239, Huntsville, AL, 35899,
United States of America, jk0012@uah.edu, Michael Anderson

This study presents a methodology to estimate state level of freight flow. Using FAF3 database, disaggregated state level O/D matrices are developed and applied to the State of Alabama. Thereafter, the expected freight flow variation affected by the Panama Canal expansion is applied to the O/D matrices. The developed O/D matrices are assigned to the statewide network. The study identifies current Alabama freight flow pattern and new freight flow trend after the Panama Canal expansion.

5 - Facility Location Problem Considering Time Window and Land use Plan using GIS

Eunsu Lee, Assistant Professor, New Jersey City University, 2039 John F. Kennedy Blvd, Jersey City, NJ, 07305, United States of America, elee3@njcu.edu, Sumadhur Shakya, Alan Dybing

This paper investigates the facility location problem through network space, considering traversable truck roads, thereby providing a strategic decision for identifying a depot location in consideration of vehicle routings from a real application. This study provides a ready-to-use example of how to adopt state-of-the-art spatial technology and operations research using Geographic Information Systems (GIS), and bring it to state-of-practice.

SA69

69-Room 201C, CC

Facility Location and Inventory Routing

Sponsor: Transportation, Science and Logistics

Sponsored Session

Chair: Natasha Boland, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332-0205, United States of America, natashia.boland@isye.gatech.edu

1 - Facility Location Design under Continuous Traffic Equilibrium

Zhaodong Wang, University of Illinois, 205 N. Mathews Ave, Urbana, IL, United States of America, zwang137@illinois.edu, Yanfeng Ouyang

This paper proposes both a continuum approximation model and a discrete mixed-integer program model to solve the facility location problem under traffic congestion in continuous space. Customized algorithms are developed and analytical properties are presented. Numerical examples show the advantages of the continuous models and shed managerial insights.

2 - Winter is Coming: A Robust Optimization Approach to Inventory Routing

Joel Tay, Graduate Student, Operations Research Center, MIT, 77 Massachusetts Ave, Bldg. E40-149, Cambridge, MA, 02139, United States of America, joeltay@mit.edu, Swati Gupta, Dimitris Bertsimas

We consider the finite horizon inventory routing problem with uncertain demand, e.g. supplying residential heating oil to customers. Current techniques that solve this problem with stochastic demand do not scale to real-world data sizes. We propose a MIP formulation using robust optimization that is made tractable with heuristic route selection, warm starts and column generation. We show promising computational results that demonstrate scalability to real-world applications.

3 - A Matheuristic for the Multi-vehicle Inventory Routing Problem

Natashia Boland, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332-0205, United States of America, natashia.boland@isye.gatech.edu, Cristina Archer, Grazia Speranza

We consider the inventory routing problem in which a supplier must replenish a set of customers using a limited fleet of capacitated vehicles over a discrete time horizon. The goal is to minimize the total cost of the distribution, comprising the inventory costs at supplier and customers, and the routing cost. We present a matheuristic, combining tabu search and integer programming formulations. Extensive computational experiments on benchmark instances show the effectiveness of the method.

SA70

70-Room 202A, CC

Railway Applications Section Student Paper Award

Sponsor: Railway Applications

Sponsored Session

Chair: April Kuo, BNSF Railway, 2400 Western Center Blvd., Fort Worth, TX, United States of America, April.Kuo@BNSF.com

1 - Railway Applications Student Paper Award

April Kuo, BNSF Railway, 2400 Western Center Blvd., Fort Worth, TX, United States of America, April.Kuo@BNSF.com

Rail Applications Section (RAS) sponsored a student research paper contest on analytics and decision making in railway applications. Papers must advance the application or theory of OR/MS for improvement of freight or passenger railway transportation, and it must represent original research that has not been published elsewhere by the time it is submitted. Authors of the First, Second and Third Place award winning papers will present their papers in this session.

SA71

71-Room 202B, CC

Transportation Network Analysis and Optimization

Sponsor: TSL/Urban Transportation

Sponsored Session

Chair: Andres Medaglia, Professor, Universidad de los Andes, Cra 1 Este No 19A - 40, Bogota, Colombia, amedagli@uniandes.edu.co

1 - On the Robust Shortest Path Problem:

A Pulse Algorithm Approach

Daniel Duque, Instructor, Universidad de los Andes, Cr 1E N 19A-40, Bogota, Colombia, d.duque25@uniandes.edu.co, Andres Medaglia

In this variant of the robust shortest path problem, the cost of traversing an arc is given by a discrete set of scenarios. The problem is then to find a (robust) path that takes into account the information arising from the multiple cost realizations of the possible scenarios. To account for a robust path, we adopt the bw-robustness criterion, which ameliorates the dramatic role played by the worst case analysis. To solve the problem, we extend the pulse algorithm, a general-purpose solution strategy that has been used on shortest path problems with side constraints. The proposed algorithm compares favorably against an integer programming approach both in terms of speed and scalability.

2 - Reliability of Interdependent Urban Infrastructure Network:

Failure Propagation and Consequential Social Impact

Liquan Lu, UIUC, United States of America, liquanlu2@illinois.edu, Yanfeng Ouyang, Xin Wang

Modern city relies on a network of multiple interdependent infrastructure systems, hence more vulnerable. Random or premeditated infrastructure disruption can propagate to large areas and cause social disasters. The system reliability is investigated under both deterministic and stochastic disruption propagation and social impacts are evaluated by a user equilibrium model.

3 - Lagrangian Relaxation Solution Approach for the Vehicle Routing Problem with Pickup and Delivery

Monirehalsadat Mahmoudi, Arizona State University, School of Sustainable Engineering and the Built Environment, Tempe, AZ, United States of America, mmahmoudi@asu.edu, Xuesong Zhou

We propose a new time-discretized multi-commodity network flow model for the pickup and delivery problem with time windows based on the integration of vehicles' carrying-states within space-time transportation networks. By a Lagrangian relaxation approach, the primal multi-vehicle routing problem is decomposed to a sequence of single vehicle routing sub-problems with Lagrangian multipliers for individual passengers' request, each can be solved by a forward dynamic programming solution algorithm.

4 - Combined Maintenance-routing Optimization: The Case of a Water Utility

Andres Medaglia, Professor, Universidad de los Andes, Cra 1 Este No 19A - 40, Bogota, Colombia, amedagli@uniandes.edu.co, Daniel Duque, Raha Akhavan-Tabatabaei, John E. Fontecha, Juan Pablo Rodriguez

The combined maintenance-routing optimization problem deals with planning and scheduling maintenance operations for a set of geographically-distributed sites that are subject to non-deterministic failures. To solve this problem, a maintenance model determines the optimal time to perform preventive maintenance operations for each site; while a routing optimization engine schedules visits of a set of technicians that perform the operations. We present a case study in the city of Bogot., where the water utility needs to perform maintenance operations to prevent sediment-related blockages of the sewer system.

■ SA72

72-Room 203A, CC

Predictive Modeling and Control for Additive Manufacturing

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Qiang Huang, Associate Professor, University of Southern California, GER 240, USC, Los Angeles, CA, United States of America, qiang.huang@usc.edu

Co-Chair: Arman Sabbaghi, Assistant Professor Of Statistics, Purdue University, Department of Statistics, 150 N. University Street, West Lafayette, IN, 47907, United States of America, sabbaghi@purdue.edu

1 - Bayesian Additive Modeling for Quality Control of 3D Printed Products

Arman Sabbaghi, Assistant Professor Of Statistics, Purdue University, Department of Statistics, 150 N. University Street, West Lafayette, IN, 47907, United States of America, sabbaghi@purdue.edu, Tirthankar Dasgupta, Qiang Huang

Three-dimensional (3D) printing is a disruptive technology with the potential to revolutionize manufacturing. However, control of product deformation remains a major issue. Quality control requires a generic methodology that can predict deformations for a wide range of designs based on data available for a few previously manufactured products. We develop a Bayesian methodology to update prior conceptions of deformation for a new design based on printed products of different shapes.

2 - Predictive Modeling of in-plane Geometric Deviation for 3d Printed Freeform Products

He Luan, University of Southern California, GER 236, USC, Los Angeles, CA, United States of America, hluan@usc.edu, Qiang Huang

Although additive manufacturing holds great promise, dimensional geometric accuracy remains a critical issue and lacks of generic solve method. Our work fills the gap by establishing a general model predicting in-plane deviations of AM built freeform products. Built upon our previous model for cylinder and polyhedron, this work directly predicts freeform shape deviations from CAD design. SLA experiments validated this method, indicating the prospect of optimal compensation for freeform products.

■ SA73

73-Room 203B, CC

Data Analytics for Reliability Evaluation and Maintenance Optimization I

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Qingyu Yang, Assistant Professor, Wayne State University, 4815 4th street, Room 2167, Detroit, MI, 48202, United States of America, qyang@wayne.edu

Co-Chair: Eunshin Byon, Assistant Professor, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, ebyon@umich.edu

1 - Modeling of Degradation Data from Disjoint Time Intervals

Xiao Liu, liuxiao@sg.ibm.com

Motivated by real-life problems, this paper presents a statistical model for degradation data collected from disjoint time intervals (blocks). Within each block, high-frequency degradation measurements are available. Of interest is the extreme (i.e., maximum or minimum) of the degradation level within each interval.

2 - A Generic Method for Analyzing Complex Data with Covariates

Haitao Liao, Associate Professor, The University of Arizona, The University of Arizona, Tucson, AZ, 85716, United States of America, hliao@email.arizona.edu, Yiwen Xu, Neng Fan

In this research, we study an automated modeling approach to constructing phase-type (PH) distributions via mathematical optimization and develop PH-based models to analyze complex data with covariates.

3 - A Discrete Semi-markov Model to Determine Optimal Repair Decisions for Trend-renewal Process

Ernie Love, Professor Emeritus, Simon Fraser University, 8888 University Drive, Burnaby, BC, v5a1r5, Canada, love@sfu.ca, Qingyu Yang, Wujun Si

The failure and repair process of a repairable machine (system) is modeled as a trend-renewal process permitting the modeling of imperfect repairs. The state of such a system can be characterized by the real age of the system and the failure count permitting the use of a two-state semi-Markov model to determine optimal repair/replacement decisions. Threshold type policies are established. Failure data from a cement kiln is used to demonstrate the approach.

4 - A Mixed Effect Kijima Model and Application in Optimal Maintenance Analysis

Wujun Si, PhD Student, Wayne State University, Detroit, MI, 48202, United States of America, wujun.si@wayne.edu, Qingyu Yang

The Kijima model has been widely applied to analyzing repairable systems with general repair efficiency. Most existing studies treat the repair efficiency as a fixed value while it can vary among a series of repair actions. In this paper, we propose a mixed effect Kijima model to characterize the variation of repair efficiency. An SAEM algorithm is developed for model parameter estimation. Based on the proposed model an optimal maintenance analysis is developed as a case study.

■ SA74

74-Room 204A, CC

IEEE T-ASE Invited Session: Manufacturing Systems Automation

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Jingshan Li, Professor, 1513 University Ave, Madison, WI, 53706, United States of America, jli252@wisc.edu

1 - A Quality Flow Model in Battery Manufacturing Systems for Electric Vehicles

Feng Ju, Assistant Professor, Arizona State University, Tempe, AZ, 53705, United States of America, jeffrey0930@gmail.com

In this paper, we present a flow model to analyze product quality in battery assembly lines with 100% inspections and repairs for defective parts. A Markov chain based model is introduced to analyze quality propagations along the battery production line. Analytical expressions of final product quality are derived and structural properties are investigated. A case study is presented to illustrate the applicability of the method.

2 - Energy-efficient Production Systems through Schedule-based Operations

Liang Zhang, University of Connecticut, 371 Fairfield Way UNIT 4157, Storrs, CT, 06269-4157, United States of America, liang@engr.uconn.edu, Jorge Arinez, Stephan Biller, Guorong Chen

Control of production operations is considered as one of the most economical methods to improve energy efficiency in manufacturing systems. This paper investigates energy consumption reduction in production systems through effective scheduling of machine startup and shutdown. The theoretical methods are applied through a case study in automotive paint shop operations.

3 - Adaptive Sensor Allocation Strategy for Process Monitoring and Diagnosis in a Bayesian Network

Kaibo Liu, Assistant Professor, UW-Madison, 1513 University Avenue, Madison, 53706, United States of America, kliu8@wisc.edu, Xi Zhang, Jianjun Shi

This talk proposes a novel approach to adaptively reallocate sensor resources based on online observations in a Bayesian Network model, which can enhance both monitoring and diagnosis capabilities. The proposed method addresses two fundamental issues in an integrated manner: when to reallocate sensors and how to update sensor layout. Case studies are performed on a hot forming and a cap alignment process to illustrate the performance of the proposed method under different fault scenarios.

4 - Online Steady-state Detection for Process Control using Multiple Change-point Models

Shiyu Zhou, Professor, University of Wisconsin-Madison, Department of Industrial and Systems Eng, 1513 University Avenue, Madison, WI, 53706, United States of America, shiyuzhou@wisc.edu, Jianguo Wu, Yong Chen, Xiaochun Li

Steady-state detection is critical in process performance assessment, fault detection and process automation and control. We proposed a robust on-line steady-state detection algorithm using multiple change-point model and particle filtering techniques. Extensive numerical analysis shows that the proposed new method is more accurate and robust than the other existing methods.

■ SA75

75-Room 204B, CC

Digital Manufacturing

Cluster: Advanced Manufacturing

Invited Session

Chair: Binil Starly, Associate Professor, North Carolina State university, 406 Daniels Hall, Raleigh, NC, 27607, United States of America, bstarly@ncsu.edu

1 - Mining Dynamic Recurrences in Nonlinear and Nonstationary Systems for Innovative Manufacturing

Hui Yang, Associate Professor, Pennsylvania State University, 310 Leonhard Building, Industrial and Manufacturing Eng., State College, PA, 16801, United States of America, huy25@psu.edu, Yun Chen

Nonlinear dynamics arise whenever multifarious entities of a system cooperate, compete, or interfere. Effective monitoring and control of nonlinear dynamics will increase manufacturing system quality and integrity, thereby leading to significant economic and societal impacts. This talk will present novel nonlinear methodologies that mine dynamic recurrences from in-process big data for real-time manufacturing system informatics, monitoring, and control.

2 - In Situ Printing – An Alternative Three Dimensional Laden Structure Fabrication Method

Yigong Liu, Drexel University, 3141 Chestnut St., Mechanical Engineering & Mechanics (MEM), Philadelphia, PA, 19104, United States of America, yl525@drexel.edu

Recapitulating a structure that mimics the anatomic geometries and intratissue cell distribution as in live organism is a major challenge of tissue engineering nowadays. This article presents a Solid Freeform Fabrication (SFF) based in situ printing method which enables simultaneous cross-linking at ambient environmental conditions (temperature and pressure). 3D laden structure with stability time of 14 days in cell culture environment was achieved by the in situ printing method.

3 - Maskless Fabrication of Cell-laden Microfluidic Chips

Qudus Hamid, Drexel University, 3141 Chestnut St, Philadelphia, PA, 19104, United States of America, qh25@drexel.edu, Wei Sun, Chengyang Wang, Yigong Liu

The utilization of the microfabrication technique to fabricate advanced computing chips has exponentially increased in the last few decades. Though many conventional microfabrication techniques today uses very harsh chemicals, the authors believe that the manipulation of system components and fabrication methods may aid in the utilization of the microfabrication techniques used in fabricating computer chips to develop advanced biological microfluidic systems.

■ SA76

76-Room 204C, CC

Sustainable Infrastructure

Sponsor: Simulation

Sponsored Session

Chair: Hakob Avetisyan, Assistant Professor, California State University, Department of Civil and Environmental En, 800 N. State College Blvd, Fullerton, CA, 92834, United States of America, havetisyan@fullerton.edu

1 - A Genetic Algorithm Based Multi-objective Resource Utilization Model for Construction Projects

Amir Movafegh, California State University, Department of Civil & Environmental Engi, 800 N. State College Blvd., Fullerton, CA, 92834, United States of America, amirmvffgh@csu.fullerton.edu, Hakob Avetisyan

Construction projects are traditionally scheduled assuming unlimited resources. Low efficiency of resource use and the ignorance of limited resource availability are the problems of these techniques. The current trend is towards sustainable construction where the resource-constrained scheduling technique seems more promising. In this study a multi-objective resource utilization model was developed to improve the efficiency level of resources and minimize the peak resource demand of the project.

2 - Use of Bayesian Network for Improving Value for Money Analysis

Deepak Sharma, Assistant Professor, Department of Civil and Environmental Engineering, California State University Fullerton, 800 N State College Blvd, Engineering Building 311, Fullerton, CA, 92831, United States of America, dsharma@fullerton.edu

Value for Money (VfM) analysis is a gateway to Public Private Partnerships (PPPs). Although VfM is the most versatile tool to justify the use of PPPs it has two limitations. First, the analysis cannot integrate qualitative and quantitative outcomes which allows for subjective decision making. Second, the analysis is quiet about risks that are exogenous and have low probability of occurrence. This work uses Bayesian Networks (BN) and simulation to address the shortcomings.

3 - Non-permutation Flowshop with Dependent Set-up Times and Missing Operations

Shaya Sheikh, Visiting Assistant Professor, University of Baltimore, 10 Ecoway Ct., Apt. 1A, Towson, MD, 21286, United States of America, ssheikh@ubalt.edu

In this paper, a mixed-integer linear programming (MILP) model is developed to solve non-permutation flowshop problem with objective of minimizing makespan and increasing service level. Setup times are assumed to be dependent to sequence of jobs on each stage and jobs are allowed to skip one or more stages. The effectiveness and robustness of the model is analyzed and assessed using a case study. A heuristic for finding initial solutions with promising quality is presented.

4 - Environmental System Modeling and Simulation of Atmospheric Fate of Sulfur-dioxide

Sudarshan Kurwadkar, Assistant Professor, California State University - Fullerton, 800 N. State College Blvd, Fullerton, CA, 92833, United States of America, skurwadkar@fullerton.edu

The objective of this study is to illustrate the transformation and deposition of various sulfur compounds using STELLA software for simulations and visualizations to demonstrate the effectiveness of a system-based approach to model environmental processes. This study documents the effectiveness of STELLA software in modeling selected environmental processes such as transformation and deposition of sulfur dioxide in the atmosphere.

5 - Defining Sustainability Index for Construction Equipment and Minimizing Costs and Emissions

Hakob Avetisyan, Assistant Professor, California State University, Department of Civil and Environmental Eng, 800 N. State College Blvd, Fullerton, CA, 92834, United States of America, havetisyan@fullerton.edu

The aim of the research was to develop a measure for assessing the sustainability of construction equipment as "Sustainability Index" (SI) that can be used as a component for construction projects sustainability criteria. The other goal was using SI for minimizing costs and emissions from construction equipment through math modeling. Extended analyses were conducted to collect data and through surveys to statewide contractors. Results indicate that similar approach can be applied nationwide.

■ SA77

77-Room 300, CC

Supply Chain Management I

Contributed Session

Chair: Niu Yu, Huazhong University of Science & Technology, 1037 Luoyu Road, Wuhan, China, nyu@hust.edu.cn

1 - The Value of Demand Forecast Updates in a Supply Chain under Asymmetric Information

James Cao, University of Saskatchewan, 118 Chubb Cove, Saskatoon, SK, S7T0E7, Canada, cao@edwards.usask.ca

We explore the role of forecast updating in a supply chain with asymmetric demand information, where a supplier sells to a downstream retailer who benefits from demand updates when sales are realized in each period. Although the supplier is unable to observe the demand, it is possible to infer the state of demand through the retailer's ordering activity. In each period the supplier attempts to extract as much profit as possible based upon her best guess regarding the state of the market.

2 - Dynamic Resource Allocation in Supply Chain Network Systems

Nasim Nezamoddini, SUNY at Binghamton, Binghamton, NY, United States of America, nasim.nezam@gmail.com, Sarah Lam

The robust network design with two different types of uncertainties including uncertainties in environment and system itself is studied. The multi-commodity supply chain network with suppliers, manufacturing plants, distribution centers and markets is considered as a typical network system. The mathematical model is introduced reflecting effect of stochastic variables such as demand, facilities and performance failures. The new method is presented to solve presented multi-stage dynamic model.

3 - Capacity Allocation with Demand Competition: Uniform, Proportional, and Lexicographic Mechanisms

Niu Yu, Huazhong University of Science & Technology, 1037 Luoyu Road, Wuhan, China, nyu@hust.edu.cn, Jianbin Li, Zhixin Liu

We examine capacity allocation mechanisms in a two-echelon supply chain comprising a monopoly supplier and duopoly retailers with asymmetric market powers and demand competition. The supplier allocates limited capacity to retailers according to uniform, proportional, or lexicographic mechanisms. Our results show that regardless of whether retailer market powers are symmetric or asymmetric, lexicographic allocation, regardless of order priority by retailer, is the best choice for the supplier.

4 - Approximate Dynamic Programming and Real Options Approaches for Sourcing Strategies under Risks

Purushottam Meena, Assistant Professor, NYIT, School of Management, Old Westbury NY 11568, United States of America, pmeena@nyit.edu

This paper demonstrates the use of real options for the valuation of different sourcing strategies for supply disruptions risk management. The Approximate Dynamic Programming (ADP) approach is used to solve the problem. The results of ADP are compared with backward recursion to benchmark the performance of ADP.

■ SA78

78-Room 301, CC

Managing Supply Chain Disruptions

Contributed Session

Chair: Hsin-Tsz Kuo, National Taiwan University, No.1, Sec. 4, Roosevelt Road, Taipei, 10617, Taiwan - ROC, d01741003@ntu.edu.tw

1 - Topological Resilience Analysis of Supply Networks under Random Disruptions and Targeted Attacks

Wenjun Wang, University of Iowa, S283 Pappajohn Business Building, Iowa City, IA, 52242, United States of America, wenjun-wang@uiowa.edu, Nick Street, Renato De Matta

We exploit the resilience embedded in the supply-network topology by investigating the multiple-path reachability of each demand node to other nodes, and propose a novel network resilience metric. We also develop new supply-network growth strategies that reflect the heterogeneous roles of different types of nodes in the network. We demonstrate the validity of our resilience metric and experimentally show the effectiveness of our growth model.

2 - Post-disaster Disruptive Crop Supply Chain Resilience with Stockpile Hoarding

Hsin-Tsz Kuo, National Taiwan University, No.1, Sec. 4, Roosevelt Road, Taipei, 10617, Taiwan - ROC, d01741003@ntu.edu.tw, Jih-bing Sheu

This paper presents a conceptual model to analyze the members' opportunistic behavior on post-disaster disruptive crop supply chain resilience. In this study, a post-disaster supplier psychology theory is proposed to investigate the antecedents of stockpile hoarding that may be revealed in a disruptive supply chain. Moreover, we examine the decisions of the suppliers with government intervention by selling stockpiled crops to the crop supply chain members for crop market stabilization.

3 - Empirical Research on Supply Chain Resilience Factors

Jingjing Li, Student, Huazhong University of Science and Technology, Luoyu Road 1037, Hongshan District, Wuhan, China, 1471058151@qq.com

Supply chain resilience is an effective index to measure the ability of the supply chain to deal with emergencies, including the ability to resist interruptions and self-healing after emergencies. The conceptual model of supply chain resilience is established on the basis of theory, including five factors. According to the empirical study using SEM, the impact of various factors on the supply chain resilience is quantized. It has substantial significance in improving supply chain resilience.

■ SA79

79-Room 302, CC

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - Microsoft Power BI – Power BI: Bring your Data to Life

Jen Underwood, Microsoft Senior Program Manager, Microsoft

In this tutorial session, you will explore Power BI with Microsoft engineering product team members. Feel free to bring a sample of your own data to create your own personalized dashboards. You will learn: • Data preparation: Discover, transform and combine data from various sources. • Data models: Create relationships, categorize your data and author business calculations. • Interactive visual reports: Author professional reports to slice/dice data to discover insights. • Power BI Dashboards: Ask language questions, create real-time dashboards and share insights. • Power BI Mobile Apps: Interact with dashboards from iOS, Android or Windows devices.

Sunday, 11:00am - 12:30pm

■ SB01

01-Room 301, Marriott

Network Mapping

Sponsor: Military Applications

Sponsored Session

Chair: Andrew Hall, COL, U.S. Army, 4760 40th St N, Arlington, VA, United States of America, AndrewOscarH@aol.com

1 - Network Inference from Grouped Data

Charles Weko, Senior Reserve Manpower Analyst, US Army, 2812 Nobel Fir Court, Woodbridge, VA, 22192, United States of America, charles.w.weko.mil@mail.mil

In many fields, network structure is not directly observed. Inferring implicit network structure requires a probabilistic model of grouped data. Grouped data records the manner in which a population forms subsets. In the existing literature, network inference from grouped data is performed using descriptive statistics. This presentation defines stochastic models for modeling group formation and applies the parameters to the famous 18th century Chinese novel, Dream of the Red Chamber.

2 - A Graph Comparison Approach to Network Attack and Defense

Jonathan Roginski, Applied Mathematics, NPS, Monterey, United States of America, jwrogins1@nps.edu

The promise of network science is to provide a foundation that supports understanding the large, dynamic, complex networks that characterize life today. In the Department of Defense, we create, manage, and defend against change in these complex networks. However, the scientists and analysts providing decision support are constrained by an acknowledged lack of tools for proper modelling of network topology and quantification of network change. In this research, we begin with the well-known problem of graph isomorphism and abstract it to the idea of similarity between graphs, rather than graph "sameness." We use structure rather than statistics to quantify similarity between graphs by introducing a matrix that captures more graph topological information than existing metrics or descriptive statistics. We show that where current structural metrics fail, the newly introduced distance-k matrix enables discrimination between graphs. We also show a methodology through which a network may be "triaged" to identify vertices which are potentially influential on the network's topology. Those candidate vertices are then analyzed using the distance-k matrix to determine the "distance between graphs," thereby quantifying the change in the network under vertex removal. The result is a "target set" of vertices a decision maker can choose from, based upon mission requirements, desired effect, and resources available-supporting attack, defense, and stability operations.

3 - A Framework for Comparing Networks

Raluca Gera, Naval Postgraduate School, Department of Applied Mathematics, Monterey, CA, United States of America, rgera@nps.edu

A challenging problem in studying large networks is that networks data is generally incomplete and often impossible to observe all members and interactions within the network. Researchers try to infer as much as possible of a network and study its structure and function. Our approach is to create a ground truth topology, infer the topology using several inference algorithms, and then compare the inferred to the true topology, using synthetic and real networks.

4 - Discovering an Unknown Network: An Optimization Based Approach

Piya Pal, University of Maryland, Electrical and Computer Engineering, College Park, United States of America, ppal@umd.edu

A central challenge in network tomography is to discover the structure of the network from partial observations. Depending on the type of the network, these measurements can provide us with different kinds of information. A key question in this regard is: how many measurements (or sensors) are needed to find out the topology of the network, and how should they be placed? We describe a discovery algorithm that iteratively maps the graph, by using entropy as a criterion for sensor placement.

■ SB02

02-Room 302, Marriott

INFORMS 2015 Data Mining Best Student Paper Award

Sponsor: Data Mining

Sponsored Session

Chair: Kamran Paynabar, Georgia Institute of Technology, 755 Ferst Drive, Atlanta, GA, 30332, United States of America, kamran.paynabar@isye.gatech.edu

1 - Falling Rule Lists

Fulton Wang, MIT, 5 Cambridge Center #792, Cambridge, MA, 02142, United States of America, fultonwang@gmail.com

Falling rule lists are classification models consisting of an ordered list of if-then rules, where (i) the order of rules determines which example should be classified by each rule, and (ii) the estimated probability of success decreases monotonically down the list. These kinds of rule lists are inspired by healthcare applications where patients would be stratified into risk sets and the highest at-risk patients should be considered first.

2 - Statistical Models for Characterizing the Heterogeneous Wake Effects in Multi-turbine Wind Farms

Mingdi You, PhD Candidate, University of Michigan, 1205 Beal Avenue, IOE 1773, Ann Arbor, MI, 48109, United States of America, mingdyou@umich.edu, Eunshin Byon, Giwhyun Lee

Wind turbines in a wind farm exhibit heterogeneous power generations due to wake effects. Because upstream turbines absorb kinetic energy in wind, downstream turbines produce less power. Moreover, the power deficit at downstream turbines shows heterogeneous patterns, depending on weather conditions. This study introduces a new approach for characterizing heterogeneous wake effects. A case study demonstrates the proposed approach's superior performance over commonly used alternative methods.

3 - Sparse Precision Matrix Selection for Fitting Gaussian Random Field Models to Large Data Sets

Sam Davanloo Tajbakhsh, Visiting Assistant Professor, Virginia Tech, 412 Hutcheson, Blacksburg, VA, 24060, United States of America, sdt144@vt.edu, Serhat Aybat, Enrique Del Castillo

Fitting Gaussian random field models and finding the Maximum Likelihood Estimate (MLE) of the parameters requires a nonconvex optimization. The problem is aggravated in big data settings since the per iteration computational complexity of MLE is $O(n^3)$ where n is the number of distinct spatial locations. We propose a theoretically provable two-stage algorithm which solves a semidefinite program in the first stage and a least square problem in the second stage.

4 - Sensor Driven Condition Based Generation Maintenance and Operations Scheduling

Murat Yildirim, PhD Student, Georgia Institute of Technology, 755 Ferst Drive, Atlanta, GA, 30332, United States of America, murat@gatech.edu, Nagi Gebrael, Andy Sun

We propose an integrated framework, which combines (1) predictive analytics methodology that uses real-time sensor data to predict future degradation and remaining lifetime of generators, with (2) novel optimization models that transforms these predictions into cost-optimal maintenance and operational decisions. We present extensive computational experiment results to show proposed models achieve significant improvements in cost and reliability.

■ SB03

03-Room 303, Marriott

Improving Efficiency and Effectiveness of Supply Chains

Cluster: Scheduling and Project Management

Invited Session

Chair: Chelliah Sriskandarajah, Hugh Roy Cullen Chair In Business Administration, Texas A&M University, 320Q Wehner, 4217 TAMU, College Station, TX, 77843, United States of America, chelliah@mays.tamu.edu

1 - Outpatient Appointment Scheduling under Patient Heterogeneity and Patient No-shows

Seung Jun Lee, PhD Student, Texas A&M University, 320N Wehner Building, College Station, TX, 77845, United States of America, sjlee@mays.tamu.edu, Chelliah Sriskandarajah, Gregory Heim, Yunxia Zhu

We study an outpatient appointment scheduling system under conditions of patient heterogeneity in service times and patient no-shows. We contribute by using more sophisticated sequential block scheduling policies, leading to effective appointment schedules when scheduling two patient types. We extend our algorithm to incorporate patient no-shows. Next, our block scheduling algorithm is adapted where outpatient clinics use an open-access policy.

2 - A Framework for Analyzing the U.S. Coin Supply Chain

Yiwei Huang, Mays Business School, Texas A&M University, 320M Wehner Building - 4217 TAMU, College Station, TX, 77843-4217, United States of America, yhuang@mays.tamu.edu, Subodha Kumar, Bala Shetty, Chelliah Sriskandarajah

We present a framework of analyzing the supply side problem for increasing cost-effectiveness of the U.S. Coin Supply Chain (CSC). We investigate the U.S. CSC from following perspectives: new coin production in the U.S. Mint, circulating coin distribution for the Federal Reserve System (FRS), and coin inventory management and coin demand forecasting at coin vaults (CV). We provide an optimal operating policy for the FRS using a minimum cost flow (MCF) network model for multi-products.

3 - Scheduling Operating Rooms with Elective and Emergent Surgeries

Kyung Sung Jung, University of Florida, P.O. Box 117169, Gainesville, FL, 32611-7169, United States of America, kyungsung.jung@warrington.ufl.edu, Chelliah Sriskandarajah, Vikram Tiwari

Operating rooms (ORs) generate the greatest revenue source for hospitals while they are the largest cost centers. Scheduling ORs are challenging tasks due to the significant uncertainty in the arrival of emergent patients. To increase the responsiveness and efficiency for OR scheduling, we develop an optimization model which deals with block schedules and determines the sequence of elective patients so that the emergency patients who arrive randomly can be accommodated without incurring delays.

4 - Operations in Currency Supply Chains – A Review

Yunxia Zhu, Rider University, Sweigart Hall 358, Lawrenceville, KS, United States of America, yuzhu@rider.edu, Chelliah Sriskandarajah, Neil Geismar

This paper provides an overview of studies of various currency supply chains across the world. The structure of a general banknote supply chain is given before the discussion of the problems from three different perspectives: the supply side, the demand side, and the secure third-party logistics providers. We also provide a framework for analyzing the U.S. coin supply chain and descriptions of the coin supply chains in other countries. Future research directions are also proposed.

■ SB04

04-Room 304, Marriott

JFIG Paper Competition II

Sponsor: Junior Faculty Interest Group

Sponsored Session

Chair: Asoo Vakharia, Professor, University of Florida, Department of ISOM, Gainesville, FL, 32611, United States of America, asoov@ufl.edu

Chair: Arda Yenipazarli, Assistant Professor of Operations Management, Georgia Southern University, COBA 2224, Statesboro, GA, 30460, United States of America, ayenipazarli@georgiasouthern.edu

The 2015 JFIG paper competition features paper submissions from a diverse array of talented junior faculty members. The prize committee evaluated submissions based on the importance of the topic, appropriateness of the approach, and significance of the contribution. After careful review, the prize committee selected a group of finalists to present their research in one of the two JFIG sessions. For information on the finalists and their papers, please refer to the online program.

■ SB05

05-Room 305, Marriott

Bridging Business and Analytics

Cluster: Social Media Analytics

Invited Session

Chair: Mingfei Li, Associate Professor, Bentley University, 175 Forest Street, Waltham, United States of America, Mli@bentley.edu

1 - Implement Business Analytics in Education: An Exploration in Business Education

Mingfei Li, Associate Professor, Bentley University, 175 Forest Street, Waltham, MA, United States of America, Mli@bentley.edu

Do we have a formula for Business Analytics in education? How do we fill the gap between business and analytics in school? Ideas of combining Business with Analytics in education will be explored. Using Bentley's business analytics programs as an example to show works from students in this field.

2 - The Analytics of Kickstarter

David Oury, Lecturer, Bentley University, 175 Forest Street, Morison room 325, Waltham, MA, 02451, United States of America, doury@bentley.edu

Our project investigates those factors that influence the success or failure of crowdfunding projects through analytics on the Kickstarter data set. We compare results, models and capabilities of the following software packages: Alteryx, IBM SPSS Modeler, KNIME, R, RapidMiner, Salford Systems, SAS Enterprise Miner and Semcasting.

3 - Analytics, Interdisciplinary Collaboration, and the Mapping of Brand DNA

Joseph Dery, PhD Student, Sr. Data Scientist, Bentley University, EMC Corporation, 175 Forest Street, Waltham, MA, 02451, United States of America, JDERY@bentley.edu

Do successful analytics projects utilize interdisciplinary collaboration? Leveraging the brand-exclusivity robbing phenomenon of brand genericide, this deceptively marketing-dependent problem is viewed through a combined lens of brand management, legal studies, linguistics and analytics. The result: newly mapped "Brand DNA" with the ability to measure brand-mutations through longitudinal text mining.

4 - An Exploration of Power Structures Utilizing Network Analysis

Kevin Mentzer, PhD Student, Bentley University, 175 Forest Street, Waltham, MA, 02451, United States of America, mentzer_kevi@bentley.edu, Dominique Haughton

This work combines Bayesian analysis with social network analysis to highlight significant change in networks over time. Applications exploring power in interlocked corporate boards as well as power in state government are explored. Findings show capabilities to identify and isolate key data as well as show shifting power dynamics.

■ SB06

06-Room 306, Marriott

Stochastic Systems in Finance

Sponsor: Financial Services

Sponsored Session

Chair: Alexandra Chronopoulou, Assistant Professor, University of Illinois at Urbana-Champaign, 117 Transportation Building, MC-238, 104 South Mathews Avenue, Urbana, IL, 61801, United States of America, achronop@illinois.edu

1 - Efficient Risk Analysis for Loan Pools

Justin Sirignano, Stanford University, Huang Engineering Center, Stanford, Ca, 93404, United States of America, jasirign@stanford.edu, Kay Giesecke

Financial institutions and investors are often exposed to default risk from large numbers of loans. Due to the size of loan pools, brute-force simulation is computationally expensive. We prove weak convergence results in order to construct an efficient Monte Carlo approximation. We test our approximation on a data set of over 25 million actual mortgages. Computational cost is often several orders of magnitude less than brute-force simulation of the actual pool with a similar level of accuracy.

2 - Optimally Thresholded Realized Power Variations for Stochastic Volatility Models with Jumps

Jose Figueroa-lopez, Purdue University, figueroa@purdue.edu

Thresholded Power Variations are popular nonparametric estimators for continuous-time processes with jumps. An optimal threshold selection approach is put forward in the presence of a stochastic volatility risk component. To this end, we further develop current kernel based estimators for the spot volatility, which in turn yield new optimal bandwidth selection procedures for stochastic volatility models.

3 - Principal Component Analysis of High Frequency Data

Dacheng Xiu, University of Chicago, Booth Business School, Chicago, IL, dachxiu@chicagobooth.edu, Yacine Ait-Sahalia

We develop a methodology to conduct principal component analysis at high frequency. The procedure involves estimation of realized eigenvalues, realized eigenvectors, and realized principal components and we provide the asymptotic distribution of these estimators.

4 - Indifference Pricing for Contingent Claims: Large Deviations Effects

Konstantinos Spiliopoulos, Assistant Professor, Boston University, Department of Mathematics and Statistics, 111 Cummington Mall, Boston, MA, 02215, United States of America, kspiliop@math.bu.edu

We study utility indifference prices and optimal positions for a non-traded contingent claim in an incomplete market with vanishing hedging errors, making connections with large deviations. Consider a sequence of semi-complete markets where for each n the claim $h_n = D_n + Y_n$, D_n is replicable and Y_n is unheadgale. In this setting, we show the prices typically are not the unique arbitrage free price in the limiting market and that optimal purchase quantities occur at the large deviations scaling.

■ SB07

07-Room 307, Marriott

Networks and Contagion Risk

Cluster: Risk Management

Invited Session

Chair: Agostino Capponi, Columbia, Mudd 313, New York, NY, 10027, United States of America, ac3827@columbia.edu

1 - Interfirm Relationships and Asset Prices

Carlos Ramirez, Finance PhD Candidate, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, 15213, United States of America, carlosrc@cmu.edu

I study asset pricing in large economies where persistent interfirm relationships generate interdependencies among firms' cash-flows. In the calibrated model: well connected firms command higher risk premium than less connected firms; firm-level return volatilities follow a factor structure; and momentum trading strategies are profitable.

2 - The Price of Uncertainty in Financial Networks

Peng-chu Chen, Purdue University, 315 N. Grant Street, West Lafayette, IN, United States of America, chen621@purdue.edu, Agostino Capponi

We derive lower and upper bounds for systemic losses incurred in networks, under partial information on interbank assets and liabilities. Our findings indicate that the uncertainty gap is highly sensitive to the realization of default events in the network.

3 - Why are Fee-to-Collateral Ratios so Extreme?

Allen Cheng, Graduate Student, Columbia University, 182 Claremont Avenue Apt. 42, New York, NY, 10027, United States of America, msa955126@gmail.com, Agostino Capponi

We develop a game-theoretic model of centralized clearing to analyze a clearinghouse's choice of transaction fee and collateral requirements. The clearinghouse's requirements affect not only the size and riskiness of her participating client base, but also the transaction fees charged to clients by her clearing member. We show that empirically observed extreme fee-to-collateral ratios can be explained as the equilibrium arising from strategic interactions between profit maximizing agents.

4 - Multivariate Systemic and Market Risk Measures

Cagin Ararat, Assistant Professor, Bilkent University, Department of Industrial Engineering, Bilkent University, Ankara, 08540, Turkey, cararat@princeton.edu, Birgit Rudloff

A common framework to study systemic risk measures and risk measures for multi-asset frictional markets is proposed. The structure of the network/market is modeled via a set-valued function whose special cases include the aggregation mechanisms for financial networks and the solvency cones for transaction cost markets. A general dual representation result is presented with economic interpretations for the special cases.

■ SB08

08-Room 308, Marriott

Cooperation and Integration Approaches to Modern Telecommunication Networks Problematics

Sponsor: Telecommunications

Sponsored Session

Chair: Albena Mihovska, Center for TeleInfrastruktur-Aalborg University, Fredrik Bajers Vej 7C1-113, Aalborg y, Da, 9220, Denmark, albena@es.aau.dk

1 - A Game Theoretic Approach to Modeling Telecommunications Security During Disasters

Michael Bartolacci, Professor, Information Sciences and Technology, Penn State University - Berks, Reading, PA, 19610, United States of America, mrb24@psu.edu

During times of crisis, the opportunities for hackers, terrorists, and other disruptive parties to disrupt important communications grows due to the sometimes chaotic conditions. A game theoretic approach is used to model disruptions to emergency management communications. Insight can be gained into how to minimize the probability and the impact of such disruptions.

2 - Behavior Model for Cooperative Communications Based on Stackelberg Game

Albena Mihovska, Center for TeleInfrastruktur-Aalborg University, Fredrik Bajers Vej 7C1-113, Aalborg y, Da, 9220, Denmark, albena@es.aau.dk

In cooperative communications the sender needs to ask a relay to forward its packets toward the destination. The relay responds to the sender about whether or not to relay the packet. This sequential procedure can be modeled by the Stackelberg competition, and the optimal strategy is solved by backward-induction.

3 - Cooperative versus Non-Cooperative Placement of Relay Stations in Wireless Sensor Networks

Chelsea Fogarty, Mba Student, Southwest Minnesota State University, 1501 State street, Marshall, MN, 56258, United States of America, Chelsea.Fogarty@smsu.edu, Vinay Gonela, Joseph Szmerekovsky

This paper focuses on designing a wireless sensor network under cooperative and non-cooperative planning schemes such that the total relay station cost is minimized. An MILP model is proposed that aims to determine the: 1) optimal location of relay stations, and 2) optimal assignment of sensors to relay stations. A case study set based on the Midwest region of the United States is conducted. The results indicate a significant trade-off between the number of relay stations and computational time.

4 - The Power of Integrated Wireless and Mobile Communication Technologies and their Impact on the Corporate World

Izabella Lokshina, Center for TeleInfrastruktur-Aalborg University, Fredrik Bajers Vej 7C1-113, Aalborg O Da 9220, Denmark, Izabella.Lokshina@oneonta.edu

The impact of integrated wireless and mobile communication technologies on the corporate world is very substantial. There is no restriction in terms of the application domains as illustrated by the models and primary scenarios provided in healthcare, education, business organizations and emergency services. Today, the challenge is to build the next generation of applications that will enable more of the models and primary scenarios across many other domains, such as transportation, energy, and manufacturing. It becomes clear through the models and primary scenarios that the power of integrated wireless and mobile technologies is certainly in several orders of magnitude greater than the simple sum of their separate individual impacts. This observation, combined with the continuous growth of wireless access and mobility, leads clearly to the belief that integrated wireless and mobile communication technologies are key success factors, even if there are challenges presented by such issues as the SLA (Service Level Agreement), security, privacy, mixed mode usage and deployment, and finding the appropriate business models for profitable growth.

■ SB09

09-Room 309, Marriott

Panel Discussion: Research Opportunities in Entrepreneurship, Innovation and Operations Management

Sponsor: Technology, Innovation Management & Entrepreneurship
Sponsored Session

Chair: Sinan Erzurumlu, Assoc. Prof., Babson College, 231 Forest St, Babson Park, MA, 02456, United States of America, serzurumlu@babson.edu

1 - Panel Discussion: Research Opportunities in Entrepreneurship, Innovation and Operations Management

Moderator: Sinan Erzurumlu, Assoc. Prof., Babson College, 231 Forest St, Babson Park, MA, 02456, United States of America, serzurumlu@babson.edu

This session brings together top scholars who do research in the interface of entrepreneurship, innovation and operations management. Each speaker will present his/her perspective on emerging research themes that may be of interest to researchers in the fields of innovation, technology management, new product development, organization science, and operations management. A follow-up Q&A and discussion with audience participation will follow to uncover research and teaching topics on the field.

■ SB10

10-Room 310, Marriott

Healthcare and Population Health in the Digital Economy

Sponsor: E-Business

Sponsored Session

Chair: Brad Greenwood, Assistant Professor, Temple University, 1810 North 13th Street, Philadelphia, PA, 19122, United States of America, brad.n.greenwood@gmail.com

1 - When is an Ounce of Prevention Worth a Pound of Cure? Finding High-risk Patients for Case Management

David Anderson, Assistant Professor, Baruch, davidryberganderson@gmail.com, Margret Bjarnadottir

One of the key questions in case management is which patients to enroll, and most programs target current high-cost patients. However the real potential is including lower cost patients at high risk of future high healthcare costs. Identifying these patient is a hard classification task. In this study we infuse classical classification models with association rules to identify and include higher order interactions.

2 - Reducing Healthcare Spending through Electronic Information Exchange: Aligning Provider and Insurer

Idris Adjerid, Assistant Professor, Notre Dame, 358 Mendoza College of Business, Notre Dame, United States of America, Idris.Adjerid.1@nd.edu

Health information exchanges (HIEs) are entities that enable the electronic sharing of patient information between disparate healthcare providers and other stakeholders but little evidence that speaks to whether promised gains to quality and efficiency have been realized. Leveraging a unique national panel dataset, we find significant cost reductions in healthcare markets that have established operational HIEs with an average reduction in spending of \$139 per Medicare beneficiary per year.

3 - The Spillover Effects of Health it Investments on Regional Health Care Costs

Hilal Atasoy, Assistant Professor, Temple University, Fox School of Business Alter Hall 445, Philadelphia, PA, United States of America, hilal.atasoy@temple.edu, Pei-yu Chen, Kartik Ganju

Electronic medical records (EMR) are often presumed to reduce the significant health care costs in the US. However, evidence on the impact of the EMR on costs is mixed, leading to skepticism about their effectiveness. We argue that the benefits EMR can go beyond the adopting hospital due to patient and physician sharing. We find that EMR investments have significant spillover effects by reducing costs of neighboring hospitals, which suggests that EMR can reduce aggregate health care costs.

4 - Show Me the Way to Go Home: An Investigation of Ride Sharing and Alcohol Related Vehicular Homicide

Brad Greenwood, Assistant Professor, Temple University, 1810 North 13th Street, Philadelphia, PA, 19122, United States of America, brad.n.greenwood@gmail.com, Sunil Wattal

We investigate how the entry of the driving service Uber affects the rate of alcohol related motor vehicle homicides. Using a difference in difference approach, the entry of Uber into markets between 2009 and 2013, results suggest a significant drop in the rate of homicides during that time. Furthermore, results suggest that not all services offered by Uber have the same effect, insofar as the effect for the Uber Black car service is intermittent and manifests only in selective locations.

SB11

11-Franklin 1, Marriott

Combinatorial Network Optimization

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Cole Smith, Professor And Chair, Clemson University, Freeman Hall, Clemson, SC, United States of America, jcsmith@clemson.edu

1 - On the Lagrangian Dual of the Maximum Quasi-clique Problem

Zhuqi Miao, Doctoral Candidate, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74078, United States of America, zhuqi.miao@okstate.edu, Baski Balasundaram

Quasi-clique is a useful model in cluster detection. The maximum quasi-clique problem (MQCP) can be formulated as a binary quadratically constrained program (BQCP). In this talk, we present new computational techniques based on the Lagrangian dual of the BQCP formulation that can provide both good feasible solutions and tight upper bounds for MQCP. We report results from our empirical studies, which show that the proposed approaches outperform the leading approaches for solving the MQCP.

2 - A Semi-Continuous Formulation for Maximizing Wireless Sensor Network Lifetime

Rob Curry, Graduate Research Assistant, Clemson University, Freeman Hall, Clemson, SC, 29634, United States of America, rmc Curry@g.clemson.edu, Cole Smith

A wireless sensor network consists of battery-powered sensors that collect and transmit data from a set of targets. Receiving and transmitting data consumes battery life; hence, multiple routes are employed to balance energy utilization and maximize network lifetime. Also, a routing configuration may need to remain stable for a minimum operating time if it is used at all. We formulate a semi-continuous linear program for this problem, along with a branch-and-price algorithm for its solution.

3 - A Branch and Price Algorithm for Solving the Hamiltonian P-median Problem

Ahmed Marzouk, Texas A&M University, 3131, TAMU, College Station, TX, 77843, United States of America, ambadr@email.tamu.edu, Erick Moreno-centeno, Halit Uster

Given an undirected graph, G , the Hamiltonian p -median problem is to find p cycles partitioning G with minimum cost. We present a Branch & Price algorithm that solves instances up to 129 nodes (state-of-the art is 40-nodes). To solve the pricing problem we developed 1) a new efficient algorithm to find the least cost cycle in undirected graphs with arbitrary edge costs but no negative cycles; and 2) an algorithm to find the most negative cycle in undirected graphs with arbitrary edge costs.

4 - A Backward Sampling Framework for Interdiction Problems with Fortification

Leonardo Lozano, PhD Student, Clemson University, 129 Freeman hall, Clemson, SC, 29634, United States of America, llozano@g.clemson.edu, Cole Smith

Three-stage sequential defender-attacker-defender problems are notoriously difficult to optimize, especially when the third-stage (recourse) problem is nonconvex. Our approach allows the third-stage problem to take any form. The algorithm restricts the defender to select a recourse decision from a sample space, and iteratively refines the sample to force convergence. We show the algorithm's effectiveness on various such problems, including games played over the TSP and CLSP.

SB13

13-Franklin 3, Marriott

Recent Advances in Stochastic Integer Programming

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Yongjia Song, Virginia Commonwealth University, 1015 Floyd Ave, 4140 Grace Harris Hall, Richmond, VA, 23284, United States of America, yjsong.pku@gmail.com

1 - On The Quantile Cut Closure of Chance-constrained Problems

Weijun Xie, Georgia Institute of Technology, School of ISYE, 755 Ferst Drive, NW, Atlanta, GA, 30332-0205, United States of America, wxie33@gatech.edu, Shabbir Ahmed

Quantile cuts for a chance-constrained problem (CCP) are projections of a subset of the well-known mixing set inequalities onto the original problem space. We study the closure of quantile cuts, and show that iterative application of the closure recovers the convex hull of a CCP.

2 - A Decomposition Framework for Stochastic Mixed Integer Programming

Suvrajeet Sen, Professor, University of Southern California, University Park Campus, Los Angeles, CA, 90089, United States of America, s.sen@usc.edu

We will summarize decomposition-based algorithms for SMIP problems. The key to these algorithms are parametric cutting planes which are developed from one of three principles: Gomory Cuts, Disjunctive Cuts, and Value Function Cuts. These concepts lead to some of the most effective schemes for SMIP problems. In a companion presentation, we will present computational results with a variety of instances.

3 - A Polyhedral Study of Multistage Stochastic Unit Commitment Polytope

Yongpei Guan, Professor, University of Florida, Weil 413, Gainesville, FL, 32611, United States of America, guan@ise.ufl.edu, Jean-paul Watson, Kai Pan

In this study, we investigate a scenario-tree based multistage stochastic integer programming formulation for the unit commitment problem under uncertainty. By exploring its polyhedral structure, several families of strong valid inequalities are generated. In particular, we obtain convex hull presentations for certain special cases and facets for the general polytope. Finally, the computational results verify the effectiveness of the proposed cutting planes.

■ SB14

14-Franklin 4, Marriott

Sampling and Learning Methods in Stochastic Optimization

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Peter Frazier, Assistant Professor, Cornell University, 232 Rhodes Hall, Cornell University, Ithaca, NY, 14850, United States of America, pf98@cornell.edu

1 - Variance Reduction Techniques for Sequential Sampling Methods in Stochastic Programming

Jangho Park, PhD Student, The Ohio State University, 1971 Neil Avenue, Columbus, OH, 43210, United States of America, park.1814@osu.edu, Guzin Bayraksan, Rebecca Stockbridge

We present variance reduction techniques, Antithetic Variates and Latin Hypercube Sampling, when used for sequential sampling procedures in stochastic programming. We discuss theoretical justification and present the resulting subtle changes in an implementation due to theoretical consideration. We empirically investigate these variance reduction techniques on a number of test problems from the literature.

2 - Multi-step Bayesian Optimization for One-dimensional Feasibility Determination

Massey Cashore, University of Waterloo, 77 Crossovers St, Toronto, On, M4E 3X3, Canada, jmcashor@uwaterloo.ca, Peter Frazier

Bayesian optimization methods allocate limited sampling budgets to maximize expensive-to-evaluate functions. One-step-lookahead policies are often used, but computing optimal multi-step-lookahead policies remains a challenge. We consider a specialized Bayesian optimization problem: finding the superlevel set of an expensive one-dimensional function, with a Markov process prior. We compute the Bayes-optimal sampling policy efficiently, and characterize the suboptimality of one-step lookahead.

3 - The Knowledge Gradient Policy with Regularized Trees

Yan Li, Princeton, Sherrerd Hall, Charlton Street, Princeton, United States of America, yanli@princeton.edu, Han Liu, Warren Powell

We propose a sequential learning policy for noisy discrete global optimization with regularized trees. Besides selecting the best alternative before the budget is exhausted, we also aim to learn the important features and the low order interactions. We derive a knowledge gradient policy for binary decision trees. Experimental work shows that the method is scalable to high dimension and efficiently learns the underlying low dimensional structures.

4 - The Knowledge Gradient with Logistic Belief Models for Binary Classification

Yingfei Wang, Princeton University, Computer Science Dept., Princeton, NJ, 08540, United States of America, yingfei@princeton.edu, Warren Powell

We consider sequential decision problems where the learner takes an active role in repeatedly selecting alternatives and receives the binary label of the selected alternatives. The goal is to find the best alternative with the highest response. We use logistic regression to model the response of each alternative. By formulating the problem within a dynamic programming framework, we develop a knowledge gradient policy to guide the experiment by maximizing the expected value of information.

■ SB15

15-Franklin 5, Marriott

Recent Advances on First Order Methods

Sponsor: Optimization/Nonlinear Programming

Sponsored Session

Chair: Fatma Kilinc Karzan, Assistant Professor Of Operations Research, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, fkilinc@andrew.cmu.edu

1 - Random Block-coordinate Gradient Projection Algorithms

Angelia Nedich, University of Illinois, Urbana IL, United States of America, angelia@illinois.edu, Chandramani Singh, R. Srikant

We discuss gradient projection algorithms based on random partial updates of decision variables. We analyze these algorithms with and without assuming strong convexity of the objective functions. We also present an accelerated version of the algorithm based on Nesterov's two-step gradient method. We show that the randomized algorithms exhibit similar rates of convergence as their full gradient based deterministic counterparts.

2 - An Extended Frank-wolfe Method, with Applications to Low-rank Matrix Completion

Paul Grigas, MIT Operations Research Center, 77 Massachusetts Ave., Cambridge, MA, 02139, pgrigas@mit.edu, Rahul Mazumder, Robert Freund

We present an extension of the Frank-Wolfe method that is designed to induce near-optimal solutions on low-dimensional faces of the feasible region. We present computational guarantees for the method that trade off efficiency in computing near-optimal solutions with upper bounds on the dimension of minimal faces of iterates. We present computational results for large-scale matrix completion problems that demonstrate significant speed-ups in computing low-rank near-optimal solutions.

3 - First-order Methods for Robust Convex Optimization

Nam Ho-nguyen, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh PA, hnh@andrew.cmu.edu, Fatma Kilinc Karzan

Robust optimization is a framework to model parameter uncertainty in optimization problems. Inspired by recent developments, we present several efficient first-order methods to approximately solve robust convex optimization problems. We also introduce the notion of weighted regret online learning and the online saddle-point problem, which form key building blocks for our methods. Finally, we discuss some proximal-type algorithms for these problems.

■ SB16

16-Franklin 6, Marriott

Recent Advances in Linear and Conic Optimization

Sponsor: Optimization/Linear and Conic Optimization

Sponsored Session

Chair: Hande Benson, Associate Professor, Drexel University, LeBow College of Business, Philadelphia, PA, 19104, United States of America, hvb22@drexel.edu

1 - A Generalization of Chubanov's Projection Algorithm

Negar Soheili, Assistant Professor Of Business Analytics, University of Illinois at Chicago, 601 S Morgan Street, University Hall 2416, Chicago, IL, 60607, United States of America, nazad@uic.edu

The Chubanov's algorithm is a projection algorithm for solving linear homogeneous feasibility problems that leverages periodic rescaling. We propose an extension of this algorithm for solving more general conic feasibility problems where our iteration bound is based on a condition measure associated with the geometry of the problem.

2 - Polynomial Time Methods for Optimal Design of Experiments for Regression using Conic Optimization

David Papp, North Carolina State University, 3222 SAS Hall, Campus Box 8205, Raleigh, NC, 27695-8205, United States of America, dpapp@ncsu.edu

Computing optimal experimental designs for regression addresses a fundamental problem regarding the collection of experimental data. Natural formulations of this problem are either semi-infinite convex programs or finite dimensional nonconvex programs. We shall present a novel approach that reduces the solution of the nonconvex formulation to the solution of two coupled semidefinite programs. This leads to the first polynomial time algorithm for the computation of such global optimal designs.

3 - The Parametric Simplex Method and its Application in Machine Learning

Haotian Pang, Princeton University, Department of Electrical Engineering, Olden Street, Princeton, NJ, 08540, United States of America, hpang@princeton.edu, Han Liu, Robert Vanderbei, Tuo Zhao

We formulate a series of machine learning problems, including Dantzig selector for sparse linear regression, CLIME for sparse precision matrix estimation and LPD rule for sparse linear discriminant analysis, into the parametric linear programming form and show that it is fast and efficient to solve it by the parametric simplex method. For the Dantzig selector model, we show that each dual iteration is guaranteed to be sparse as well as under the irrepresentable conditions.

4 - Warmstarts for Mixed-integer Second-order Cone Programming

Hande Benson, Associate Professor, Drexel University, LeBow College of Business, Philadelphia, PA, 19104, United States of America, hvb22@drexel.edu

In this talk, we will discuss warmstarting strategies after different types of cuts within an algorithm for solving mixed-integer second-order cone programming problems. The underlying SOCPs are solved using an interior-point method.

■ SB17

17-Franklin 7, Marriott

Networks Robustness and Vulnerability Analysis

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Foad Mahdavi Pajouh, Assistant Professor, University of Massachusetts Boston, 100 Morrissey Boulevard, Boston, MA, 02125, United States of America, Foad.Mahdavi@umb.edu

1 - On Imposing Connectivity Constraints in Integer Programs

Austin Buchanan, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74078, United States of America, buchanan@okstate.edu, Sergiy Butenko, Yiming Wang

In many network applications, one searches for a connected subset of vertices that exhibits other desirable properties. To this end, we study the connected subgraph polytope of a graph, which is the convex hull of subsets of vertices that induce a connected subgraph. We investigate two classes of valid inequalities—separator inequalities and indegree inequalities—and show when they induce (all nontrivial) facets. We also consider extended formulations, lifting, and separation.

2 - On Biconnected and Fragile Subgraphs of Low Diameter

Oleksandra Yezerska, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, yaleksa@tamu.edu, Sergiy Butenko, Foad Mahdavi Pajouh

An s-club is a subset of vertices inducing a subgraph with a diameter of at most s. It is commonly used to characterize network clusters in applications for which easy reachability between group members is of high importance. In this paper, we study two special cases of the 2-club model – a biconnected 2-club, and a fragile (not biconnected) 2-club, respectively. By investigating certain properties of both models, we develop exact algorithms for their corresponding optimization problems.

3 - Integer Programming Formulations for Solving the Minimum Edge Blocker Spanning Tree Problem

Jose Walteros, University at Buffalo, 342 Bell Hall, Buffalo, NY, United States of America, josewalt@buffalo.edu, Ningji Wei, Foad Mahdavi Pajouh

The minimum edge blocker spanning tree problem consists of removing a minimum number of edges in a weighted graph so that the weight of any spanning tree in the remaining graph is at least r. We study the convex hull of feasible solutions and identify facet-inducing inequalities for this polytope. We develop an exact algorithm that solves our formulation via branch-and-cut. Finally, we provide the computational results obtained after solving a set of randomly generated and real-life instances.

■ SB18

18-Franklin 8, Marriott

Joint Session Modeling Methodologies/Big Data: Large-Scale Data Analytics and Applications

Cluster: Modeling and Methodologies in Big Data

Invited Session

Chair: Chou-An Chou, Binghamton University, 4400 Vestal Parkway, Vestal, United States of America, cachou@binghamton.edu

Co-Chair: Anas Hourani, Binghamton University, 4400 Vestal Parkway, Vestal, United States of America, ahouran1@binghamton.edu

1 - Understanding Patterns or Relations of the Terrorist Attacks in Big Data to Prevent Future Threats

Salih Tutun, Binghamton University, 4400 Vestal Parkway East, Binghamton, NY, 13902, United States of America, stutun1@binghamton.edu, Chou-An Chou

This research interests value in 5Vs that is the useful results about terrorist attacks (incidents) to analyze the terrorist activity patterns or relations, to predict their future moves, and finally to prevent potential terrorist attacks. We focused on understanding of why incident succeed or fail, duration of incident extended, and doubt as to whether the incident is an act of terrorism. The results will be very useful for law enforcement agencies to propose reactive strategies.

2 - Machine Learning Based Robust Optimization with Application to Healthcare Treatment Recommendations

Sung Hoon Chung, Binghamton University, P.O. Box 6000, Binghamton, NY, United States of America, chung@binghamton.edu, Yinglei Li

When making decisions, one may use robust optimization (RO) to reduce the impact of uncertainty modeled from the past data. In RO, uncertain parameters are generally assumed to be within a convex set, within which decision makers want to protect the system against the worst case. We propose a machine learning approach to design such uncertainty sets, and discuss the application of machine learning based robust optimization to healthcare treatment recommendations.

3 - Frequency-based Rule Classification Algorithm with Big Data

Anas Hourani, Binghamton University, 4400 Vestal Parkway, Vestal, NY, United States of America, ahouran1@binghamton.edu, Chou-An Chou

Frequency-based rule classification algorithm is a simple, fast and accurate associative algorithm. In this study, we are going to introduce an improvement on the FRC algorithm to work Hadoop system. Then several comparisons are made between the conventional FRC and FRC on Hadoop to demonstrate the efficiency of the proposed algorithm with big data.

■ SB19

19-Franklin 9, Marriott

Computational Optimization for Applied Problems I

Sponsor: Computing Society

Sponsored Session

Chair: David Morrison, Inverse Limit, 255 McDowell Lane Unit A, W Sacramento, CA, 95605, United States of America, dmorrison@invlim.com

1 - Enumeration and Bounding Arguments for Infrastructure Resilience Analysis

W. Matthew Carlyle, Naval Postgraduate School, mcarlyle@nps.edu, David Alderson

We propose a functional definition of infrastructure resilience based on attacker-defender models and using a parametric analysis of attacker capability. In general, this parametric analysis requires enumeration of a potentially enormous number of optimization problems. In this talk, we present a computational technique that uses bounding arguments to significantly limit the enumeration while still providing useful measures of infrastructure resilience. We illustrate with a real case study.

2 - Computational Study of Stabilization Methods in Crew Pairing Problems

Jiadong Wang, Senior Operations Research Developer, Sabre, 3150 Sabre Drive, 76092, United States of America, jiadwang@gmail.com, Xiaodong Luo

Column generation has been successfully applied to solve large-scale optimization problems. In this talk, we review the various stabilization methods by revisiting primal-dual subproblem approach. Experiments on large set-partitioning instances from crew pairing problem in Sabre provide insight on the effectiveness of various stabilization methods.

3 - An Implicit Hitting-set Solution Method for the Sensor Location Problem

David Morrison, Inverse Limit, 255 McDowell Lane Unit A, W Sacramento, CA, 95605, United States of America, dmorrison@invlim.com, Paul Rubin

Given a two-way directed network, the sensor location problem seeks to find the minimal number of vertices that must be monitored so that flow over the entire network can be determined, given prior assumptions on flow patterns. We reduce the problem to an implicit hitting set problem and use Benders' decomposition to solve the problem. The decomposition subproblem is a novel network flow problem called the incremental flow problem, for which we present several solution techniques.

■ SB20

20-Franklin 10, Marriott

Cloud Resource Management and Pricing

Cluster: Cloud Computing

Invited Session

Chair: Daniel Grosu, Wayne State University, 5057 Woodward Ave, Detroit, United States of America, dgrosu@wayne.edu

Co-Chair: Lena Mashayekhy, mlena@wayne.edu

1 - Efficient and Online Reconfigurations in NoSQL Databases

Indranil Gupta, Associate Professor, University of Illinois at Urbana-Champaign, 201 N. Goodwin Ave., Urbana, IL, 61801, United States of America, indy@illinois.edu, Mainak Ghosh, Yosub Shin, Wenting Wang, Gopalakrishna Holla

NoSQL databases are soon to be a multi-billion dollar market. In live NoSQL deployments “reconfiguration operations,” affecting a lot of data at once, are a major pain point, e.g., changing a table’s primary key. We describe techniques to perform reconfiguration in NoSQL systems (sharded and ring-based) quickly and online, i.e., while supporting high availability and low latency for reads/writes. We present results from our implementation and deployment with popular open-source NoSQL systems.

2 - Exploring Market Models for Software-defined Systems

Manish Parashar, Rutgers University, 110 Frelinghuysen Road, Piscataway, NJ, 08854, United States of America, parashar@rutgers.edu

Software-defined platforms, such as those enabled by Cloud services, provide new levels of flexibility, which can lead to very dynamic infrastructures that adapt themselves to application needs. In this talk I will explore how a cloud-of-clouds marketplace can support data-driven applications by programmatically federating geographically distributed resources to satisfy QoS demands. Specifically, I will focus on market and utility based models that can drive the synthesis of such systems.

3 - Stochastic Optimal Control of Time-varying Workloads

Mark Squillante, IBM Research, Thomas J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, United States of America, mss@us.ibm.com, Yingdong Lu, Mayank Sharma, Bo Zhang

Motivated by cloud computing, we consider GI/GI/1 queueing systems under time-varying workloads on one time scale and under time-varying controls on another time scale. We derive structural properties for the optimal dynamic control policy in general, establishing that this policy can be obtained through a sequence of convex programs. We also derive fluid and diffusion approximations and solutions for the problem. Computational experiments demonstrate the benefits of our approach.

■ SB21

21-Franklin 11, Marriott

Healthcare Data Analytics

Sponsor: Health Applications

Sponsored Session

Chair: Donald Lee, Yale School of Management, 165 Whitney Ave, New Haven, CT, United States of America, donald.lee@yale.edu

1 - A Statistical Approach to Cost-effectiveness Analysis under Uncertainty about the Willingness-to-pay

Reza Yaesoubi, Yale School of Public Health, 60 College Street, New Haven, CT, 06510, United States of America, reza.yaesoubi@yale.edu, Forrest Crawford, David Paltiel

Although it plays a central role in cost-effectiveness analysis, societies’ willingness to invest for an additional unit of health is rarely known to policy makers. In this work, we develop a statistical model to help decision makers determine whether a new healthcare alternative is considered cost-effective in the absence of exact value for the willingness-to-pay for health.

2 - Networks Classification via Mathematical Programming

Daehan Won, University of Washington, Seattle, 1415 NE Ravenna Blvd, #401, Seattle, WA, 98105, United States of America, wondae@uw.edu

We are developing mathematical programming models to classify the network structured data. Along the line with the feature selection, we present node selection approach to increase the classification accuracy as well as improving interpretability. To verify the utility of our proposed approach, we demonstrate the result of brain functional connectivity network data set.

3 - Outcome-driven Personalized Treatment Design for Managing Diabetes

Eva Lee, Georgia Institute of Technology, eva.lee@gatech.edu

This work is joint with Grady Memorial Hospital and the Atlanta VA Medical Center. We discuss an evidence-based decision support tool that couples a treatment predictive model with a planning model. Specifically, the predictive model uncovers drug effect based on pharmacokinetics and dynamics analysis. This evidence is then modeled within the personalized planning model for optimal treatment plan design. Results for a collection of patients will be presented.

■ SB22

22-Franklin 12, Marriott

Experiment Design and A-B Testing

Sponsor: Applied Probability

Sponsored Session

Chair: Ciamac Moallemi, Columbia Business School, 3022 Broadway, Uris Hall, New York, United States of America, ciamac@gsb.columbia.edu

Co-Chair: Vivek Farias, Associate Professor, MIT, 100 Main Street, Cambridge, MA, United States of America, vivekf@mit.edu

1 - Online A-B Testing

Vivek Farias, Associate Professor, MIT, 100 Main Street, Cambridge, MA, United States of America, vivekf@mit.edu, Nikhil Bhat, Ciamac Moallemi

We consider the problem of optimal A-B testing when the impact of a treatment is marred by a large number of covariates and subjects arrive and are assigned to a treatment sequentially. Our objective is to maximize the efficiency of our estimate of the treatment effect. Our main contribution is to show that what is typically thought of as a high-dimensional, intractable problem is, in fact, tractable under reasonable assumptions.

2 - Covariate Balanced Restricted Randomization: Optimal Designs, Exact Tests, and Asymptotic Results

José Zubizarreta, Columbia Business School, 3022 Broadway, Uris Hall, Room 417, New York, NY, 10027, United States of America, jz2313@columbia.edu, Jingjing Zou

We present a new method for the design of randomized experiments that (i) uses integer programming to optimally match subjects before randomization, (ii) assigns matched subjects to treatment and control in a randomized but controlled or restricted fashion, (iii) yields an explicit exact randomization distribution for small samples, and (iv) has good asymptotic properties in large experiments. We illustrate this method with a real experiment and show its advantages beyond standard methods.

3 - Can I Take a Peek? Continuous Monitoring of A/B Tests

Ramesh Johari, Stanford University, 475 Via Ortega, Stanford, Ca, 94305, United States of America, ramesh.johari@stanford.edu, Leo Pekelis, David Walsh

Statistical results for A/B tests are computed under the assumption that the experimenter will not continuously monitor their test. If users continuously monitor experiments, as is common in practice, then what statistical methodology is appropriate for hypothesis testing, significance, and confidence intervals? We present recent work addressing this question, building from results in sequential hypothesis testing. This work was carried out with Optimizely, a leading A/B testing platform.

■ SB23

23-Franklin 13, Marriott

Reflected Diffusions and Stochastic Networks

Sponsor: Applied Probability

Sponsored Session

Chair: Kavita Ramanan, Professor, Brown University, 182, George Street, Box F, Providence, RI, 02912, United States of America, kavita_ramanan@brown.edu

Co-Chair: Mohammadreza Aghajani, Brown University, Providence, RI, United States of America, Mohammadreza_Aghajani@Brown.edu

1 - Reflected Brownian Motions in Stable Models for Large Equity Markets

Ioannis Karatzas, Columbia University, Department of Mathematics, New York, NY, 10027, United States of America, ik@math.columbia.edu

We construct systems of Brownian particles interacting through their ranks. These interactions give rise to invariant measures which are in broad agreement with stability properties observed in large equity markets over long time-periods. The models have connections with the analysis of Queueing Networks in heavy traffic. Their hydrodynamic-limit behavior is governed by generalized porous medium equations with convection. We survey briefly recent progress on some of these fronts.

2 - Pathwise Differentiability of Semimartingale Reflected Brownian Motions in Convex Polyhedrons

David Lipshutz, Postdoctoral Research Associate, Brown University, 182 George Street Box F, Providence, RI, 02912, United States of America, David_Lipshutz@brown.edu, Kavita Ramanan

We consider the pathwise differentiability of semimartingale reflected Brownian motions (SRBMs) in convex polyhedrons with respect to input parameters that determine the initial condition and drift. The derivatives are characterized as solutions to time-dependent Skorokhod type problems associated with the SRBMs. As applications, we characterize derivatives of stochastic flows for SRBMs and compute the sensitivity of SRBMs to small perturbations of the drift.

3 - Existence and Nonexistence Results for Diffusion Limits of Serve-the-Longest-Queue

Rami Atar, Technion, Department of Electrical Engineering, Technion, Haifa, Israel, atar@ee.technion.ac.il, Subhamay Saha

When serve-the-longest-queue is considered for a system with finite buffers that are equal in size, diffusion limits of queue length exist in conventional heavy traffic, while they do not always exist in the Halfin-Whitt regime. This phenomenon will be described, along with implications on a game theoretic set up of the network, in which customers are strategic.

■ SB24

24-Room 401, Marriott

Data Mining and Network Inference for Social and Health Application I

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Sung Won Han, New York University, 650 First Avenue, New York, NY, United States of America, sungwonhan2@gmail.com

Co-Chair: Chen Kan, University of South Florida, 4202 E. Fowler Ave. ENB118, Tampa, FL, United States of America, chenkan@mail.usf.edu

1 - The Evolution of User Roles in Online Health Communities

Xi Wang, The University of Iowa, S343 PBB, The University of Iowa, Iowa City, IA, 52242, United States of America, xi-wang-1@uiowa.edu, Zhiya Zuo, Kang Zhao

Online health communities (OHCs) have become a major source of social support for people with health problems. By analyzing how users' roles change over time, we constructed transition graphs to illustrate evolution of users' roles in an OHC. It was revealed that the types social support received by a user may facilitate or delay her role transitioning. Our research has implications to for OHC operators to track users' behaviors in order to manage an OHC.

2 - Extracting Biomedical Relationships from Unstructured Documents

Adel Javanmard, Assistant Professor, Marshall School of Business, University of Southern California, Los Angeles, CA, United States of America, ajavanma@marshall.usc.edu

The published biomedical research is growing at an unprecedented rate. On the other hand, the information we need to extract for many research objectives is

becoming increasingly complex. This trend has driven the need for automated curation of scientific literature. We consider the problem of extracting drug-gene relationships from unstructured documents and propose a novel algorithm to this end. Our algorithm is intimately related to new advances in clustering sparse graphs.

3 - Network Models for Monitoring High-Dimensional Image Profiles

Chen Kan, University of South Florida, 4202 E. Fowler Ave. ENB118, Tampa, FL, United States of America, chenkan@mail.usf.edu, Hui Yang

Advanced sensing brings the proliferation of image profiles, which pose significant challenges for process monitoring and control. However, traditional SPC is limited in its ability to readily address complex structures of high-dimensional profiles. This paper presents a novel dynamic network methodology for monitoring and control of high-dimensional imaging streams. Experimental results show that the proposed approach provides an effective online control chart for monitoring image profiles.

■ SB25

25-Room 402, Marriott

Mobile and Social Data Analytics

Sponsor: Information Systems

Sponsored Session

Chair: Rajiv Garg, Assistant Professor, McCombs School of Business, 2110 Speedway, UT-Austin, Austin, TX, 78705, United States of America, rajiv.garg@mcombs.utexas.edu

1 - Mobile Big Data Analytics

Xueming Luo, Temple University, 1801 Liacouras Walk, Philadelphia, PA, United States of America, Xueming.Luo@temple.edu

This presentation discusses how smart devices (smartphones, machine-to-machine connected solutions, wearables, Internet-of-things technologies) and big data affect advertising, promotions, marketing ROI, and omni-channel targeting effectiveness. Over 3.6 billion people worldwide are deeply engaged with smartphone devices. More than half of adult Americans rely on smartphones to go about daily life.

2 - An Expository Study of Human Geographic Affinity Measurement Based Mobility Network

Rong Duan, AT&T Labs, Research, 1 AT&T Way, Bedminster, NJ, United States of America, rongduan@research.att.com

Geographic data play critical roles in different domains. Based on the nearly complete coverage of mobile cell towers and the frequent activities of mobile devices, we propose a Human Geographic Affinity (HGA) metric. HGA measures the degree of recapture for a crowd in a specific geographic area during a time period. The metric quantifies the stability of a crowd in a geographic area, and categories areas by their dynamic of human mobility. This study is completed in-line with privacy policy.

■ SB26

26-Room 403, Marriott

INFORMS Undergraduate Operations Research Prize I

Cluster: INFORMS Undergraduate Operations Research Prize

Invited Session

Chair: Aurelie Thiele, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, aut204@lehigh.edu

1 - A Composite Risk Measure Framework for Decision Making under Uncertainty

Pengyu Qian, Columbia University, Columbia Business School c/o PhD Office, 3022 Broadway, 311 Uris Hall, New York, NY, 10027, United States of America, qianpengyu@pku.edu.cn, Zizhuo Wang, Zaiwen Wen

In this talk, we present a unified framework for decision making under uncertainty. Our framework is based on the composite of two risk measures accounting for parametric (given distribution) and distributional uncertainty respectively. The framework generalizes many existing models. We also propose new models within this framework whose solutions have probabilistic guarantees and are less conservative comparing to traditional models. Numerical experiments demonstrate the strength of our models.

2 - Optimizing Community Healthcare Coverage in Remote Liberia through an Integer Linear Programming Model

Paige Von Achen, Northwestern University, Sheridan Road,
Evanston, IL, United States of America,
PaigeVonAchen2014@u.northwestern.edu

Here we present a collaborative effort by the NGO, Last Mile Health, and Northwestern University to aid the expansion of healthcare accessibility throughout remote Liberia. Two integer linear programming models are developed that determine (1) the location assignments of healthcare workers and their supervisors and (2) the routing of the supervisors. We highlight the benefits of rigorous data collection and using a cross-disciplinary team to provide proper scoping and representation of a given problem.

3 - A Faster Algorithm for the Resource Allocation Problem with Convex Cost Functions

Chao Qin, PhD Candidate, Northwestern University, 2145
Sheridan Road, Evanston, IL, 60208, United States of America,
chaoqin2019@u.northwestern.edu, Cong Shi, Huanan Zhang

We revisit the classical resource allocation problem with general convex objective functions, subject to an integer knapsack constraint. This class of problems is fundamental in discrete optimization and arises in a wide variety of applications. In this paper, we propose a novel polynomial-time divide-and-conquer algorithm and prove that it has a computational complexity of $O(n \log n \log N)$, which outperforms the best known polynomial-time algorithm with $O(n (\log N)^2)$.

4 - Integrated Optimization of Aircraft Utilization and On-time Performance

Beril Burçak, Bilkent University, 1972. Sok. Melis Sit. D Blok No: 8, Ankara, Turkey, beril.burcak@gmail.com, Alaz Ata Senol, Hakan Sentörk, Ayça Karatepe, Osman Rauf Karaaslan, Dr. Kemal Güler, Kaan Yavuz

This paper concerns the decision-support system created for Pegasus Airlines of Turkey, designed to improve the company's two key performance indicators; aircraft utilization and on-time performance. A unique approach is introduced to tackle the tradeoff between these two indicators via mathematical modeling. Significant improvements in operational performance and customer satisfaction are achieved as the previously manually done flight scheduling process has been automatized.

5 - Routing Optimization of a Drone for Agricultural Inspections

Kaan Telciler, Koc University, Rumelifeneri yolu Koç University,
Main Campus Sariyer, Istanbul, Turkey, ktelciler@ku.edu.tr,
Ezgi Karakas, Cagan Urkup

Drones can be used in various areas with developing drone technologies. In order to provide an automatized usage for drones, there is a need of routing approach. We developed a mathematical model and routing heuristic for drones which considers recharge stations, battery limit, wind changes, restricted regions and sequential routes. We used cluster first, route second approach for heuristic. In several datasets and cases, we obtained near-optimal routing in feasible times.

SB27

27-Room 404, Marriott

Multi-objective Choice Problems

Sponsor: Multiple Criteria Decision Making
Sponsored Session

Chair: Ozlem Karsu, Bilkent University, Bilkent Universitesi, Endustri Muhendisligi, Ankara, 06800, Turkey, ozlemkarsu@bilkent.edu.tr

1 - Two Approaches for Inequity-averse Sorting

Ozlem Karsu, Assistant Professor, Bilkent University,
Bilkent, Ankara, Turkey, ozlemkarsu@yahoo.co.uk

We consider multi-criteria sorting problems where the decision maker (DM) has equity concerns. In such problems each alternative represents an allocation of an outcome over multiple entities. We propose two sorting algorithms that are different from the ones in the current literature in the sense that they apply to cases where the DM's preference relation satisfies anonymity and convexity properties. We illustrate their use by sorting countries into groups based on their income distributions.

2 - A Preference-based Approach to Multi-objective Feature Selection

Muberra Ozmen, Middle East Technical University, Industrial Engineering Department, Ankara, 06800, Turkey,
mozmen@metu.edu.tr, Gulsah Karakaya, Murat Koksalan

In feature selection problems, one or more subsets of available features that best characterize the output of interest are selected. In this study, we develop a preference-based approach for the multi-objective feature selection problems considering objectives such as maximizing classification performance and minimizing the number of selected features. We test the approach on several instances.

SB28

28-Room 405, Marriott

Contingent Mechanisms

Cluster: Auctions

Invited Session

Chair: Rakesh Vohra, University of Pennsylvania, 3718 Locust Walk, Philadelphia, United States of America, rvohra@seas.upenn.edu

1 - Implementation with Contingent Contracts

Rahul Deb, Assistant Professor, University of Toronto, 150 St. George St, Toronto, ON, m5s3g7, Canada, rahul.deb@utoronto.ca

We study dominant strategy incentive compatibility with contingent contracts where the payoff of each agent is observed by the principal and can be contracted upon. We characterize outcomes implementable by linear contracts and provide a foundation for them by showing that, in finite type spaces, every social choice function (SCF) that can be implemented using a more general nonlinear contingent contract can also be implemented using a linear contract.

2 - Market Selection and the Information Content of Prices

Mehmet Ekmekci, Boston College, 140 Commonwealth Avenue, Chestnut Hill, MA, 02467, United States of America, ekmeckci@bc.edu, Alp Atakan

In an economy where buyers with unit demand decide to purchase one of two possible goods which are traded in two distinct markets. The goods traded within each market are identical, common-value objects and the price formation process as a large uniform-price auction. imperfectly informed bidders choose to participate in one of the markets. If market frictions lead to uncertain gains from trade in any of the two markets, then there is no equilibrium where prices aggregate information.

3 - Contingent Mechanisms with Endogenous Information

Yunan Li, University of Pennsylvania, 160 McNeil Building, 3718 Locust Walk, Philadelphia, PA, 19104, United States of America, yunanli0202@gmail.com

I study the auction design problem when buyers can make payments contingent on their ex-post returns. An example is selling a company using securities like shares. I consider settings where buyers can covertly acquire information at a cost before the auction. I find that auctions using steeper securities provide lower incentives for agents to acquire information, and thus may generate lower revenues. I also study the design of the optimal linear contingent mechanism with endogenous information.

4 - Participation and Unbiased Pricing in CDS Settlement Mechanisms

Ahmad Peivandi, Participation and Unbiased Pricing in CDS Settlement Mechanisms, Georgia State University, 35 Broad St, Atlanta, GA, United States of America, apeivandi@gsu.edu

Credit default swaps are insurance contracts on default. Currently, there are over 20 trillion USD worth of outstanding CDS contracts. These contracts are settled through a centralized market that has been criticized for underpricing the asset. In this paper, I take a mechanism design approach and characterize robust settlement mechanisms that deliver an unbiased price for the asset. A second contribution of my paper is a new notion of the core for games of incomplete information. This is particularly relevant here because participation in the settlement mechanism cannot be compelled.

SB29

29-Room 406, Marriott

A Collection of State of the Art Analytics Models and Methods

Sponsor: Analytics

Sponsored Session

Chair: Michael Katehakis, Professor And Chair, Rutgers University, 100 Rockefeller Rd., Piscataway, NJ, 08854, United States of America, mnk@rutgers.edu

1 - The $[\text{Map}(t) / \text{Ph}(t) / \text{Inf}]^k$ Queueing System and Network

Ira Gerhardt, Manhattan College, 4513 Manhattan College Parkway, Riverdale, NY, 10471, United States of America, ira.gerhardt@manhattan.edu, Michael Taafe, Barry Nelson

We generalize a numerically exact method for evaluating time-dependent moments of the entities in a $\text{Ph}(t) / \text{Inf}$ queueing system to the $\text{MAP}(t) / \text{Ph}(t) / \text{Inf}$ queueing system, and show that these same results can be used to analyze the multiclass $[\text{MAP}(t) / \text{Ph}(t) / \text{Inf}]^K$ queueing network system. Finally we show that the covariance of the number of entities at different nodes and times may be described by a single closed differential equation.

2 - Reliability of a Two Parallel K Out of N System with Removable Repair Mechanism

George Mytalas, S. Lecturer, NJIT, University Heights, Newark, NJ, United States of America, mytalas@njit.edu

We study the reliability of a $(k1, k2)$ -out-of- $(n1, n2)$ system which consists of two different types of components with finite populations and a single repair machine. The system operates under the $(N1, N2)$ -policy i.e. the server is activated for exhaustive repairs. The repaired components are assumed to be as good as new. Repair times of components and life times are assumed to be independent of each other.

3 - Bullwhip Effect in a Pharmaceutical Supply Chain

Ming Jin, University of Utah, 1655 E Campus Center Dr, Salt Lake City, UT, United States of America, ming.jin@utah.edu, Glen Schmidt, Nicole Dehoratius

We investigate the bullwhip effect in a pharmaceutical supply chain. Specifically, we estimate the bullwhip effect at the stock keeping unit (SKU) level, analyze the bias in aggregated measurement of the bullwhip effect, and examine various driving factors of the bullwhip effect. Data aggregation across products or over long time periods tends to mask the bullwhip effect in some cases. Price promotion, order batching, and inventory are three main factors associated with the bullwhip effect.

SB30

30-Room 407, Marriott

Model Building like a Boss

Sponsor: Analytics

Sponsored Session

Chair: Drew Pulvermacher, Director, Decision Sciences, PerformanceG2, Inc., 3432 Sunset Dr, Madison, 53705, United States of America, drew@performanceG2.com

1 - Descriptive, Predictive and Prescriptive Analysis for and by Business Users

Alain Chabrier, IBM Spain, Santa Hortensia 26-28, Madrid, Spain, achabrier@es.ibm.com, Xavier Ceugniet, Stéphane Michel

Visual analytics tools such as Watson Analytics provide easy ways for business users to benefit of descriptive and predictive analytics. Using configuration and elicitation of constraints and goals based on suggestions and natural language, we show how prescriptive analytics can also be supported and more complex business problems solved using the combinations of the 3 analytics area. We illustrate with a campaign marketing optimization use case.

2 - The Five Minute Analyst

Harrison Schramm, Navy Headquarters Staff, 1507 22nd Street South, Arlington, VA, 22202, United States of America, Harrison.Schramm@gmail.com

A little bit of analysis can go a long way – provided it's both scoped appropriately and presented in a way that is appealing to the layperson. The Five Minute Analyst, appearing in INFORMS/Analytics Magazine, attempts to apply some analysis to everyday problems with the goal of both improving decisions and sharing the power of a little bit – five minutes' worth, to be precise – of analysis towards everyday problems. This session will be a 'best of', going further in depth on the articles I've written, as well as discussing some 'also rans' – interesting problems that did not make the column. The application areas contain (but are not limited to) probability, statistics and game theory, although others may find their way in. Problems addressed will include Star Wars and Downton Abbey. There will be zombies.

SB31

31-Room 408, Marriott

Predictive Analytics for Health Care Decision Making

Sponsor: Data Mining

Sponsored Session

Chair: Nick Street, Professor And Departmental Executive Officer, The University of Iowa, 108 Pappajohn Business Building, S210, Iowa City, IA, 52242, United States of America, nick-street@uiowa.edu

1 - Sparse Logical Machine Learning Models

Cynthia Rudin, Associate Professor, Massachusetts Institute of Technology, MIT, Cambridge, MA, United States of America, rudin@mit.edu

CART (Classification and Regression Trees) is possibly the most popular machine learning method in industry. For the last few years, my research group has been trying to build competitors for CART. I will overview our work on sparse logical models that are direct competitors for CART. They are competitive in all ways: accuracy, interpretability, and tractability.

2 - Using Machine Learning Approaches to Predict Patient Risk from EHR Data

Alexander Cobian, Department of Computer Sciences, University of Wisconsin-Madison, 1300 University Ave, Madison, WI, 53706-1532, United States of America, cobian@cs.wisc.edu, Mark Craven

We explore the task of learning from electronic health record (EHR) data to predict patient risk levels for conditions of interest (asthma exacerbation and post-operative deep venous thrombosis.) While standard risk questionnaires focus on small numbers of known risk factors, we consider thousands of variables elicited from the EHR in order to identify novel risk indicators. Further, our approach attempts to discover latent variables that connect related, observed variables.

3 - Reducing Patient Risk through Inverse Classification: An SVM-based Method

Michael Lash, The University of Iowa, 318 MacLean Hall, Iowa City, IA, 52242, United States of America, michael-ash@uiowa.edu, Nick Street, Qihang Lin

In this work we propose a novel algorithm to address the problem of inverse classification, and apply the result to a recommendation system for patient risk minimization. We propose a mixed-integer nonlinear programming based on SVMs that finds the optimal values of the attributes that achieve the targeted probability of being in a desired class. The result is a flexible model that arrives at a set of realistic recommendations to mitigate patient risk.

4 - Understanding Emergency Department 72-hour Revisits Among Medicaid Patients

Kristin Bennett, Mathematical Sciences Dept., Rensselaer Polytechnic Institute, 110 8th Street, AE 327, Troy, NY, 12180, bennek@rpi.edu, James Hendler, James Ryan

We analyze emergency department (ED) usage at one hospital to understand ED return visits within 72 hours. "Frequent flier" patients with multiple revisits account for 47 percent of Medicaid patient revisits over a two year period. Statistical and L1-logistic regression analysis reveals distinct patterns of ED usage between frequent- and infrequent-patient encounters suggesting distinct opportunities for interventions to improve care and streamline ED workflow.

SB32

32-Room 409, Marriott

Advances in Community Detection and Influence Analysis in Social Networks

Sponsor: Data Mining

Sponsored Session

Chair: Wenjun Wang, University of Iowa, S283 Pappajohn Business Building, Iowa City, IA, 52242, United States of America, wenjun-wang@uiowa.edu

1 - Finding Hierarchical Communities in Complex Networks

Wenjun Wang, University of Iowa, S283 Pappajohn Business Building, Iowa City, IA, 52242, United States of America, wenjun-wang@uiowa.edu, Nick Street

Based on a Shared-Influence-Neighbor (SIN) similarity measure, we propose two novel influence-guided label propagation (IGLP) algorithms for finding hierarchical communities in complex networks. One is IGLP-Weighted-Ensemble (IGLP-WE), and the other is IGLP-Direct-Passing (IGLP-DP). Extensive tests demonstrate superior performance of our methodology in terms of excellent quality and high efficiency in both undirected/directed and unweighted/weighted networks.

2 - Community Detection in Dynamic Networks with Multiple Attributes

Xiang Li, University of Florida, Room 555, CSE Building U. of Florida, Gainesville, FL, 32611, United States of America, xixiang@cise.ufl.edu, My Thai

In this talk, we provide a mathematical model to qualify the relationship between communities based on network structure and that based on the common node attributes. We next present a dynamic and scalable algorithm to detect such communities, based on the multiplex graph theory.

3 - A Structural Approach to Community Detection in Complex Networks

Song Chew, Associate Professor, Southern Illinois University
Edwardsville, Southern Illinois University-Edwardsville,
Edwardsville, IL, 62026, United States of America,
schew@siue.edu

We in this study develop a novel measure of community structure that gauges the strengths and weaknesses of a proposed community structure against an ideal. In addition, we present an algorithm that may, as it maximizes our measure, return several alternative community structures for consideration. We provide several examples to demonstrate use of our measure, and to illustrate applications of our algorithm as well.

■ SB33

33-Room 410, Marriott

Applications of Markov Models to Medical Decision Making Problems

Sponsor: Health Applications

Sponsored Session

Chair: M. Reza Skandari, University of British Columbia, Vancouver, Vancouver, Canada, reza.skandari@sauder.ubc.ca

1 - Evaluation of Breast Cancer Mammography Screening Policies Considering Adherence Behavior

Maboubeh Madadi, University of Arkansas, mmadadi@uark.edu,
Shengfan Zhang, Louise Henderso

The efficacy of mammography screening guidelines is highly associated with women's compliance with these recommendations. Currently, none of the existing policies take women's behavior into consideration. In this study, we develop a randomized partially observable Markov chain model to evaluate a wide range of screening mammography policies, incorporating heterogeneity in women's adherence behaviors.

2 - Policy Approximation for Optimal Treatment Planning

Wesley Marrero, University of Michigan, 500 South State Street,
Ann Arbor, MI, 48109, United States of America,
wmarrero@umich.edu, Mariel Lavieri, Jeremy B. Sussman,
Gregory J. Schell, Rodney A. Hayward

Markov decision process (MDP) models are powerful tools which enable the derivation of optimal treatment policies, but may incur long computational times and decision rules which are challenging to interpret by physicians. To reduce complexity and enhance interpretability, we study how Poisson regression may be used to approximate optimal hypertension treatment policies derived by a MDP for maximizing a patient's expected discounted quality-adjusted life years.

3 - Optimal Decision Making in a Markov Model with Parameter Uncertainty: The Case of CKD

M. Reza Skandari, University of British Columbia-Vancouver,
Vancouver, BC, Canada, reza.skandari@sauder.ubc.ca,
Steven Shechter, Nadia Zalunardo

We investigate a Markov decision process whose unknown transition parameters are revealed partially through state observation. Decisions are made as the state evolves. We use the model to study the optimal time to start preparing a type of vascular access for chronic kidney disease patients who will need dialysis.

4 - Reinforcement Learning Algorithm for Blood Glucose Control in Diabetic Patients

Mahsa Oroojeni Mohammad Javad, Northeastern University, 334
Snell Engineering, Northeastern Univ, Boston, United States of
America, oroojeni.m@husky.neu.edu, Stephen Agboola,
Kamal Jethwani, Ibrahim Zeid, Sagar Kamarthi

In this paper a reinforcement learning algorithm is proposed for regulating the blood glucose level of Type I diabetic patients. In the proposed reinforcement learning algorithm body weight and A1C level define the state of a diabetic patient. For the agent, insulin dose levels constitute the actions. As a result of a patient's treatment, after each time step t , the patient receives a numerical reward depending on the response of the patient's health condition.

■ SB34

34-Room 411, Marriott

Smart Medical Prognosis and Decision Making via Data Mining

Sponsor: Health Applications

Sponsored Session

Chair: Danica Xiao, PhD Candidate, University of Washington, Seattle, 3900 Northeast Stevens Way, Seattle, WA, 98195, United States of America, xiaoc@uw.edu

Co-Chair: Shouyi Wang, Assistant Professor, University of Texas at Arlington, 3105 Birch Ave, Grapevine, TX, 76051, United States of America, shouyiw@uta.edu

1 - Does Specialization of Health Care Services Increase Operational Efficiency?

Saied Samiedaluie, Postdoctoral Fellow, University of British Columbia, E204 - 4500 Oak Street, BC Women's Hospital, Women's Health Rese, Vancouver, BC, V6H 3N1, Canada, saied.samiedaluie@gmail.com, Vedat Verter

We study a health care network configuration problem considering two scenarios: specialization versus generalization. We characterize the settings in which each scenario is preferred in terms of minimizing the patient admission refusal rate. Our results show that the decision of system configuration for a multi-hospital network requires careful consideration of patient mix among arrivals, relative length of stay of patients, and distribution of patient load between hospitals.

2 - A Model to Predict Depression among Diabetes Patients with Application in Screening Policymaking

Haomiao Jin, University of Southern California, 3715 McClintock Ave, GER 240, Los Angeles, CA, United States of America, haomiaoj@usc.edu, Shinyi Wu

About 30% of diabetes patients are suffering from depression, but nearly half of them are undiagnosed. Universal screening improves depression diagnosis rates but is labor-intensive. A machine learning model is developed to predict depression among diabetes patients. The model is applied in a screening policy to help healthcare providers to better prioritize the use of their resources and time and increase efficiency in managing their patient population with depression.

3 - Data Mining Techniques Applied to the Study of Canines with Disease

Zhenpeng Miao, Saint Joseph's University, 5600 City Ave, Philadelphia, PA, 19131, United States of America, mmkuchi0@gmail.com, Yingdao Qu, Virginia Miori

This paper, the third in a series, aims at providing models effective in predicting the degree of pain and discomfort in canines suffering from osteoarthritis, sarcoma, dermatitis and side effects of radiation treatments. The R programming language and SAS JMP are used to clean data and execute multivariate analyses to predict changes in different activity levels. The predictive models provide information that can assist in effective diagnosis and medication of suffering dogs.

4 - Understanding Linear and Non Linear Brain Dynamics During Manual Lifting Tasks

Awad Aljuaid, PhD Student, UCF, University of Central Florida 4000 Cent, Department of Industrial Engineering, Orlando, FL, 32816-2993, United States of America, amjuaid@knights.ucf.edu, Waldemar Karwowski, Petros Xanthopoulos

The aim of this study is to test the change on different EEG measures during various psychophysical lifting frequencies. High-density wireless dry cell EEG device have been used to record brain signals. Twenty healthy males participated in this experiment performing two physical lifting sessions psychophysical weight lifting (low, medium, and high) and strength measurements (Isometric and isokinetic). EEG recording at different brains locations are analyzed with linear and non-linear methods.

■ SB35

35-Room 412, Marriott

Joint Session HAS/Analytics: Predictive Models for Clinical and Public Health Decision Making

Sponsor: Health Applications

Sponsored Session

Chair: Ozgur Araz, University of Nebraska Lincoln, College of Business Administration, Lincoln, United States of America, ozgur.araz@unmc.edu

1 - Risk Factors for Disease Progression in Sepsis Patients: A Retrospective Cohort Study

Benjamin Whitsitt, University of Nebraska Medical Center, 42nd and Emile, Omaha, NE, 68198, United States of America, benjamin.whitsitt@unmc.edu, Micah Beachy, Lorena Baccaglini, Gleb Haynatzki, Michael Ash, Ozgur Araz

In this study we identify risk factors associated with the progression of sepsis to severe sepsis and/or septic shock and estimate the likelihood of disease progression for different patient groups. We also assess the probability of death and readmission amongst a sepsis population at two area hospitals in Omaha, Nebraska. Multiple logistic regression model is used to determine the likelihood of disease progression, mortality, and readmission.

2 - The Impact of Geographic Localization of Patients on Hospital Performance

Paul Cronin, PhD Student, University of Texas at Austin, 2110 Speedway Stop B6500, Austin, TX, 78712, United States of America, paul.cronin@utexas.edu, Douglas Morrice, Jonathan Bard, Luci Leykum

We study the impact of geographic localization of patients on hospital performance using patient-level data from a Texas teaching hospital. Performance is measured by length of stay in ED and hospital, waiting time for bed assignments, patient transfers between teams, and hour of discharge. The results of this study inform admission decision-making including patient allocation to medical teams and admission capacity planning.

3 - A Dynamic Model for Population Screening: Risk Perception and Feedback in Screening Decision

Ozge Karanfil, PhD Candidate, MIT Sloan School of Management, 100 Main Street, E62-379, Cambridge, MA, 02142, United States of America, karanfil@mit.edu, John D. Sterman

In this study we built a behaviorally realistic, bounded simulation model to explain changes in policy action thresholds of clinical practice guidelines, and to document evidence of gaps between scientific evidence-based guidelines and actual practice. This is the first theory building piece for cancer screening dynamics in the US that takes into account the broader cognitive and socio-political environment in which screening decisions are embedded.

4 - Modeling the Impact of Chronic Disease Combinations on 30-day Hospital Readmissions

Sabrina Casucci, University at Buffalo (SUNY), 339B Bell Hall, Amherst, NY, 14260, United States of America, scasucci@buffalo.edu, Alexander Nikolaev, Li Lin, Sharon Hewner

Individuals with chronic disease are at high risk for hospital readmission. There is significant opportunity to reduce utilization and costs by developing new readmission reducing interventions for this population. This work reveals and quantifies the causal impacts of specific chronic disease combinations on hospital readmissions. The results are reported for a subset of the New York State adult Medicaid population using observational causal inference methods and tools.

■ SB36

36-Room 413, Marriott

Humanitarian Applications II

Sponsor: Public Sector OR

Sponsored Session

Chair: Mahyar Eftekhari, Arizona State University, P.O. Box 874706, Tempe, AZ, 85287, United States of America, eftekhari@asu.edu

1 - Blood Storage and Transportation: An Important Component of Humanitarian Logistics

Divya Nagilla, Faculty Associate, Institute of Management Technology, Survey No.38, Cherlaguda Village, Shamshabad, RR District, Hyderabad, 501218, India, ndivya@imthderabad.edu.in, Sourabh Bhattacharya

Supply of blood during and after disasters is a major part in humanitarian logistics. The major problem during disasters is not the lack of blood supply but disruption of the blood distribution system. A large number of practical and

logistical issues related to communication, transportation, managing donors and volunteers arise. Depending upon the phase of the disaster the blood products required to treat the victims vary. Safety of the blood supply and adherence to regulations is crucial.

2 - Humanitarian Logistics in the Philippines: Case of Typhoon Haiyan

Brian Gozun, La Salle - Universitat Ramon Lull, Carrer de Sant Joan de La Salle 42, Barcelona, Spain, bgozun@gmail.com, Francesc Miralles

The study applied a humanitarian logistics framework through a deductive approach on the experiences of various stakeholders in the Philippines after the onslaught of Super Typhoon Haiyan in November 2013. The researchers made use of primary and secondary data in order to explore humanitarian operations management challenges before, during and after the onslaught of the typhoon by analyzing the current humanitarian logistics practices in the country.

3 - Vehicle Management Policies under Stochastic Budget for Humanitarian Development Programs

Milad Keshvari Fard, ESSEC Business School, 1 Avenue Bernard Hirsch, Cergy, France, milad.keshvarifard@essec.edu, Mahyar Eftekhari, Felix Papier

In this paper we attempt to find the optimal fleet management policies in a humanitarian organization running development programs. As the budget of these organizations - mostly financed through donations - is uncertain, the transportation planning is challenging. We try to identify the optimal number of vehicles to be purchased, the fraction of demand to be satisfied, and the fraction of budget that should be saved for future periods with low levels of donations.

4 - A Stochastic Programming Model for Prepositioning and Distributing Emergency Supplies

Xiaofeng Nie, Assistant Professor, Nanyang Technological University, 50 Nanyang Avenue, Singapore, Singapore, xiaofengnie@ntu.edu.sg, Aakil Caunhye, Yidong Zhang, Mingzhe Li

We propose a two-stage stochastic program to preposition and distribute emergency supplies. In the first stage the model decides where to locate warehouses and how many quantities to stock for prepositioning purposes, while in the second stage the model decides how many quantities to transport to demand sites and the corresponding routing. A case study is provided to illustrate our model and compare with other benchmark models.

■ SB37

37-Room 414, Marriott

Health Care Modeling and Optimization II

Contributed Session

Chair: Dongping Du, University of South Florida, Tampa, FL, 33613, United States of America, dongpingdu@mail.usf.edu

1 - A Network Heuristic for Stochastic Healthcare Facilities Location and Configuration in Sequence

Xue Han, Assistant Professor, Southeast Missouri State University, 1933 Rock Creek Ln, Cape Girardeau, MO, 63701, United States of America, xhan@semo.edu, Wilbert Wilhelm

This research aims on finding the best locations and capacities for new healthcare facilities providing multiple services over a 10-20 years planning horizon under stochastic demand in a competitive environment. We develop a heuristic algorithm for introducing new facilities in the market in sequence by solving resource constrained shortest path problem iteratively on a specially-constructed network. This heuristic preserves the advantages in solution time and linearity in objective function.

2 - Simulation Optimization for Reconstructing Rhythmic Mechanisms in Atrial Fibrillation

Dongping Du, University of South Florida, Tampa, FL, 33613, United States of America, dongpingdu@mail.usf.edu, Hui Yang

Atrial fibrillation (AF) is a common cardiac arrhythmia that affects more than 5 million Americans. The understanding of AF initiation and maintenance has remained sketchy due to the inability of reconstructing rhythmic mechanisms. This study develops a multi-scale atrial model and an optimization algorithm to reconstruct fibrillatory conduction and replicate patterns in clinical recordings. The research will produce a computer-aided decision support tool for optimizing AF surgical treatments.

3 - Early Warning Methods and Predictive Models for Hospital Risk and Readmissions

Jakka Sairamesh, CEO and President, CapsicoHealth, Inc, 2225 E Bayshore Rd. Ste. 200, Palo Alto, CA, 94303, United States of America, ramesh@capsicohealth.com, Ruichen Rong

This poster and research abstracts presents the effectiveness of methods for improving patient quality outcomes (e.g. reducing 30-day readmissions) based on clinical and cost based factors. We will present early-warning methods to predict patients at risk of 30-day readmissions based on past admissions, ER visit rates, mortality rates, and charges. The dominant factors include clinical risk, costs, emergency room visits and mortality rates. The prediction showed nearly 88 percent accuracy.

■ SB38

38-Room 415, Marriott

Big Data II

Contributed Session

Chair: Christoph Wunck, Professor, Jade University of Applied Sciences, Friedrich-Paffrath-Str. 101, Wilhelmshaven, 26389, Germany, wunck@jade-hs.de

1 - Making Billions of Decisions a Day: Experiment Driven Bid Optimization in Online Advertising

Daizhuo Chen, PhD Candidate / Senior Data Scientist, Columbia Business School / Dstillery, 470 Park Avenue S, 6th Floor South, New York, NY, 10016, United States of America, dchen16@gsb.columbia.edu, Robert Phillips, Garrett Van Ryzin, Brian D'alessandro, Perlich Claudia

Online advertising is a good playground for operations researchers who want to explore the opportunities and pitfalls of the "Big Data" promise. This talk will focus on bid optimization: as an ad buyer, how to determine the best bid prices for billions of ad opportunities everyday, in today's dynamic and opaque marketplaces of real-time bidding. We introduce a solution based on continuous experimentation and optimization, and touch on a paradox of big data: you never have the data you need.

2 - Fast Gaussian Process Regression for Large Non-Stationary Spatial Data

Babak Farmanesh, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74074, United States of America, babak.farmanesh@okstate.edu, Arash Pourhabib

We propose Sparse Pseudo-input Local Kriging (SPLK) as a predictive model for large non-stationary spatial data. SPLK uses orthogonal cuts to create small domains, where it applies sparse Gaussian process regression. The orthogonal cuts enable SPLK to be applied to spatial datasets that include exogenous variables, hence having a dimension greater than three. We apply SPLK to real and simulated datasets and demonstrate it can efficiently predict the response variable.

3 - Advanced Decision-Making Procedures in Massive Failure Data Classification

Keivan Sadeghzadeh, Graduate Research Assistant, Northeastern University, 27 Payne Rd, Newton, MA, 02461, United States of America, k.sadeghzadeh@neu.edu, Nasser Fard

In many professional areas, management decision-making process is based on the type and size of data where data classification is a necessary procedure. Massive amount of data in high-dimensions are increasingly accessible from various sources and it has become more difficult to process the streaming data in traditional application approaches. This paper presents advanced procedures to analyze high-dimensional failure data in order to facilitate decision-making through data classification.

4 - Preprocessing of Manufacturing Process Signals using Wavelet-based Filters

Christoph Wunck, Professor, Jade University of Applied Sciences, Friedrich-Paffrath-Str. 101, Wilhelmshaven, 26389, Germany, wunck@jade-hs.de

Bringing Big Data to the shop floor is one of the current visions to increase product quality, process reliability and overall productivity in manufacturing. Extracting the information content hidden in the flood of sampled data of process variables in real time requires data reduction and filtering techniques that are not commonly applied in manufacturing processes. A case study on injection molding shows how wavelet-based data preprocessing can simplify any subsequent data analysis.

■ SB39

39-Room 100, CC

Interdisciplinary Focus on Problem Solving

Cluster: Operations/Marketing Interface

Invited Session

Chair: Kathleen Iacocca, University of Scranton, 439 Brennan Hall, Scranton, PA, United States of America, kathleen.iacocca@scranton.edu

1 - A Functional Robust Newsvendor Model with Uncertain Price-Sensitive Demand

Junxuan Li, Graduate Student Instructor, University of Michigan-Dearborn, 23935 W Outer Dr. Apt. H16, Melvindale, MI, 48122, United States of America, junxuanl@umich.edu, Jian Hu, Sanjay Mehrotra

A functional robust newsvendor model with coordination of pricing and inventory decisions in uncertain market is proposed, which specifies an uncertainty set of nonparametric demand curves and seeks the best decisions against the worst case. We discuss the impact of functional robustness and wholesale price and develop a cut generation algorithm for convex demand curve case, while reformulate the model as second-order conic program for concave case. A grocery store case study is then discussed.

2 - Supply Chain Robust Optimization: An Examination of the Relationship Between Flexibility, Agility

Sayed Nooraie, NCAT university, 2205 New Garden Rd #1210, Greensboro, NC, 27410, United States of America, snooraie@aggies.ncat.edu, Mahour Mellat Parast, Paul M Stanfield

A robust multi-objective mixed integer nonlinear programming model is defined for an Aggregate Production Planning (APP) incorporating three conflicting objective functions simultaneously. We propose a theoretical construct linking elements of uncertainty with aspects of agility and flexibility where we use responsiveness to enhance these elements to overcome the future risk.

3 - Spreadsheet Approach for Integrating Production, Marketing, and Finance Decisions in Aggregate Plans

Kathleen Iacocca, University of Scranton, 439 Brennan Hall, Scranton, PA, United States of America, kathleen.iacocca@scranton.edu, Kingsley Gnanendran

The well-known aggregate planning model is extended to explicitly incorporate demand forecasts as modified by any sales promotions, along with working capital constraints. The components of the extended model are implemented on a spreadsheet and linked using VBA programming to demonstrate the ease of managerial applicability. Optimal decision variables include workforce size; production, inventory, and outsourcing levels; and the magnitude and timing of price promotions and infusions of cash.

■ SB40

40- Room 101, CC

Organization Theory II

Contributed Session

Chair: Amit Das, Associate Professor, Qatar University, P.O. Box 2713, Doha, Qatar, amit.das@qu.edu.qa

1 - Refocusing Business Incubator Research: The Process of Business Incubation

David Scheaf, UNC Charlotte, 9201 University City Blvd, Charlotte, NC, United States of America, dscheaf@uncc.edu

Literature on business incubation resembles the early stages of entrepreneurship research. Research has focused on defining business incubators and the associated outcomes. The lack of a cohesive framework has resulted in numerous definitions that have prevented adequate theoretical development. Presented is a conceptualization of the incubation process and how various theories from the organizational sciences can inform future research.

2 - Performance in Knowledge Intensive Environments: Interplay of Worker and Managerial Experience

Juan Pablo Madiedo, PhD Candidate, IE Business School, Calle Maria de Molina 12, Bajo, PhD Program Office, Madrid, 28028, Spain, jpmadiedo.phd2014@student.ie.edu, Aravind Chandrasekaran, Fabrizio Salvador

This study examines the importance of workers and managers as sources of experience in a knowledge intensive work environment. We analyze the interplay of workers and managers and its effect on task performance. We use a dataset with information on over 1500 software maintenance tasks collected from a global IT and consulting corporation for testing our model.

3 - A Hybrid Social Network-system Dynamics Model of Team Performance

Kyle Lewis, Professor, U. California - Santa Barbara, 1318 Phelps Hall, Santa Barbara, CA, 93106, United States of America, klewisl@tmp.ucsb.edu, Edward Anderson

Social network analysis has explored many aspects of inter-personal interaction, yet it is limited in its power to describe important features of team behavior. We present a hybrid system dynamics-agent based methodology that extends the power of SNA to analyzing emergent team behavior. We present a proof-of-concept hybrid model and use it to simulate the: differential effects of hierarchy; impact of overspecialization; role of generalists; and disruption created by member turnover.

4 - IT Governance Mechanisms and Organizational Performance: Investigating the Moderating Role of Platform

Hossein Kalantar, PhD Student, University of Colorado Denver, 1475 Lawrence Street, Denver, CO, 80202, United States of America, Hossein.Kalantar@ucdenver.edu, Jiban Khuntia

Information Technology governance plays a key role in creating value through IT within an enterprise. There are studies that show the positive impacts of IT governance on organizational performance. However, there are not many studies that answer "How IT governance improves organizational performance". In this study, we investigate the moderating role of platforms, on the relationship between IT governance and organizational performance. Context of Health IT organizations was selected to conduct this study.

5 - Organizational Changes to Benefit from Big Data

Amit Das, Associate Professor, Qatar University, P.O. Box 2713, Doha, Qatar, amit.das@qu.edu.qa

While developments in computing have ushered in the age of Big Data, accounts of Big Data being actually used to improve the management of organizations are still relatively rare. We ascribe this to the incompatibility of traditional management practices with the form of evidence-based decision-making enabled by Big Data. We suggest that the profession of management is not alone in its struggle to incorporate Big Data into its established routines.

SB41

41-Room 102A, CC

Optimization Methods in Healthcare Scheduling

Sponsor: Manufacturing & Service Oper
Mgmt/Healthcare Operations
Sponsored Session

Chair: Retsef Levi, J. Spencer Standish (1945) Professor of Operations Management, Sloan School of Management, MIT, 100 Main Street, BDG E62-562, Cambridge, MA, 02142, United States of America, retsef@mit.edu

1 - Real-time Pooling for Multi-site Imaging Facilities

David Shmoys, Cornell University, School of ORIE, Rhodes Hall, Ithaca, NY, 14853, United States of America, david.shmoys@cornell.edu, Chaoux Tong, Shane Henderson

MRI patients waste a great deal of time in the waiting room; this is largely due to the misalignment between scheduled and actual imaging time. By selecting among a pool of nearby MRI facilities, we can redirect patients shortly before their scheduled appointment time. We demonstrate that this improved load-balancing can decrease patient waiting time. Working with New York Presbyterian Hospital, we are implementing a trial for our approach in a complicated real-life environment.

2 - Increasing throughput in a Large Oncology Infusion Unit

Ana Cecilia Zenteno Langle, Massachusetts General Hospital, 55 Fruit Street, White 400, Boston, MA, 02114, United States of America, azentenolangle@mgh.harvard.edu, Retsef Levi, Wendi Rieb, Inga Lennes, Mara Bloom, Bethany Daily, Peter Dunn

We describe a data-driven online scheduling algorithm aimed at generating a more predictable and balanced intra-day resource utilization in the Infusion Unit at the Massachusetts General Hospital Cancer Center. The implementation of the algorithm, which is based on integer optimization and simulation methods, has a projected impact of reducing by 30% the average peak utilization and its standard deviation by 35%. The hospital has contracted with an outside vendor to build a customized IT tool.

3 - Simultaneous Scheduling of Nurses in Multiple Hospital Units using Stochastic Integer Programming

Sanjay Mehrotra, Northwestern University, Industrial Engineering and Management, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, mehrotra@northwestern.edu, Kibaek Kim

We will present theoretical and computational results on simultaneous scheduling of nurses in multiple hospital units using a two-stage stochastic mixed integer programming model. The model allows a nurse pool as well as sharing of nurses from a more specialized unit to a lesser one. We show that the integrality of the second stage can be convexified in our model, which allows for the solution of larger scale models.

4 - Logic-Based Benders' Decomposition Approaches with Application to Operating Room Scheduling

Vahid Roshanaei, PhD Candidate, University of Toronto, 5 King's College Road, Toronto, ON, Canada, vroshana@mie.utoronto.ca, Dionne Aleman, David Urbach

We develop three logic-based Benders' decomposition (LBBD) approaches and a cut propagation mechanism to solve location-allocation integer programs (IPs). Each LBBD is implemented in four different ways, yielding 24 distinct LBBD variants. We illustrate the LBBDs' performance on the distributed operating room scheduling problem, where patients and operating rooms are scheduled across hospitals. Our LBBDs are 10-100x faster than IP+Gurobi and are more successful at finding optimal solutions.

SB42

42-Room 102B, CC

Healthcare Operations Modeling and Optimization

Sponsor: Manufacturing & Service Oper
Mgmt/Healthcare Operations
Sponsored Session

Chair: David Kaufman, University of Michigan, 1205 Beal Ave., 1710 IOE Building, Ann Arbor, MI, United States of America, davidlk@umich.edu

1 - Allocating Operating Room Time for Elective Surgery

Steven Shechter, Associate Professor, Sauder School of Business, University of British Columbia, University of British Columbia, Vancouver, BC, Canada, steven.shechter@sauder.ubc.ca, Mahesh Nagarajan, Stephanie Carew

We examine how to allocate operating room hours to different surgical specialties at the British Columbia Children's Hospital. This is a longer-run planning decision which has major effects on the wait time experience of the patient population. To evaluate policies, we construct and validate a simulation model of patient arrival and appointment processes. We then apply optimization and dynamic programming techniques to recommend improved allocation policies.

2 - Panel Size, Office Visits and Care Coordination Events in Primary Care

Hari Balasubramanian, University of Massachusetts Amherst, 160 Governors Drive, Amherst, MA, 01002, United States of America, hbalasubraman@ecs.umass.edu, Michael Rossi

Using the Medical Expenditure Panel Survey (MEPS, AHRQ), we present a method to estimate office visit and care coordination workload generated by patients in a primary care panel. The method uses individual patient histories for a one year period.

3 - Allocating Scarce Resources in a Patient Centered Medical Home (pcmh)

Jingxing Wang, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, jeffwjx@umich.edu, Romesh Saigal

We consider a two stage stochastic allocation problem to assign the number of hours of Primary Care Physician to teams in a PCMH. In the first stage, a preliminary assignment is made. In the second stage, the demand is observed and the preliminary assignment adjusted to meet it exactly. We use real options theory and present three ways to achieve a fair and consistent mechanism to price the disruption caused by adjustment. The assignments are made such that the price of disruption is the same.

4 - An Outpatient Planning Optimization Model for Integrated Care and Access Management

David Kaufman, University of Michigan, 1205 Beal Ave., 1710 IOE Building, Ann Arbor, MI, United States of America, davidlk@umich.edu, Jivan Deglise-hawkinson, Todd Huschka, Mark Van Oyen, Jonathan Helm

We present a data-driven methodology for outpatient scheduling. Our work is the result of a practice-based collaboration with a major medical destination center. Our capacity planning model seeks to meet visit targets on the time delay from the appointment request to the appointment occurrence by patient type while managing the patient mix, which is steered by goals such as increasing the volume of new patient visits. The focus of the talk is on model validation and insights.

■ SB43

43-Room 103A, CC

New Directions in Revenue Management

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Dan Iancu, Assistant Professor, Stanford University, 655 Knight Way, Stanford, CA, 94305, United States of America, daniancu@stanford.edu

Co-Chair: Omar Besbes, Professor, Columbia University, Graduate School of Business, New York, NY, 10027, United States of America, ob2105@columbia.edu

Co-Chair: Nikolaos Trichakis, HBS, ntrichakis@hbs.edu

1 - Dynamic Pricing in the Presence of Consumers with Stochastically Changing Valuations

Ying Liu, Stern School of Business, New York University, 44 West 4th Street, KMC 8-154, New York, NY, 10012, United States of America, yliu2@stern.nyu.edu, Rene Caldentey, Guillermo Gallego

Motivated by Revenue Management applications, we consider a firm selling a finite inventory of a perishable product to a population of price sensitive customers. We consider the case in which consumers' valuation for the product is not static but rather changes stochastically over time after they purchase the item. The firm can take advantage of this feature to buy back some units and resell them to new arrivals. We investigate the structure of an optimal buy/sell dynamic pricing strategy.

2 - Financing Capacity Investment under Demand Uncertainty

Francis De Vericourt, Professor, ESMT, Schlossplatz 1, Berlin, 101178, Germany, devericourt@esmt.org, Denis Gromb

We consider the capacity choice problem of a firm whose access to external capital markets is hampered by moral hazard. The firm must therefore not only calibrate its capacity investment, but also optimize its sourcing of funds. We find that when higher demand realizations are more indicative of high effort, debt financing is optimal. In this case, the optimal capacity is never below the efficient capacity level but sometimes strictly above that level.

3 - Points for Peanuts or Peanuts for Points: Dynamic Management of Loyalty Programs

So Yeon Chun, McDonough School of Business, Georgetown University, 3700 O St. NW, Washington, DC, United States of America, sc1286@georgetown.edu, Nikolaos Trichakis, Dan Iancu

We study the problem of dynamically managing a loyalty program. While originally viewed as marketing efforts, in the last two decades loyalty programs have grown substantially in size and scope, to the extent that they now often significantly interact with other firm functions, including operations, accounting and finance. We develop a dynamic programming model to study the problem of optimally setting prices and point requirements.

4 - Dynamic Pricing under Convex Incentives

Dan Iancu, Assistant Professor, Stanford University, 655 Knight Way, Stanford, CA, 94305, United States of America, daniancu@stanford.edu, Omar Besbes, Nikolaos Trichakis

We discuss optimal dynamic pricing policies when certain convex incentives govern the terminal payoffs. These could arise in a multitude of settings, including debt financing or sales incentives.

■ SB44

44-Room 103B, CC

Models of Customer Behavior

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Xuanming Su, The Wharton School, University of Pennsylvania, Philadelphia, United States of America, xuanming@wharton.upenn.edu

Co-Chair: Jaelynn Oh, The University of Utah, 1655 East Campus Center Drive, Spencer Fox Eccles Business Building, Salt Lake City UT, jaelynn.oh@business.utah.edu

1 - Mass Customization, Externalities, and Guardrail Products: iYou Can't be all Things to all People!

Eren Cil, University of Oregon, 1585 East 13th Avenue, Eugene, OR, United States of America, erencil@uoregon.edu, Michael Pangburn

Firms employ mass customization to closely match customers' taste with the delivered product. We additionally consider the brand-level issue of mismatch between customers' tastes and the firm's full range of products. We show that such a brand-level mismatch limits the usage of mass customization, even when costless to the firm, and makes the firm employ differential pricing.

2 - Cannibalization in Secondary Markets

Wedad Elmaghraby, Associate Professor, University of Maryland, University of Maryland, 4311 Van Munching Hall, College Park, MD, 20742, United States of America, welmaghr@rhsmith.umd.edu

We present results from a field experiment conducted on the platform of a leading business-to-business wholesale liquidators. By manipulating starting prices for auctions of iPads, we explore the presence of cannibalization and reference price effects in these online markets.

3 - Advance Selling with Reservations: Optimal Pricing and Overbooking Strategies

Jaelynn Oh, jaelynn.oh@business.utah.edu, Xuanming Su

Customers who make reservations in advance are guaranteed service when they show up. We study whether and how firms should charge for reservations and relate our results to advance selling strategies.

4 - Trade-in Remanufacturing, Strategic Customer Behavior, and Government Subsidies

Renyu Zhang, Doctoral Student, Olin Business School, Washington University in St. Louis, Campus Box 1133, 1 Brookings Drive, St. Louis, MO, 63130, United States of America, renyu.zhang@wustl.edu, Fuqiang Zhang

We study the impact of remanufacturing under strategic customer behavior and government subsidies. We find that trade-in remanufacturing can serve as an effective mechanism to mitigate strategic customer behavior, and that the adoption of remanufacturing and the government subsidies for remanufactured products may not lead to an environmentally better outcome. We also characterize the government subsidy/tax scheme that can induce the socially optimal outcome.

■ SB45

45-Room 103C, CC

Retail Pricing

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Goker Aydin, Indiana University, 1309 East Tenth Street, Bloomington, IN, 47405, United States of America, ayding@indiana.edu

1 - Group Buying under Consumer's Uncertainty

Victor Araman, American University of Beirut, Beirut, Lebanon, va03@aub.edu.lb, Skander Esseghaier

We develop a model of group buying under consumer uncertainty where a consumers' decision to acquire information and decision to share the acquired information is endogenously determined as a result of a game between these consumers. We determine the optimal group buying strategies and show that when there is sufficient heterogeneity across consumers with respect to their cost of information search and acquisition, group buying dominates the more traditional individual selling strategy.

2 - Online Inventory Disclosure: Consumer Uncertainty and Experience

Tolga Aydinliyim, Baruch College, One Bernard Baruch Way, Dept of Management Box B9-240, New York, United States of America, Tolga.Aydinliyim@baruch.cuny.edu, Michael Pangburn, Elliot Rabinovich

Given varied consumer perceptions of inventory information, online retailers' presentation of such information influences purchase behavior. We investigate optimal inventory disclosure policies assuming two distinct consumer segments: savvy consumers who can predict a retailer's stock levels (even when masked) and naive consumers who rely on priori (stochastic) beliefs regarding inventory.

3 - Better Late than Now: Delayed vs. Instantaneous Retail Price Discounts

Monire Jalili, University of Oregon, 1208 University of Oregon, Eugene, United States of America, mjalili@uoregon.edu, Michael Pangburn

Retailers commonly offer a percent off a purchase and apply it either immediately or toward a future purchase. Permitting rational, forward-looking consumers, we prove that delayed discounting can improve profitability if the market is heterogeneous.

4 - Why Markdown as Pricing Modality? Role of Entry Threat

Elodie Adida, University of California at Riverside, Riverside, CA,
elodie.goodman@ucr.edu, Ozalp Ozer

Retailers commonly use markdowns jointly with inventory rationing with the goal of creating scarcity and segmenting the market when consumers are strategic. We show that the presence of competition can help explain why markdown is a more sustainable pricing strategy than everyday-low-price. We also give a new rationale for inventory rationing as a need to maintain a market share for the competitor. We investigate how consumers' behavioral motives affect this rationing effect.

SB46

46-Room 104A, CC

Drivers of Employee Productivity in Service Settings

Sponsor: Manufacturing & Service Oper Mgmt/Service Operations
Sponsored Session

Chair: Anita Tucker, Associate Professor, Brandeis University,
415 South Street, Waltham, MA, 02453, United States of America,
atucker@brandeis.edu

1 - Collaboration and Professional Labor Productivity: An Empirical Study of Physician Workflows

Lu Wang, Kellogg School of Management, Northwestern University, 2001 Sheridan Road, 5th Floor, Evanston, IL, 60201, United States of America, vivianluluw@gmail.com,
Jan Van Mieghem, Kevin O'leary, Itai Gurvich

Theory predicts that simultaneous collaboration among professionals can introduce a capacity loss due to synchronization requirements. We empirically test the theory with the data collected from closely observing physicians at Northwestern Memorial Hospital in Chicago. We show that there exists a 21% potential productivity improvement if the task preemptions inherent in collaboration can be fully eliminated and estimate that more than 50% can be achieved by eliminating the task preemption cost.

2 - When You Work with a Super Man, Will You Learn to Fly?**An Empirical Study of the Impact of Coworkers**

Fangyun (Tom) Tan, Assistant Professor, Cox Business School, SMU, 6212 Bishop Blvd, Dallas, TX, 75275, United States of America, ttan@cox.smu.edu, Serguei Netessine

We use a large detailed operational data set from a casual restaurant chain to understand how peer effects affect servers' performance. In particular, we analyze the effect of coworkers' sales ability on how servers expend efforts in service speed (measured as meal duration) and quality (measured as sales), separately. Our study highlights a need for more nuanced approaches to leveraging peer effects in optimal scheduling decisions.

3 - How will the Increased Workload of Primary Care Providers Affect Patient Health?

Hessam Bavafa, Assistant Professor, Wisconsin School of Business, Madison, WI, United States of America, hbavafa@bus.wisc.edu

With the implementation of the Affordable Care Act in the United States, the healthcare system will experience an influx of newly insured patients with complex medical needs, thus increasing the workload of the primary care providers (PCPs). It is not clear how this increased workload will affect patient care. In this paper, we seek to understand the impact of primary care provider (PCP) workload on patients' access to care using a large dataset from the Veterans Health Administration.

4 - Queue Discretion, Batching, and Performance in Teleradiology

Maria Ibanez, Doctoral Candidate, Harvard Business School, Soldiers Field, Boston, MA, 02163, United States of America, mibanez@hbs.edu, Jonathan Clark, Robert Huckman, Bradley Staats

We examine how knowledge workers exert discretion on the order in which to execute tasks and the subsequent performance implications of those choices. Using two and a half years of data on more than 2.7 million cases read by outsourced radiologists working at one of the largest teleradiology firms in the US, we explore potential heuristics in ordering decisions, and how this endogenous ordering affects performance.

SB47

47-Room 104B, CC

The Sharing Economy

Sponsor: Manufacturing & Service Oper Mgmt/Sustainable Operations

Sponsored Session

Chair: Saif Benjaafar, Professor, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, saif@umn.edu

1 - Collaborative Consumption in Peer-to-peer Car Sharing

Saif Benjaafar, Professor, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, saif@umn.edu, Guangwen Kong, Xiang Li

We consider a two-sided market consisting of car owners and renters, mediated by an online platform. Individuals decide on whether to be owners or renters and the platform decides on rental prices, commission rates, and membership fees. We compare car ownership and car usage in economies with and without sharing and the corresponding social welfare, including environmental impact.

2 - The Last Mile of the Sharing Economy

Arun Sundararajan, Professor And Rosen Faculty Fellow, NYU, 44 West 4th Street, New York, NY, 10012, United States of America, asundara@stern.nyu.edu

Disruption associated with what is called the "sharing economy" is altering local logistics dramatically. In my talk, I will discuss recent research on the new economics of the last mile for physical products, analyzing whether they favor the emergence of Amazon-like digital channels that reduce physical store to intelligent warehouses, or an expansion of the footprint of local retail powered by third-party peer-to-peer delivery services.

3 - Collaborative Consumption: Strategic and Economic Implications of Product Sharing

Baojun Jiang, Olin Business School, Washington University, St. Louis, MO, 63130, United States of America, baojunjiang@wustl.edu, Lin Tian

This paper examines the strategic and economic impacts of collaborative consumption-product sharing among consumers. Our analysis shows that friction in the product-sharing market may have a non-monotonic effect on the firm's profits, consumer surplus, and social welfare. When the firm strategically chooses its retail price, product sharing among consumers can be either win-win or lose-lose for the firm and the consumers, depending on whether the firm's marginal cost is high or low.

4 - The Sharing Newsboys

Ming Hu, Associate Professor, University of Toronto, 105 St. George Street, Toronto, Canada, Ming.Hu@Rotman.Utoronto.Ca

We study resource sharing behavior among a network of connected newsboys. Our focus is to investigate the impact of network structure on the sharing behaviors.

SB48

48-Room 105A, CC

Quality and Compliance Enforcement in the Supply Chain

Sponsor: Manufacturing & Service Oper Mgmt/Sustainable Operations

Sponsored Session

Chair: Saed Alizamir, Assistant Professor, Yale University, 165 Whitney Ave, New Haven, CT, 06511, United States of America, saed.alizamir@yale.edu

1 - Quality Certification under Poor Legal Enforcement

Mariya Bondareva, PhD Candidate, University of Rochester, Simon School PhD Program, UoR, 500 Joseph C. Wilson B., 4-345 Carol Simon, Rochester, NY, 14627, United States of America, Mariya.Bondareva@Simon.Rochester.edu, Edieal Pinker

Outsourcing to developing countries is complicated by imperfect quality monitoring and inefficient legal enforcement. To ensure quality, the brands can use self-enforcing contracts. We study dynamic relational contracts using certification, inspections and penalties and determine when the certification mechanism is justified. The optimal equilibrium is characterized by non-decreasing expected profits for suppliers, non-decreasing penalties for quality failures and non-increasing defect rates.

2 - Increasing the Quality of Agricultural Produce in Developing Countries

Andre Calmon, Assistant Professor, INSEAD, Boulevard de Constance, Fontainebleau, 77300, France, andre.calmon@insead.edu, Sameer Hasija

We introduce and analyze a model to capture the interaction between farmers and retailers in agricultural supply chains that are common in the developing world. Namely, we discuss the problem of a retailer that sources perishable goods from small farmers. The quality of a crop depends on the effort that the farmer exerts and this effort is non-contractable. This problem emerged from a collaboration with a large supermarket chain that has operations in Asia.

3 - Cooperative Approaches to Managing Supplier Quality: Joint Auditing and Information Sharing

Xin Fang, Assistant Professor, Singapore Management University, 50 Stamford Road, #05-01, Singapore, 178899, Singapore, xfang@smu.edu.sg, Soo-Haeng Cho

Product safety incidents in recent years have compelled manufacturers to rethink approaches to manage product quality of their suppliers. We investigate two cooperative approaches: auditing common suppliers jointly ("joint auditing") and sharing independently collected information with other manufacturers ("information sharing"). Our analysis reveals that, while competing manufacturers may voluntarily cooperate with each other, such cooperation does not necessarily improve product safety.

4 - Managing a Responsible Supply Chain under Threat of Public Disclosure

Saed Alizamir, Assistant Professor, Yale University, 165 Whitney Ave, New Haven, CT, 06511, United States of America, saed.alizamir@yale.edu, Sang Kim

We analyze a game-theoretic model in which a downstream supply chain member ("buyer") is penalized disproportionately due to a compliance violation by an upstream member ("supplier"). Buyer's ability to audit the supplier is limited, and she faces a risk of being publicly blamed after the supplier's violation is caught by a third party. Supplier exerts effort to enhance compliance in each period, but risks having his relationship terminated due to a stochastic compliance outcome.

SB49

49-Room 105B, CC

Understanding and Managing Risk in Extended Supply Chains

Sponsor: Manufacturing & Service Oper Mgmt/Supply Chain
Sponsored Session

Chair: Robert Swinney, Associate Professor, Duke University, 100 Fuqua Dr, Durham, NC, 27708, United States of America, robert.swinney@duke.edu

1 - Disruption Cascades and Risk Mitigation in Supply Chains

Shyam Mohan, London Business School, London, NW14SA, United Kingdom, smohan@london.edu, Nitin Bakshi

Disasters such as the Tohoku earthquake in Japan and Thai floods in 2011 serve as a reminder about the extent to which a supply chain is vulnerable to disruptions. The resulting losses arise not only through direct damage but also from disruptions to suppliers belonging to adjacent tiers. As per a recent study, nearly 40% of the disruptions originate in tier 2 and beyond. In this paper, we study the relationship between network structure and disruption cascades in supply chain networks.

2 - Contracting for Shared Value: Efficiencies from Endogenous Process Yield

Joann De Zegher, PhD Candidate, Stanford University, 473 Via Ortega, Stanford, CA, United States of America, jfdezegher@stanford.edu, Dan Iancu, Hau Lee

We focus on agricultural value chains where farmers have an opportunity to create value through the adoption of a new management practice, but the economic benefit is either too small for the farmers or accrues primarily to other parties in the supply chain. In a setting with uncertain and endogenous process yield, we study two components of supply chain design – namely contracts and sourcing channels – as possible mechanisms for creating shared value in decentralized value chains.

3 - Risky Suppliers or Risky Supply Chains?

Yixin Iris Wang, Ross School of Business, University of Michigan, 701 Tappan Street R3410, Ann Arbor, MI, 48109, United States of America, iriswang@umich.edu, Ravi Anupindi, Jun Li

The goal of this research is to assess interdependency of risks in supply network and to understand the process of risk aggregation using firm-level supplier relationship data. We concentrate on the impact of tier-2 overlapping. Our research aims to help firms manage risks more efficiently and acknowledge sub-tier importance.

4 - Supply Chain Disruptions: Evidence from the Great East Japan Earthquake

Alireza Tahbaz-Salehi, Columbia Business School, 3022 Broadway, Uris Hall 418, New York, NY, 10023, United States of America, alirezat@columbia.edu, Vasco Carvalho, Makoto Nirei, Yukiko Saito

This paper examines whether propagation of idiosyncratic, firm-level shocks through input-output linkages can lead to sizable fluctuations at the aggregate level. Using a large-scale dataset on supply chain linkages among Japanese firms together with information on firm-level exposures to a large, but localized, natural-disaster (the Great East Japan Earthquake in 2011) we quantify the earthquake's impact on firms that were (directly or indirectly) linked to affected firms.

SB50

50-Room 106A, CC

Designing Dynamic Markets

Sponsor: Manufacturing & Service Operations Management
Sponsored Session

Chair: Kostas Bimpikis, Stanford GSB, 655 Knight Way, Stanford, CA, 94305, United States of America, kostasb@stanford.edu

1 - Auctions for Assortments of Differentiated Products: Design and Applications

Daniela Saban, Stanford University, 655 Knight Way, Stanford, CA, United States of America, dsaban@stanford.edu, Gabriel Weintraub

We study the problem of a procurement agency using an auction to construct an assortment of differentiated products, to satisfy the demand from heterogeneous customers. This setting arises in "framework agreements" (FAs), commonly used in public procurement. Using mechanism design and auction theory, we propose recommendations to improve the design of FAs. We apply our results to the FAs run by the Chilean government to buy US\$2 billion worth of goods per year.

2 - Mean Field Equilibria in Competitive Exploration

Krishnamurthy Iyer, Assistant Professor, School of Operations Research and Information Engineering, Cornell University, 225 Rhodes Hall, Ithaca, NY, 14853, United States of America, kriyer@cornell.edu, Pu Yang, Peter Frazier

We study a dynamic setting where multiple agents each explore a set of locations. Each location receives stochastic rewards over time, which is shared among all agents at that location. Based on the location's reward level and the number of other agents at that location, each agent decides whether to stay or switch to a new location. We study the equilibrium behavior as the number of agents and locations increase proportionally, and investigate the effect of information sharing.

3 - Designing Dynamic Contests

Shayan Ehsani, Stanford University, 450 Serra Mall, Stanford, CA, 94305, United States of America, shayane@stanford.edu, Mohamed Mostagir, Kostas Bimpikis

Tournaments are best suited for projects that feature a high degree of uncertainty. Information about the status of competition leads to an interesting tradeoff: participants learn about the underlying state from their competitors' progress but on the other hand their incentive to exert effort may weaken if they are lagging behind. We characterize the design that maximizes the (discounted) payoff for the principal and discuss its implications.

4 - Dynamic Mechanism Design with Budget Constrained Buyers under Non-commitment

Santiago Balseiro, Assistant Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, srb43@duke.edu, Omar Besbes, Gabriel Weintraub

We study the dynamic mechanism design problem of a firm repeatedly selling items to budget-constrained buyers when the seller has no commitment power. We argue that this problem is generally intractable. Thus motivated we introduce a fluid model that allows for a tractable characterization of the optimal mechanism. We leverage our characterization to provide insights into the dynamic structure of the optimal mechanism and show that the proposed mechanism is a good approximation in large markets.

■ SB51

51-Room 106B, CC

Retail Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Amy Pan, Assistant Professor, University of Florida, Dept. of ISOM, Warrington College of Business Administration, Gainesville, FL, 32608, United States of America, amy.pan@warrington.ufl.edu

Co-Chair: Dorothee Honhon, Associate Professor, University of Texas at Dallas, 800 W. Campbell Road, Richardson, TX, 75080, United States of America, Dorothee.Honhon@utdallas.edu

1 - Do MOOCs Work in Retail? Improving Store Execution through Online Learning

Santiago Gallino, Tuck School of Business, 100 Tuck Hall, Hanover, NH, United States of America, santiago.gallino@tuck.dartmouth.edu, Youran Fu, Serguei Netessine

Conversion of retail store traffic into sales depends heavily on store execution. Although a critical piece, performance improvement of sales associates through training has received relatively scant research effort. We focus on a very specific type of training: online learning. Available to date analysis of MOOCs indicates poor engagement of the participants and questionable outcomes. Our analysis shows that online training has a strong positive impact on employee sales performance.

2 - Backroom Effect in Shelf Space Optimization

Zumbul Atan, Assistant Professor, TU/e, Eindhoven, Eindhoven, Netherlands, Z.Atan@tue.nl, Nesim K. Erkip, Tim Huh

Most retailers use backrooms as extra storage space. Backrooms are necessary when inventories do not fit to the available shelf space. We study a continuous review (r,q) policy with limited shelf capacity. We determine the optimal policy parameters and the optimal shelf space and quantify the benefits of considering the existence of backrooms when making replenishment decisions.

3 - Probabilistic Selling for Vertically Differentiated Products

Quan Zheng, Student, University of Florida, Department of ISOM, Gainesville, FL, 32611, United States of America, quanzheng@ufl.edu, Janice E. Carrillo, Amy Pan

We investigate the probabilistic selling strategy for vertically differentiated products. Both deterministic and stochastic demand models are explored. The results show that capacity constraints and demand uncertainty play important roles. The probabilistic products could be offered alone in the deterministic demand model while they are offered alone or with the low quality products in the stochastic demand model.

4 - The Impact of Consumer Search Cost on Assortment Planning and Pricing

Ruxian Wang, Johns Hopkins University, 100 International Dr, Baltimore, MD, 21202, United States of America, ruxian.wang@jhu.edu, Ozge Sahin

We incorporate search cost into consumer choice: a consumer first forms her consideration set; she evaluates and chooses the highest-utility product. We propose the k-quasi attractiveness-ordered assortment and show that it is arbitrarily near-optimal. Assortment problems are generally NP-hard, so we develop efficient exact and approximation algorithms. We propose a new pricing strategy and investigate its optimality: the quasi-same-price policy with a same price for all products except one.

■ SB52

52-Room 107A, CC

Uncertainty and Performance of Service Processes

Sponsor: Service Science

Sponsored Session

Chair: Genady Grabarnik, St. John's University, 8000 Utopia Parkway, Queens, NY, 11439, United States of America, grabarnig@stjohns.edu

1 - Palm Khinchine Theorem and Performance Evaluation under Uncertainty

Genady Grabarnik, St. John's University, 8000 Utopia Parkway, Queens, NY, 11439, United States of America, grabarnig@stjohns.edu, Yefim Haim Michlin, Larisa Schwartz

We refine estimates for Palm Khinchine theorem, which allows us to tighten boundaries for comparison performance evaluation in sequential testing

2 - Recommending Resolutions for Monitoring Tickets in Automated Service Management

Larisa Schwartz, lshwart@us.ibm.com, Genady Grabarnik

We study the problem of automated resolution recommendation for monitoring tickets. We analyzed monitoring tickets from a production service infrastructure and identified a vast number of repeated resolutions. We improve the similarity measure in comparison to prior work by utilizing both the description and resolution information from historical tickets via a topic-level feature extraction using the LDA model. Furthermore effective similarity measure is learned using metric learning.

3 - Comparison Performance Evaluation for Services Systems

Yefim Haim Michlin, Senior Research Fellow, Technion - Israel Institute of Technology, Faculty of IEM, Technion City, Haifa, 32000, Israel, yefim@technion.ac.il, Ofer Shaham, Genady Grabarnik

Enterprises spend significant effort on introduction of innovations. We suggest a novel method based on Wald's sequential test idea to identify performance gain by running comparison test. The advantage in comparison to the existing tests suggested in textbooks and standards are: more strict limitation on maximum number of trials, wider range of failure ratio, variable risks and wider discrimination ratio. Suggested methodology is oriented on usage by product designers and quality engineers.

■ SB53

53-Room 107B, CC

From Behavioral/Experimental Economics to Behavioral Operations: Opportunities and Challenges

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Tony Haitao Cui, Associate Professor, University of Minnesota, Carlson School of Management, Minneapolis, MN, 55455, United States of America, tcui@umn.edu

1 - Non-equilibrium Models in Games

Teck-Hua Ho, William Halford Jr. Family Professor of Marketing, University of California, Berkeley, Berkeley, CA, 94720-1900, United States of America, hoteck@haas.berkeley.edu

The notion of equilibrium is central to economic analysis. Standard equilibrium analysis relies on strong assumptions of human cognitive ability, which often do not match actual behavior. Based on this, we explain why management science should embrace non-equilibrium models. We describe recent research on them and discuss the promise that they hold based on their ability to predict better than equilibrium analysis, behavior observed in more than 100 laboratory experiments and field settings.

2 - Economics and Operations: Similarities and Differences

Rachel Croson, Dean, College of Business, University of Texas at Arlington, Arlington, TX, 76019-0377, United States of America, croson@uta.edu

This presentation will identify some of the similarities and differences between the underlying fields of economics and operations, with a goal of highlighting how experimental and behavioral research should be differentially applied to each field.

3 - The Effect of Bargaining on Testing Operations Management Models

Elena Katok, Ashbel Smith Professor of Supply Chain Management, University of Texas at Dallas, 800 W. Campbell Rd., Dallas, TX, 75080, United States of America, ekatok@utdallas.edu

OM models that involve strategic interactions are usually silent about the bargaining process. The outcome of laboratory tests of these models, however, can critically depend on how the bargaining is implemented. I will discuss the challenges and opportunities of incorporating bargaining in laboratory tests.

■ SB54

54-Room 108A, CC

Pricing Inspired by Data and Practice

Cluster: Tutorials

Invited Session

Chair: Georgia Perakis, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, georgiap@mit.edu

1 - Tutorial: How Analytics Can Impact Promotion Pricing

Georgia Perakis, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, georgiap@mit.edu, Lennart Baardman, Maxime Cohen, Swati Gupta, Jeremy Kalas, Zachary Leung, Danny Segev, Kiran Panchangam, Anthony Smith

Pricing has seen exciting developments in the recent years. A particular area of pricing that has recently emerged is promotion pricing. In many important settings such as in grocery retail, promotions are a key instrument for driving sales. The Promotion Optimization Problem is a challenging problem as the retailer needs to decide which products to promote, what is the depth of price discounts, when to schedule the promotions and how to promote the product. We will discuss our collaboration with Oracle RCU on how analytics can have a key impact.

■ SB55

55-Room 108B, CC

Airline Revenue Management and Customer Choice

Sponsor: Aviation Applications

Sponsored Session

Chair: Emmanuel Carrier, Delta, emmanuel.carrier@delta.com

1 - Estimation of Airline Itinerary Choice Models using Disaggregate Ticket Data

Laurie Garrow, Georgia Institute of Technology, Mason Building, Atlanta, GA, United States of America, laurie.garrow@ce.gatech.edu, Virginie Lurkin, Michael Schyns

Airline itinerary choice models support many multi-million dollar decisions, i.e., they are used to evaluate potential route schedules. Classic models suffer from major limitations, most notably they use average fare information but to not correct for price endogeneity. We use a novel database of airline tickets to estimate itinerary choice models using detailed fare data and compare these to classic itinerary choice models that use aggregate fare information but correct for price endogeneity.

2 - Insights from Mining Airline Booking Data

Catherine Cleophas, RWTH Aachen, Kackertstrasse 7, 52070, Germany, catherine.cleophas@rwth-aachen.de, Sebastian Vock, Laurie Garrow

We present a new perspective on airline booking data by comparing data from geographically and temporally distinct travel itineraries. To this end, we mine several hundred origin-destination-carrier combinations and several thousand itineraries. By clustering booking class distributions, we measure market similarity. The goal is to use cluster-adherence to compute decision trees, so as to investigate the relevance of traditional assumptions about market differentiation.

3 - Nonparametric Estimation of Demand Structures in Airline Revenue Management

Johannes Jürg, RWTH Aachen University, Kackertstr. 7, Aachen, 52072, Germany, johannes.ferdinand.joerg@ada.rwth-aachen.de, Catherine Cleophas

A central theme of airline revenue management is analyzing historical booking data to draw conclusions on the underlying demand structure. This contribution focuses on the estimation of demand segments present in a market using nonparametrical methods on panel data. We employ finite mixtures to model booking events over time frames and to obtain an estimator for the number of demand segments and their probability distribution over products.

■ SB56

56-Room 109A, CC

Location Applications

Sponsor: Location Analysis

Sponsored Session

Chair: Mihiro Sasaki, Professor, Nanzan University, 18 Yamazato, Showa, Nagoya, 466-8673, Japan, mihiro@nanzan-u.ac.jp

1 - A New Formulation for Energy-efficient Aggregation of Virtual Machines in Cloud Data Centers

Hajime Miyazawa, Nanzan University, 18 Yamazato-cho, Showa-ku, Nagoya, 4668673, Japan, miyazawa@nanzan-u.ac.jp, Mihiro Sasaki

One of the main concerns of cloud computing is energy consumption in data centers. Appropriate aggregation of virtual machines (VMs), which are the computing entities of cloud computing, on limited number of physical servers in data centers can reduce energy consumption by shutting down the rest of the servers. We present a new formulation of assigning VMs among physical servers to achieve energy-efficient VM aggregation in cloud data centers.

2 - Mathematical Properties of New Indices for Evaluating Spatial Demand-and-supply Balance

Takamori Ukai, Tokai University, 143 Shimokasuya, Isehara, 2591193, Japan, ukai@tsc.u-tokai.ac.jp, Mihiro Sasaki

In this presentation, we show some mathematical properties of new indices for evaluating spatial demand-and-supply balance. More precisely, we show that the sequence of solutions generated by the iterative algorithm converges to the proposed indices. We also discuss the relationship between the solutions and those obtained by solving a mathematical programming problem with an objective of minimizing the variance of indices. The objective corresponds to minimize unfairness among customers.

3 - Optimal Location Model for Anti-piracy Activity in Somalia

Daisuke Watanabe, Associate Professor, Tokyo University of Marine Science and Technology, 2-1-6 Etchujima, Koto-ku, Tokyo, 135-8533, Japan, daisuke@kaiyodai.ac.jp, Richard Church

A significant number of pirate attacks have occurred off the coast of Somalia. This is a major threat to ships navigating the major sea lane between Asia and Europe. The purpose of this study is to analyze the optimal location for anti-piracy activity in Somalia using the maximal covering location model.

4 - Optimal Real-time Pricing of Electricity for Supply and Demand Control in a Smart Community

Mihiro Sasaki, Professor, Nanzan University, 18 Yamazato, Showa, Nagoya, 466-8673, Japan, mihiro@nanzan-u.ac.jp, Yoichi Tanaka, Yasuaki Oishi, Masao Fukushima, Masaki Yasunishi

We consider a smart community where the supplier of electricity presents the electricity price varying with different time, and consumers determine their own optimal levels of buying/selling electricity in responding to the time-varying price. We formulate the problem of finding supplier's optimal pricing as a bilevel programming problem. Computational results show that real-time pricing can effectively control supply and demand of electricity.

■ SB57

57-Room 109B, CC

Electricity Market Models

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Hung Po Chao, Energy Trading Analytics, 2842 Main St., Suite 206, Glastonbury, CT, 06033, United States of America, hungpo.chao@gmail.com

1 - Decentralized Markets with LMP for Efficient Congestion Management of Renewable Electricity Feed-in

Hans Schermeyer, Research Associate, Karlsruhe Institute of Technology, Hertzstr. 16, Karlsruhe, 76187, Germany, hans.schermeyer@kit.edu, Valentin Bertsch, Wolf Fichtner

In this work, we analyse electricity grid congestion caused by renewables and their necessary curtailment on distribution grid level. To explore the possibilities of enhanced congestion management, we develop an agent-based simulation model that represents a distribution grid in Germany which faces frequent congestion caused by renewables. Inspired by (Distribution) Locational Marginal Pricing theory we implement a decentralized market design for a more efficient congestion management.

2 - Operational Flexibility in Dutch Electricity Markets

Robin Broder Hytowitz, Johns Hopkins University, 3400 North Charles Street, Ames 313, Baltimore, MD, United States of America, robin.hytowitz@gmail.com, Ozge Ozdemir, Benjamin Hobbs

A two-stage study is performed to evaluate the impact of renewable energy on operational flexibility in the Dutch market given current demand projections. A unit commitment model for a pan-European network simulates the day-ahead market, and the successive balancing market is simulated for the Netherlands alone. The two stages are run for several business cases to analyze resources that can provide further flexibility, including demand-side management, storage, and reserve constraints.

3 - A Market Mechanism for Electric Distribution Networks

Na Li, Assistant Professor, Harvard University, 33 Oxford St,
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An efficient electricity market in distribution networks plays an important role in incentivizing end-users to participate in smart grid. However, the externalities associated with the voltage capacity constraints and line losses constitute a significant barrier. In this paper, we present a market mechanism to internalize the external effects within private decisions by defining trading rules. A competitive market is established to achieve a social optimum within a radial distribution network.

4 - Ramsey Pricing of Transmission System Platform

Hung Po Chao, Energy Trading Analytics, 2842 Main St., Suite
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This paper examines second-best pricing for jointly optimized investments in a transmission network subject to a budget constraint. Ramsey pricing I works by setting energy prices to raise revenue to cover investment costs, and Ramsey pricing II obtains revenue from injection and withdrawal charges. We show that Ramsey pricing II achieves allocation that not only is better than Ramsey pricing I but achieves nearly the first-best allocation.

SB58

58-Room 110A, CC

Smart Grids and Demand Response

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Mahdi Kefayati, Senior Software And Control Engineer, Electric Power Engineers, Inc., 13001 Highway 71, Suite G100, Austin, TX, 78738, United States of America, kefayati@utexas.edu

1 - Optimizing Intelligent Infrastructure Coupled with the Power Grid

Mahnoosh Alizadeh, Stanford University, Packard EE Building,
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United States of America, malizade@stanford.edu,
Andrea Goldsmith

Electric utilities are leveraging smart grid networks to extend demand response programs to a broad class of loads. What is commonly ignored is that a significant amount of flexibility that DR programs aim to harness will be due to electricity consumption that supports the delivery of goods and services by other networked infrastructure. Thereby, DR could introduce a complicated closed-loop interaction between the power grid and various other infrastructures that we highlight in this talk.

2 - Plug-in Vehicle to Home (V2H) Operation under a Grid Outage

Hunyoung Shin, University of Texas at Austin, 1616 Guadalupe
UTA, Austin, TX, 78759, United States of America,
hunyoung@utexas.edu, Ross Baldick

During a grid outage, Vehicle to Home (V2H) system with photovoltaic generation can be used to create a small micro-grid. In this work, we investigate V2H operation under a grid outage that provides backup power without the help of an external electric grid. First, we introduce a novel optimization model that maximizes backup duration. Motivated by the solution of optimization problem, a new algorithm for V2H system is suggested. Then we extend the work to Vehicles-to-Homes (V2Hs) system.

3 - Convexification of Power Flow Problem over Arbitrary Networks

Javad Lavaei, Assistant Professor, UC Berkeley, 4121 Etcheverry
Hall, University of California, Berkeley, CA, 94720, United States
of America, lavaei@berkeley.edu, Ramtin Madani, Ross Baldick

Consider an arbitrary power network with PV and PQ buses, where active powers and voltage magnitudes are known at PV buses, and active and reactive powers are known at PQ buses. The classical power flow (PF) problem aims to find the unknown complex voltages at all buses. The objective of this talk is to propose a class of convex optimization problems with the property that they all solve the PF problem as long as the solution belongs to a good regime containing voltage vectors with small angles.

4 - Ancillary Services Potential of Plug-in Electric Vehicle Charging

Mahdi Kefayati, Senior Software And Control Engineer, Electric Power Engineers, Inc., 13001 Highway 71, Suite G100, Austin, TX, 78738, United States of America, kefayati@utexas.edu, Ross Baldick

Taking a data driven approach, we show that, plug-in electric vehicles can provide a substantial amount of ancillary services. We propose algorithms to realize this potential and demonstrate that in ERCOT market, as an example, less than 20% electrification can potentially cover all regulation service needs.

SB59

59-Room 110B, CC

Underground Mining

Sponsor: ENRE – Natural Resources I – Mining

Sponsored Session

Chair: Alexandra Newman, Professor, Colorado School of Mines, Mechanical Engineering, Golden, CO, 80401, United States of America, anewman@mines.edu

1 - Logistics Planning at LKAB

Mikael Ronnqvist, Professor, Université Laval, 1065, Avenue de la
Médecine, Québec, QC, Canada, mikael.ronnqvist@gmc.ulaval.ca,
Patrik Flisberg, Olivier Sirois, Dick Carlsson

The logistic planning at a mining company is a complex task. There are large volumes of products of uncertain quality and many unforeseen events. There is a need to keep inventories within distinct bounds and use the fleet of train systems in an efficient way. We report on some planning models based on optimization and describe results from tests.

2 - Maintenance Planning of Freight Train for a Mining Company

Olivier Sirois, Student, Université Laval, 1065, Avenue de la
Médecine, Québec, QC, Canada, olivier.sirois.1@ulaval.ca

We conduct an analysis based on a simulation model of a real-case railway network for LKAB, a large mining company, on which we investigate two maintenance planning issues. First, the implementation of a strategic planning for locomotives maintenance is evaluated in terms of capacity usage of the maintenance facility throughout a fixed horizon. Second, we analyzed different strategies for post maintenance wagons sorting in order to minimize the shunting time linked to those operations.

3 - Crown Pillar Placement in an Open-Pit-to-Underground Mining Transition

Barry King, PhD Candidate, Colorado School of Mines, 1500
Illinois Street, Golden, CO, 80401, United States of America,
barking@mymail.mines.edu

Open pit and underground mine planning, i.e., scheduling three-dimensional, notional blocks to maximize a deposit's value, are often performed independently. We show how the placement of the crown pillar (that separates open pit and underground operations) is affected by discount rate, production capacities, and metal content of the deposit. Our methodology incorporates scheduling at the block level, accounts for detailed precedence and capacity constraints, and allows for parametric analysis.

4 - From Opening Towards Closing a Mine – A Case for Popmusic and Generalized Local Branching?

Alessandro Hill, Hamburg University of Technology,
Schwarzenbergstrasse 95 D, Hamburg, Germany,
alessandro.hill@tuhh.de, Stefan Voss

Within our research on sustainable mining we came across the needs to develop some solid closure plans for mining. Here we investigate to which extent combinatorial optimization may be useful in the lifecycle of a mine including its eventual closure. For some problems we encountered the option to apply matheuristics like POPMUSIC or generalized local branching being successful while others are more of a handwaving nature. We exemplify in both cases with specific examples and related results.

SB60

60-Room 111A, CC

Case Competition I

Sponsor: INFORM-ED

Sponsored Session

Chair: Palaniappa Krishnan, Associate Professor, University of Delaware, 212 Townsend Hall, 531 S.College Avenue, Newark, DE, 19711, United States of America, baba@udel.edu

1 - Using Optimization for Team Information

Wendy Roth, Assistant Professor, Georgia State University,
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United States of America, wroth@gsu.edu

Introductory Business Modeling classes often focus on types of models (linear, integer and nonlinear) and tool usage to solve various problems. Textbook and single solution cases help develop skills, but are often more straight forward than the business problems students will face in their careers. Additionally, the subjects of these problems, including production, can be unfamiliar or uninteresting to many students. This case focuses on something students are very familiar with, dividing participants into teams. Since there are many ways teams can be formed, this case is created to encourage groups to take different approaches to solve this problem.

2 - Baseball- Discovering the Moneyball Effect

Sean Barnes, University of Maryland, 4352 Van Munching Hall,
University of Maryland, College Park, MD, 20742, United States
of America, sbarnes@rhsmith.umd.edu, Margret Bjarnadottir

This case uses player evaluation and personnel decision-making in the Major League Baseball to introduce many of the key steps of data mining projects. The data mining process is a unique combination of art and science, and teaching the art of data mining is challenging to do in a standard classroom setting with small data sets. The goal of this case is to move beyond the simple "cookie cutter" data sets, and introduce students to the challenges of dealing with real data to answer important questions, as well as introduce or reinforce multiple data mining methods. The case builds on a very rich data set collected by the authors, which allows for students or groups of students to arrive at very different answers to the same question. For example, what is the best predictive model? Which players should be pursued?

3 - Medication Waste Reduction in an In-hospital Pharmacy: A Case that Bridges Problem Solving between a Traditional Case and an Industry Project

Gregory Dobson, University of Rochester, University of Rochester,
Rochester, NY, United States of America,
greg.dobson@simon.rochester.edu, Vera Tilson

This Operations Management case describes a waste-reduction project in a compounding pharmacy in a hospital. Every day, pharmacy technicians prepare a large number of patient-specific medication doses and then deliver these doses to various hospital units. With the rising cost of medications, pharmacy managers become concerned that a significant number of compounded medication doses are not administered to patients and are subsequently wasted. The students are asked to quantitatively evaluate proposed changes to the compounding and delivery process and to estimate savings from process reconfiguration. Two large datasets are provided with the case to facilitate hypothesis generation regarding probable causes of waste and to analyze proposed changes. The analysis will deepen students' spreadsheet skills as well as mathematical modeling of inventory problems. The case is presented in parts, and it is discussed over one and a half class meetings – simulating the steps of a field project: interviewing a client, framing the client's problem, formulating a data request, and then analyzing the data and delivering a recommendation. This case has been used in a core MBA operations management class; it could also be used in a health-care operations or in a business modeling course.

SB61

61-Room 111B, CC

Dimensionality Reduction Techniques for Generation Capacity Expansion Problems with Intermittent Resources

Sponsor: ENRE – Energy II – Other (e.g., Policy, Natural Gas, Climate Change)

Sponsored Session

Chair: Fernando de Sisternes, Argonne National Laboratory - MIT
Energy Initiative, 77 Massachusetts Avenue, E19-341, Cambridge, MA,
02139, United States of America, ferd@mit.edu

1 - On the Temporal Resolution of Electric Sector Capacity Expansion Models

James Merrick, Stanford University, Huang Engineering Center,
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When hours are assumed to be independent, we can capture hourly information by removing similar hours and weighting a representative. Applying hierarchical clustering to a sample dataset, I show that while the variability of demand can be captured in the order of 10 hours, including wind and solar resources warrants in the order of 1000. A similar analysis is undertaken for days and weeks. I conclude with how the approach can reduce resolution further using information about problem structure.

2 - A Robust Method to Choose Representative Weeks in Renewable Generation Capacity Expansion Problems

Fernando de Sisternes, Argonne National Laboratory - MIT
Energy Initiative, 77 Massachusetts Avenue, E19-341, Cambridge,
MA, 02139, United States of America, ferd@mit.edu,
Ignacio Núñez

We propose a new week selection method for capacity expansion formulations with unit commitment constraints that is robust to the renewable capacity in the system. This method enables the use of such formulations in determining the optimal amount of thermal and renewable capacity. The proposed method selects a week combination with hourly resolution that represents the energy below the net load duration curve and its inter-temporal variability across different renewable capacity scenarios.

3 - Optimization-based Method for Scenario Reduction in Generation Expansion Models

Ignacio Núñez, Research Assistant Professor, University of the
Andes, Av. Monseñor Alvaro del Portillo 12.455, Las Condes,
Santiago, RM, 7620001, Chile, ijnunez@uandes.cl, Fernando de
Sisternes

Including intermittent generation in generation expansion models requires a detailed representation of the short-term operation of the system, increasing dramatically the dimensionality of the problem. We present a mixed integer linear model that selects a specific number of representative scenarios (e.g. days or weeks) and weights to minimize the maximum error in representing the net load duration curve for different capacities of solar photovoltaic and wind power.

4 - Modeling a Paradigm Shift: Distributed vs. Centralized Options in Electricity Capacity Planning

Jesse Jenkins, PhD Student And Researcher, MIT Engineering
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Distributed energy resources such as solar PV, combined heat and power, batteries, and demand response, may compete with conventional power plants in the provision of electricity services. This research employs state-of-the-art dimensionality reduction techniques to ensure the computational tractability of a generation capacity expansion model that considers tradeoffs between distributed and centralized energy options, including impacts on network costs, losses, congestion, and system services.

SB62

62-Room 112A, CC

Modeling, Analysis, and Management of Water-Centric Systems

Sponsor: ENRE – Environment I – Environment and Sustainability
Sponsored Session

Chair: Nagesh Gavirneni, Associate Professor, Cornell University, 325
Sage Hall, Ithaca, United States of America, nagesh@cornell.edu

1 - Inland Waterway System Dynamics

Furkan Oztanriseven, University of Arkansas, 1900 N. Garland
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America, oztanriseven@gmail.com, Heather Nachtmann

The growth of population and economic advancement led to a higher demand for transportation services. However, the expansion in the transportation sector comes with substantial costs, such as higher gas emissions and traffic congestion. Inland waterways offer an environmental friendly and economically sound transportation alternative. In this study, we utilized a system dynamics model to better understand the interconnected relationships between the economy and the inland waterways performance.

2 - A Novel Mathematical Model for Water Value Chain Management

Mengqi Hu, University of Illinois at Chicago, Chicago, IL,
United States of America, mhu@uic.edu, Afshin Ghassemi

The amount of water in the world is limited and a large amount of water is wasted due to ineffective operation for water infrastructure. A decision model which can efficiently manage the water value chain is urgently needed to reduce water consumption. In this research, we develop a model for water management where the water flows at different stages of transitions (e.g., source, distribution) are modeled. The proposed model is demonstrated to be able to significantly reduce water consumption.

3 - Automated Analysis of Online Reviews to Improve Visitor Experience in New York State Parks

Nagesh Gavirneni, Associate Professor, Cornell University, 325
Sage Hall, Ithaca, NY, United States of America,
nagesh@cornell.edu, Hari Udayapuram

The New York State Park system has a large volume of visitor feedback on online platforms such as Yelp, TripAdvisor, and Google. We design, develop, and implement software systems that can download, organize, and analyze the text from these online reviews and help the park managers identify strategies to improve the visitor experience at their facilities.

■ SB63

63-Room 112B, CC

Doing Good with Good OR I

Cluster: Doing Good with Good OR

Invited Session

Chair: Lisa Maillart, University of Pittsburgh, Pittsburgh, PA,
lisa.maillart@engr.pitt.edu

Co-Chair: Itai Ashlagi, MIT, 100 Main St, Cambridge, MA, 02139,
United States of America, iashlagi@mit.edu

1 - Optimal Policy Design to Motivate Blood Donation: Evidence from a Randomized Field Experiment and a Structural Model

Tianshu Sun, University of Maryland Smith School of Business,
3330 Van Munching Hall, College Park, MD, 20740-2840,
United States of America, tianshusun@rhsmith.umd.edu

Using a randomized field experiment involving 80,000 participants, we test the effect of different policies in driving donation. We find: blood banks can use group reward to motivate group formation to increase donation; such group reward is four times more cost effective than individual reward. We build a structural model and perform simulations to identify optimal incentive and targeting strategy.

2 - Improving Blood Collection Policies for Cryoprecipitate

Chenxi Zeng, Georgia Tech, Atlanta, GA, United States of America, czeng8@gatech.edu, Turgay Ayer, Chelsea White Iii, Roshan Vengazhiyil, John Deshane

Working closely with the American Red Cross (ARC), we have developed and analyzed a donor collection model for whole blood that is to be processed into cryoprecipitate (cryo), a critical blood product for controlling massive hemorrhaging. Our numerical results show that the proposed solution approaches may reduce the expected cryo collection cost by up-to 70%, compared with the current practice. Implementation of the model at the ARC supports our estimates.

3 - Ebola Treatment Facility Location Planning in Guinea

Chu Qian, Georgia Tech, GA, United States of America, qianchu31@gmail.com, Charmaine Chan, Matt Daniels, Javiera Javiera, Caleb Mbuvi, Ivan Renaldi, Jonathan Sutomo, Kimberly Adelaar

In the recent Ebola outbreak, treatment facilities were critical but beds were unavailable in some areas while unused in others. A spatial simulation was built to project the spread within Guinea, overlaid with heuristics on when and where to place treatment facilities. Results showed units set up quickly or in advance could have saved more than 2000 lives.

■ SB64

64-Room 113A, CC

Applications of Decision Analysis & Large-Scale Data Analytics

Sponsor: Decision Analysis

Sponsored Session

Chair: Mazen Skaf, Partner & Managing Director, Strategic Decisions Group, 745 Emerson St, Palo Alto, Ca, 94301, United States of America, mskaf@sdg.com

1 - Expert Calibration and Elicitation for Large Scale Investment Decisions

Saurabh Bansal, Assistant Professor, Penn State University, 405 Business Building, University Park, PA, 16802, United States of America, sub32@psu.edu, Genaro Gutierrez

We discuss a new approach for the use of expert calibration and elicitation for estimating probability distributions. The approach has been in use since last two years at a Fortune 500 firm for making an annual large-scale investment decision. Practical insights for expert elicitation are also discussed.

2 - Reducing Risk and Improving Incentives in Funding Entrepreneurs

Samuel E. Bodily, Professor, Darden Graduate Business School, Univ. of Virginia, 100 Darden Boulevard, Charlottesville, VA, 22903, United States of America, BodilyS@Darden.virginia.edu

Backer financing mechanisms that encourage an entrepreneur are identified, risk analysis models are developed, and insights are obtained about how mechanisms (e.g. equity capital, incentive gifts, insurance, revenue contracts, and derivative swaps) can best reduce risk to the entrepreneur and give proper incentives, at given cost to the backers. Attention is given to avoiding problems of moral hazard and providing proper incentives. Certainty equivalents for financing alternatives are derived.

3 - Using Decision Analysis and Large Data Analytics to Enhance Decision Quality

Mazen Skaf, Partner & Managing Director, Strategic Decisions Group, 745 Emerson St, Palo Alto, CA, 94301, United States of America, mskaf@sdg.com

Increasingly, in multiple domains, the use of large data analytics is enhancing the way we apply DA from identifying a decision opportunity, to framing, generating new alternatives, and evaluating alternatives. We present cases from various industries to illustrate how using large data analytics contributes to decision quality and how, in some situations enables a totally new approach to alternatives generation and strategy development.

■ SB65

65-Room 113B, CC

Quantifying Uncertainty in Decision Analysis Practice

Sponsor: Decision Analysis

Sponsored Session

Chair: Christopher Hadlock, PhD Student, The University of Texas at Austin, 1 University Station Austin, TX 78713, United States of America, cchadlock@austin.utexas.edu

1 - A Theory of Tail Behavior for Decision Analysis

Brad Powley, Senior Consultant, Strategic Decisions Group, 745 Emerson Street, Palo Alto, CA, 94301, United States of America, bpowley@sdg.com

On occasion, it is useful for a decision analyst to encode a decision maker's probability distribution with one or more infinite tails. However, an infinite tail of one probability distribution might be heavier than that of another, adding a wrinkle to probability encoding. This talk defines heavier tails and introduces a theory of tail behavior tailored to help a decision analyst encode a probability distribution with one or more infinite tails.

2 - Assessment Error and Discrete Approximations to Continuous Distributions

Robert Hammond, Decision Analyst, Chevron, 1400 Smith St, Houston, TX, United States of America, rhammond@chevron.com, Eric Bickel

Decision analyses often use continuous probability distributions, elicited from subject matter experts, and discretized for use in decision trees. In practice, cognitive biases reduce the precision of the assessments, and discretization introduces approximation error. We compare several discretization methods when the assessments are imprecise, and show that assessment precision often has significantly more impact on model performance than accuracy tradeoffs between discretization methods.

3 - Decision Making under Incomplete Information: Sequential Probability Assessment Heuristics

Tao Huang, The University of Texas at Austin, 204 E. Dean Keeton Street, Stop C2200, ME department, ETC II, Room 5.152, Austin, TX, 78712, United States of America, huangt55@gmail.com, Eric Bickel

Expected utility of an alternative is not explicitly computable in cases where probability mass function is partially known. Previous research has tried to establish dominance to solve the problem. In practice, however, dominance is rarely established and further probability assessments are needed. In this paper, we propose a novel way called Sequential Probability Assessment Heuristic that iteratively selects a feasible assessment based on a method from machine learning to solve this problem.

4 - Assessment-adaptive Discretizations (AAD) for Decision Analysis Practice

Christopher Hadlock, PhD Student, The University of Texas at Austin, 1 University Station Austin, TX 78713, United States of America, cchadlock@austin.utexas.edu, Eric Bickel

It is common practice in decision analysis to discretize continuous uncertainties into several points, and then assign probabilities to these points. Shortcuts pre-specify percentiles to assess, along with the probabilities to assign to each of them. However, shortcuts optimized towards matching the mean often differ from those optimized to match the variance. We present assessment-adaptive discretization methods, which adapt the probability assignments based upon the observed assessments.

■ SB66

66-Room 113C, CC

Aviation Applications Section: Best Student Presentation Competition 1

Sponsor: Aviation Applications

Sponsored Session

Chair: Bo Zou, University of Illinois at Chicago, 2095 Engineering Research Facility, 842 W. Taylor Street (M/C 246), Chicago, IL, 60607-7023, United States of America, bzou@uic.edu

1 - Predicting Airport Arrivals using Data Mining Techniques

Sreeta Gorripaty, Student, University of California Berkeley, 116 McLaughlin Hall, UC Berkeley, Berkeley, CA, 94720, United States of America, gorripaty@berkeley.edu, Yi Liu, Alexey Pozdnukhov, Mark Hansen

One way to define similarity between two days in the NAS is measuring the difference in their airport arrival counts. Similar historical days can be extracted by predicting the airport arrivals for a given day and can be subsequently used in decision support tools. In our work, we use machine learning algorithms of support vector regression and random forest to predict the number of arrivals. These models also quantify the contribution of factors such as weather and demand, on airport arrivals.

2 - Airline Alliance and Product Quality: The Case of the U.S. Domestic Airline Industry

Jules Yimga, Kansas State University, KS, United States of America, jjules@ksu.edu, Philip Gayle

Collusion on price and service levels tends to be the main concern of policymakers when appraising an airline alliance formation. We posit that product quality is an important dimension to be considered in alliance appraisals. This paper investigates the product quality implications of the Delta/Continental/Northwest codeshare alliance with a particular focus on the codeshare effects in markets where the alliance partners competed prior to the alliance.

3 - Statistical Analysis of Dispatcher Fuel Loading Behavior

Lei Kang, University of California, Berkeley, 107D McLaughlin Hall, UC Berkeley, Berkeley, Ca, 94720, United States of America, lkang119@gmail.com, Mark Hansen, Megan Ryerson, Lu Hao

Airlines are moving aggressively to reduce fuel consumption. Thus, gaining a better understanding of dispatcher fuel loading behavior regarding discretionary fuel (i.e. contingency fuel and alternate fuel) is of great interest to airlines. By combining a large flight level fuel loading dataset with a dispatcher survey provided by a major US airline, dispatcher heterogeneity and its impacts in loading discretionary fuel regarding domestic and international flights will be quantified and compared.

■ SB67

67-Room 201A, CC

Working Towards the Physical Internet

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Tom Van Woensel, Full Professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, NB, Netherlands, t.v.woensel@tue.nl

1 - Exploring Operational Problems for Future Delivery Service Operations using Unmanned Aerial Vehicles

Heng Chen, University of Massachusetts Amherst, Isenberg School of Management, Amherst, MA, 01003, United States of America, heng@som.umass.edu, Senay Solak

It is well accepted that commercial use of UAVs in the near future will involve delivery service operations by retailers and courier companies. We outline some strategic and tactical decisions that these companies will face in UAV based delivery operations, and use currently available data to develop preliminary models for guiding such decisions by a firm. Specifically, optimal policies on certain capacity and revenue management decisions under stochastic demand are studied and derived.

2 - Crowdshipping for Same-day Delivery

Niels Agatz, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, Netherlands, nagatz@rsm.nl, Alp Arslan

Crowdshipping entails obtaining transportation services from approved drivers and carrier companies with spare capacity rather than from traditional logistics partners. The key idea is to exploit unused capacities and existing transportation flows of the crowd to save delivery cost and provide faster delivery. This study investigates the use of crowdshippers for last-mile delivery in a same-day delivery setting.

3 - The Pickup and Delivery Problem with Time Windows, Scheduled Lines and Stochastic Demands

Tom Van Woensel, Full professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, NB, Netherlands, t.v.woensel@tue.nl

This paper concerns scheduling a set of vehicles to serve a set of requests, whose expected demands are known in distribution when planning, but are only revealed with certainty upon vehicles' arrival. In addition, a part of the transport plan can be carried out on limited-capacity scheduled public transportation lines using bus, train, tram, metro, etc. We present the model, solution approach and numerical results.

■ SB68

68-Room 201B, CC

Joint Session TSL/Public Sector: Transportation Issues in Emergency Response

Sponsor: Transportation, Science and Logistics & Public Sector

Sponsored Session

Chair: Kash Barker, Associate Professor, University of Oklahoma, 202 W Boyd St, Rm. 124, Norman, OK, 73019, United States of America, kashbarker@ou.edu

1 - Combining Worst and Average Case Considerations in an Integrated Emergency Response Network Design

Jyotirmoy Dalal, Assistant Professor, Indian Institute of Management Udaipur, IIM Udaipur, MLSU Campus, Udaipur, 313001, India, jyotirmoy.dalal@gmail.com, Halit Uster

We design an emergency response network, integrating relief (supply) and evacuation (demand) sides under uncertainties in demand amount and location. We formulate a MIP, combining stochastic and robust optimization concepts as the weighted sum of the corresponding objectives. For varying relative weights, we devise alternative approaches to solve large scale problem instances. We present computational result and insights gained by applying the model to a GIS-based case study on coastal Texas.

2 - A Multi-period Dynamic Location Planning Model for Emergency Response

Burcu Keskin, Associate Professor, The University of Alabama, 345 Alston Hall, 361 Stadium Drive, Tuscaloosa, AL, 35487, United States of America, bkeskin@cba.ua.edu, Jianing Zhi, Sharif Melouk

We propose a deferred service model to analyze the daily operations of ambulances that involve dispatch and redeploy. Given incident priority levels and patterns, we decide which incidents to serve immediately or to defer to following periods while incurring deferral penalty costs. Considering network size, fleet size, incident patterns, and time-dependent parameters, we compare the results in terms of service, response time, and cost through experimentation and offer new dispatch policies.

3 - Replenishment Location Planning for Service Trucks under Network Congestion and Routing Constraints

Leila Hajibabai, Clinical Assistant Professor, Washington State University, 405 Spokane St., Sloan 119, P.O. Box 64291, Pullman, WA, 99164, United States of America, leila.hajibabai@wsu.edu

It is often challenging to plan service trucks operations under network design constraints, especially on congested roadways. An integrated model is developed to simultaneously determine the optimal location design of replenishment facilities, minimize routing cost in the proposed network, assign traffic, and select candidate links for capacity expansion. A genetic algorithm is proposed that integrates a continuous approximation model for routing cost estimation and traffic assignment algorithm.

■ SB69

69-Room 201C, CC

Routing Problems with Uncertainty I

Sponsor: Transportation, Science and Logistics

Sponsored Session

Chair: Shu Zhang, School of Economics and Business Administration, Chongqing University, No. 174 Shazheng Street, Shapingba, Chongqing, 400030, China, zhangshu@cqu.edu.cn

1 - Technician Scheduling Problem with Experience-based Service Times

Xi Chen, The University of Iowa, Iowa City IA 52242
xi-chen-3@uiowa.edu, Michael Hewitt, Barrett Thomas

We study a dynamic technician scheduling problem with experience-based service times. We use well-established models from the psychology community to model how gains in experience impact service times. We assume that customer requests are uncertain. We model the problem as a Markov decision process with the objective of minimizing the expected total service times over a finite horizon. We also propose a number of lookahead schemes and present results.

2 - Route Evaluators for the Vehicle Routing Problem with Stochastic and Correlated Travel Times

Jorge E. Mendoza, Associate Professor, Polytech Tours, 64 Avenue Jean Portalis, Tours, 37200, France, jorge.mendoza@univ-tours.fr, Andres Medaglia, Andrés Sarmiento, Carlos Felipe Ruiz, Raha Akhavan-Tabatabaei

Vehicle routing problems with stochastic travel times (VRPSTTs) consist in designing transportation routes of minimal expected cost over a network where times are represented by random variables. In this research we consider the case of correlated random variables. We present two methodologies, one analytical and one based on simulation, to efficiently evaluate routes. We present computational experiments showing the value of considering correlations in VRPSTTs.

3 - Revenue Driven Supply Chains under Uncertainty

Nizar Zaarour, Northeastern University, Boston, MA, United States of America, n.zaarour@neu.edu, Emanuel Melachrinoudis, Marius M. Solomon

We consider the discount pricing of products that are being phased-out in retail stores. This triggers a time horizon for the retailer to sell the existing inventory or sell it at a major discount in a reverse logistics move. We develop mathematical programming models to deal with this issue. The models are tested on real data provided by a national retailer.

4 - Multi-Period Orienteering with Uncertain Adoption Likelihood and Waiting at Customers

Shu Zhang, School of Economics and Business Administration, Chongqing University, No. 174 Shazheng Street, Shapingba, Chongqing, 400030, China, zhangshu@cqu.edu.cn, Barrett Thomas, Jeffrey Ohlmann

We consider a problem in which a traveler visits customers over a multi-period horizon to influence and observe the chance of customer adoption. Over the multiperiod horizon, each customer's likelihood of adopting the traveler's product stochastically evolves. We model the problem as a partially observed Markov decision process with an objective to maximize the expected sales. Each period, the traveler must decide which customers to schedule and which order to visit, knowing that due to uncertain wait times the traveler may not be able to meet customers even if they are on the schedule.

■ SB70

70-Room 202A, CC

RAS Problem Solving Competition 2015

Sponsor: Railway Applications

Sponsored Session

Chair: Francesco Corman, Delft University Of Technology, Mekelweg 2, Delft, Netherlands, F.Corman@tudelft.nl

1 - Railway Applications Society Problem Solving Competition

Francesco Corman, Delft University Of Technology, Mekelweg 2, Delft, Netherlands, F.Corman@tudelft.nl

This session is reserved for the finalists of the RAS Problem Solving Competition (PSC). The presenters and their abstracts won't be determined until we finish the judging process, which happens around mid-October. The selection committee will identify the top three teams who will present their results during the session. PSC asks participants to build a model to predict track failures on a railway network. Data about recorded traffic over a railway network is given, together with yellow and red tags. Yellow tags are measured deviations from the railway regulations for track layout, alignment and condition, which would require

maintenance, but still allow for running traffic. Red tags are failures with require immediate intervention. The goal of the PSC is to predict when yellow tags will turn red, to be able to plan optimally maintenance and repair actions.

■ SB71

71-Room 202B, CC

Traffic State Estimation Methods and Data

Sponsor: TSL/Urban Transportation

Sponsored Session

Chair: Kai Yin, Nomis Solutions, 1111 Bayhill Drive, Suite 230, San Bruno, CA, 94066, United States of America, yinkai1000@gmail.com

1 - Trip Splitting Approximation to Link Travel Time Estimation on a Transportation Network

Kai Yin, Nomis Solutions, 1111 Bayhill Drive, Suite 230, San Bruno, CA, 94066, United States of America, yinkai1000@gmail.com, Bruce Wang, Wen Wang, Teresa Adams

We study link travel time estimation using time stamps of trips on a transportation network. Assuming that each link associates with a random travel time, a statistical inference method, trip splitting approximation, is proposed to deal with a general link travel time distribution and also address the case that the routes of some trip observations are unknown. We explore an iterative procedure analogous to the Expectation-Maximization (EM) algorithm and apply the Bayesian method for solutions. The properties of solutions and the effect of data quality are examined.

2 - Map Inference using Probe Vehicle GPS Data with Low Reporting Frequency

Wen Jin, Tsinghua University, 519A Shunde Building, Beijing, 100084, China, jinw11@mails.tsinghua.edu.cn, Hai Jiang

The accuracy of road maps is critical to providing quality navigation services. As rapid urbanization takes place in Chinese cities, there are frequent changes to road networks due to the expansion of the city to suburban areas as well as urban redevelopment in developed districts. Most, if not all, existing literature on map inference problems requires GPS data with high reporting frequency (≥ 1 Hz). In this talk, we present a network optimization based approach to solve the map inference problem when the reporting frequency is low. Our algorithm is validated using real data from a leading navigation service provider in China.

3 - Predicting the Status of Traffic Signals using GPS Data from Probe Vehicles

Xin Qi, Department of Industrial Engineering, Tsinghua University, Shunde Building 519A, Tsinghua University, Beijing, China, qixin19900808@126.com, Hai Jiang

It has been recognized that intersection delay accounts for over 1/3 of the total travel time for a trip in the city. To provide quality route guidance to drivers, it is therefore critical to be able to estimate the delays caused by traffic signals. Since intersection delays are dependent on the status of traffic signals, in this talk we develop models to estimate key operating parameters of intersection signals: their cycle lengths as well as the corresponding signal timings. We test our models in the city of Beijing and results show that satisfactory results can be obtained in a wide variety of scenarios.

■ SB72

72-Room 203A, CC

QSR Student Introduction and Interaction and Best Student Poster Competition

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Kaibo Wang, Associate Professor, Tsinghua University, Department of Industrial Engineering, Beijing, China, kbwang@tsinghua.edu.cn

Co-Chair: Hui Yang, Associate Professor, Pennsylvania State University, 310 Leonhard Building, Industrial and Manufacturing Eng., State College, PA, 16801, United States of America, huy25@psu.edu

1 - QSR Student Introduction and Interaction and Best Student Poster Competition

Kaibo Wang, Associate Professor, Tsinghua University, Department of Industrial Engineering, Beijing, China, kbwang@tsinghua.edu.cn

Student poster exhibition starts at 10:00am in the session room; all are welcomed to arrive earlier to interact with the students. The Introduction&Interaction session formally starts at 11:00am. Each of the student members presents a 2-min elevator speech first; interactions with invited guests are then followed. A lunch gathering in the same room for student members and invited guests with tickets starts at 12:30pm. The student poster exhibition continuous until 1:00pm.

■ SB73

73-Room 203B, CC

Data Analytics for Quality Control and Improvement II

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Xi Zhang, Assistant Professor, Peking University, 5 Yiheyuan Rd., Beijing, 100871, China, xi.zhang@pku.edu.cn

Co-Chair: Kaibo Liu, Assistant Professor, UW-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, kliu8@wisc.edu

1 - Multistage Process Monitoring through Mewma Control Chart with Generalized Smoothing Parameters

Sangahn Kim, Rutgers University, 96 Frelinghuysen Road CoRE Building, Room 201, Piscataway, NJ, 08854, United States of America, sk1389@scarletmail.rutgers.edu, Myong K (MK) Jeong, Elsayed Elsayed

The multivariate exponentially weighted moving average (MEWMA) control chart is effective in monitoring a multistage process when the residual is applied to remove variance propagation effect. In this paper, we propose a generalized model of multivariate EWMA, which uses appropriate non-diagonal elements in the smoothing matrix based on the correlation between stages and within a stage, and suggest an optimal design for the proposed chart.

2 - Modeling In-Process Data of Machining Operations: Time Series vs. Spatial Point Cloud

Mohammed Shafae, PhD Candidate, Virginia Tech, 112 Durham Hall, Blacksburg, VA, 24061, United States of America, shafae1@vt.edu, Lee Wells, Jaime Camelio, Marco Ferreira

Traditional approaches for analyzing machining data revolve around representing them as time-series. The world of time-series analysis has provided several techniques for data analysis. However, they are implemented without asking, "Is time-series the most appropriate way to represent this data, and if not, how should the data be represented and what techniques need to be developed to analyze this alternate representation?" Exploring the answer to this question is the focus of this presentation.

3 - Separation and Prognostics of HRV Based on a Kernel-distance-based Multivariate Control Chart

Lili Chen, Peking University, 5 Yiheyuan Rd., Beijing 100871, China, chenlili@coe.pku.edu.cn, Xi Zhang

Isolating component signals directly from the observed heart rate variability signals can be a challenge. In this article, a signal separation based on integration of EMD and ICA is developed to separate the frequency components in HRV. A prognostics framework with Kernel-distance based multivariate control chart for disease detection has been developed to monitor the component signals. A real case study demonstrates the effectiveness of the proposed method.

4 - Data Fusion Approach for Degradation Modeling and Prognostics with Multiple Failure Modes

Abdallah Chehade, UW-Madison, 1513 University Avenue, Madison, 53706, United States of America, chehade@wisc.edu, Xi Zhang, Kaibo Liu

Operating units often suffer from multiple modes of failure in practice. This study proposes a data fusion approach to online classify the failure mode of the operating unit based on multiple degradation-based sensor data and then predict the remaining lifetime of the unit. A case study that involves a degradation dataset of aircraft gas turbine engines is used to numerically evaluate and compare the performance of the developed method with existing literature.

■ SB74

74-Room 204A, CC

QSR Refereed Research Session

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Haitao Liao, Associate Professor, University of Arizona, University of Arizona, Tucson, AZ, 85716, United States of America, hliao@email.arizona.edu

Co-Chair: Associate Professor, Pennsylvania State University, 310 Leonhard Building, Industrial and Manufacturing Eng., State College PA 16801, United States of America, huy25@psu.edu

Co-Chair: Tirthankar Dasgupta, Associate Professor, Harvard University, Department of Statistics, 1 Oxford Street, 7th Floor, Cambridge MA 02138, United States of America, dasgupta@stat.harvard.edu

1 - QSR Refereed Research Session

Hui Yang, Associate Professor, Pennsylvania State University, 310 Leonhard Building, Industrial and Manufacturing Eng., State College, PA, 16801, United States of America, huy25@psu.edu

The papers in this refereed session are selected after a rigorous peer-review process. Four finalists will make presentations in the QSR refereed session. The winner of best paper award will be announced at the QSR business meeting during the conference.

■ SB75

75-Room 204B, CC

Advanced Manufacturing I

Cluster: Advanced Manufacturing

Invited Session

Chair: Yuan-Shin Lee, Professor, North Carolina State University, 400 Daniels Hall, Department of Industri, Raleigh, NC, 27695, United States of America, yslee@ncsu.edu

1 - Supply Chain Design Implications of Modular Production Systems

Satya Malladi, Graduate Student, Georgia Institute of Technology, 755 Ferst Drive NW, ISyE., Atlanta, GA, 30332, United States of America, mss@gatech.edu, Alan Erera, Chelsea White

Modular/mobile production systems allow production capacity to be transported closer to demand. We address the following questions: When should some or all production capacity be modular? When should spatial changes in customer demand result in logistics adjustments only and when should it also be met by relocating modular production capacity?

2 - Regenerative Medicine Manufacturing – Challenges and Tools for Scale-up and Scale-out

Rohan Shirwaiker, North Carolina State University, 406 Daniels Hall, Raleigh NC 27607, United States of America, rashirwa@ncsu.edu, Binil Starly

Regenerative medicine technologies continue to be developed and successfully tested in labs, but their translation to commercial-scale viable production continues to be a significant challenge. This talk will discuss the current state of the art, hurdles in bench to bedside translation, and manufacturing and systems engineering tools and approaches that can be used to enable efficient scale-up and scale-out.

3 - A Simulation Model of the EBM Additive Manufacturing Process

Richard Wysk, Dopaco Distinguished Professor, North Carolina State University, 400 Daniels Hall, 111 Lampe Dr, Raleigh, NC, 27606, United States of America, rawysk@ncsu.edu, Michael Blum, Ismail Lekorchi, Ola Harryson, Kali Drake, Christopher Kelly, Timothy Horn

Electron beam melting is a 3D printing process that has deficiencies that need improvement. This paper defines, and analyzes each step in the EBM process. A simulation model of the process is created to determine time required to process a part. This model focuses on the processing steps required to bring about the production of mechanical metal parts. An investigation to improve the efficiency of each step has been created to model this additive process. This model and process is described.

4 - Smart Machining and Manufacturing Systems

Yuan-Shin Lee, Professor, North Carolina State University, 400 Daniels Hall, Department of Industri, Raleigh, NC, 27695, United States of America, yslee@ncsu.edu

With recent advancements in manufacturing process, information technology, sensing and automation technologies, it is envisioned a new kind of smart manufacturing that can locally deliver customized products with high quality but with the cost structure of a mass manufactured product. One of the major building block is the new generation smart CNC machines. In this talk, we will discuss the new generation smart machines and manufacturing systems.

■ SB76

76-Room 204C, CC

Efficient Learning in Stochastic Optimization

Sponsor: Simulation

Sponsored Session

Chair: Ilya Ryzhov, University of Maryland, 4322 Van Munching Hall, Robert H. Smith School of Business, College Park, MD, 20742, United States of America, iryzhov@rhsmith.umd.edu

1 - Cost-efficient Learning for Crowdsourced Ranking

Qihang Lin, The University of Iowa, 21 East Market Street, Iowa City, IA, 52245, United States of America, qihang-lin@uiowa.edu, Xi Chen, Kevin Jiao

Crowdsourcing is often used as a tool to rank a list of items based on pairwise comparisons. However, the comparison results by crowdsourcing have a low quality due to unreliable workers. To reduce the cost and increase the accuracy of ranking, we propose a multistage strategy where pairs of items are assigned to workers based on a joint learning of item's ranking and worker's reliability. The performances of our strategies are evaluated over simulated and real data.

2 - Sequential Allocation for Customer Acquisition

Eric Schwartz, University of Michigan, ericmsch@umich.edu, Katie Yang, Peter Fader

To acquire customers, firms allocate resources across a range of sources of acquisition, but they are uncertain about which ones are best. Over time they learn about their customers and sequentially reallocate their resources to earn a better return on acquisition spend. We frame the sequential acquisition decisions as a multi-armed bandit problem, and comparing a set of acquisition policies to assess their ability to acquire from the right sources of customers.

3 - Optimal Dynamic Pricing with Demand Model Uncertainty:

A Squared-Coefficient-of-Variation Rule

Bora Keskin, Duke University, Fuqua School of Business, 100 Fuqua Drive, Durham, NC, 27708-0120, United States of America, bora.keskin@duke.edu

We consider a price-setting firm that sells a product over a continuous time horizon. The firm is uncertain about the sensitivity of demand to price changes, and updates its prior belief on an unobservable sensitivity parameter by observing demand responses. We derive and solve a partial differential equation to show how the value of learning should be projected onto prices in an optimal fashion.

4 - Expected Improvement is Equivalent to OCBA

Ilya Ryzhov, University of Maryland, 4322 Van Munching Hall, Robert H. Smith School of Business, College Park, MD, 20742, United States of America, iryzhov@rhsmith.umd.edu

We consider ranking and selection with independent normal observations, and analyze the asymptotic sampling rates of expected improvement (EI) methods in this setting. EI often performs well in practice, but general rate results have been largely unavailable. We prove that variants of EI produce simulation allocations that are essentially identical to those chosen by the optimal computing budget allocation (OCBA) methodology. This is the first general equivalence result between EI and OCBA.

■ SB77

77-Room 300, CC

Supply Chain Management II

Contributed Session

Chair: Ehsan Bolandifar, Assistant Professor, The Chinese University of HongKong, Room 922, 9/F, Cheng Yu Tung Building, No.12, Chak Cheung Street, Shatin, N.T., HongKong, Hong Kong - PRC, ehsan@baf.cuhk.edu.hk

1 - Cooperative Replenishment in the Presence of Intermediaries

Behzad Hezarkhani, Assistant Professor, Nottingham University Business School, Jubilee Campus, Nottingham, United Kingdom, behzad.hezarkhani@nottingham.ac.uk, Marco Slikker, Tom Van Woensel

In complex supply chains, individual downstream buyers would often rather replenish from intermediaries than directly from manufacturers. Direct replenishment from manufacturers can be a less costly alternative when carried out by the buyers cooperatively. This talk presents a framework for cooperative/non-cooperative replenishment in multi-product supply chains with intermediaries.

2 - Two-class Single-period Inventory Allocation Policies in Smart Meter Installation Projects

Behzad Samii, Vlerick Business School, Ave de Boulevard 21, Brussels, Belgium, behzad.samii@vlerick.com

Smart meter device are the costliest elements of rollout projects. Complexity stems from supply inflexibility due to strict tendering procedures and high holding cost due to fast obsolescence. If some partial information regarding the bottom line impact of a shortage in one customer class compared to the other can be conjectured, then we can derive closed form expressions for the expected number of units short in each demand class under commonly used SN and TN nesting allocation mechanisms.

3 - Architecting Fail-safe Supply Networks

Shabnam Rezapour, The University of Oklahoma, 2248 Houston Ave., apt # 2, Norman, OK, 73071, United States of America, shabnam_rezapoor@yahoo.com, Amirhossein Khosrojerdi, Janet K. Allen, Farrokh Mistree

A fail-safe network is one which mitigates the impact of disruptions and provides an acceptable service level. This is achieved by designing its topology (structurally fail-safe) and coordinating flow dynamics (operationally fail-safe). We analyze the importance of being robust, resilient, and controllable in having structurally fail-safe against disruptions. We show to have an operationally fail-safe supply network, flow dynamics should be reliable against demand and supply-side variations.

4 - Waveless Warehousing ? Why and Why Not ?

Adrian Kumar, Exel Inc, 570 Polaris Parkway, Westerville, OH, United States of America, adrian.kumar@exel.com, Manjeet Singh

E-fulfillment operations constantly struggle with processing peak volumes quickly due to system, labor and equipment constraints. Waveless is a dynamic order fulfillment method that pulls demand into a resource/sub-system when it becomes available. The dynamic order set is built on optimal real time decisions based on productivity, equipment utilization, etc. This study defines complete and partial waveless systems and discusses the pros and cons of implementing them.

5 - Component Procurement through Group Purchasing Organizations

Ehsan Bolandifar, Assistant Professor, The Chinese University of Hong Kong, Room 922, 9/F, Cheng Yu Tung Building, No.12, Chak Cheung Street, Shatin, N.T., Hong Kong - PRC, ehsan@baf.cuhk.edu.hk, Mojtaba Soleimani

This paper studies component procurement in a supply chain setting where two competing Original Equipment Manufacturers (OEMs) source a common component from a competitive supply market. We assume that ordering happens after procurement negotiations, i.e., OEMs first compete in the market before they negotiate for their component procurement potentially through Group Purchasing Organizations (GPOs). We show that procurement through a GPO may hurt an OEM with a lower bargaining power.

■ SB78

78-Room 301, CC

Supply Chain Practice and Empirics

Contributed Session

Chair: Faraz Ramtin, University of Central Florida, 2011 Puritan Rd, Orlando, FL, 32807, United States of America, faraz.ramtin@ucf.edu

1 - Is Supply Chain Success Emulatable? A Framework of Analogous Learning from Supply Chains and a Case Study

Violette Wen, PhD Student, The University of Auckland, 12 Grafton Rd, CBD, Auckland, 1010, New Zealand, violette.wen@auckland.ac.nz, Tiru Arthanari

We explore the feasibility of emulating from one successful supply chain to another produce line in agri-fresh produce. The case will study the state-of-art New Zealand kiwifruit supply chain and provide a framework with key enablers and disablers for transferring knowledge to the struggling Xinjiang Hami melon industry in China. The research will provide rich empirical evidence about a developing country's agri-fresh supply chain at various levels.

2 - The Inventory Value of Cross Docking in a Supply Chain: An Empirical Study

Xingyue Zhang, Lehigh University, 621 Taylor Street, Bethlehem, PA, 18015, United States of America, xiz313@lehigh.edu, Oliver Yao, Jiazhen Huo, Yongrui Duan

Cross docking is a supply chain strategy to enhance supply chain performance by directly moving inbound orders to outbound shipments without storage. Using a large-scale, SKU level data set collected from a large retail chain, we find that cross docking reduces store-level inventory by 101 units on average and that cross docking is more beneficial to reduce inventories for products with higher prices or higher demand rate, or for the stores that are closer to their distribution center.

3 - An Empirical Analysis of Sustainable Supply Chain Capabilities and Cross-Value Integration

Peiran Gao, Huazhong University of Science and Technology, School of Management, 1037 Luoyu Road, Wuhan, China, gaopeiran2007@126.com, Yeming Gong, Jinlong Zhang

Using multi-source data from more than 100 organizations in retailing industry, we apply structural equation modeling to understand nonlinear relationship among cross-value integration, supply chain coordination and integration, and the performance of sustainable supply chain. We find the moderate effect of cross-value integration on the relationship between sustainable supply chain capabilities and operational competencies.

4 - Storage Location and Pick Position Assignment Problem for MIAPP-AS/RS

Faraz Ramtin, University of Central Florida, 2011 Puritan Rd, Orlando, FL, 32807, United States of America, faraz.ramtin@ucf.edu, Jennifer Pazour

MIAPP-AS/RS is a semi-automated case-level order fulfillment technology. The put-away to the storage locations and replenishment to pick positions are performed by the crane and the in-the-aisle case-picking is done by human order pickers. We develop binary integer models to find the optimal assignment of SKUs to storage locations, as well as to pick positions for a dedicated storage policy. We develop an accelerated Benders Decomposition approach to improve the tractability of the models.

SB79

79-Room 302, CC

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - Simio Simulation and Scheduling Software - Introduction to Simio Simulation and Scheduling Software

C Dennis Pegden, CEO and Founder, Simio Simulation and Scheduling Software, Eric Howard

Simio is a premier simulation and scheduling software that allows you to expand traditional benefits of simulation to improve daily operations. In this tutorial, we will demonstrate Simio's 3D rapid modeling capability to effectively solve real problems. Explore how a single tool can be used to not only optimize your system design, but also provide effective planning and scheduling. Come explore the Simio difference and see why so many professional and novice simulationists are changing to Simio.

2 - Forio Simulations - Publishing Interactive Analytics or Operations Research Models on the Web

Michael Bean, Co-Founder and President, Forio Simulations

Forio's web platform makes your analytic model available to hundreds of people within your organization through the browser. We will start with an introduction to the platform and example analytics applications. Then we'll divide the workshop into two parts. In the first part we will teach you how to get your analysis on a server so it can be shared. In the second part we'll focus on creating a user interface for your model.

Sunday, 1:30pm - 3:00pm

SC01

01-Room 301, Marriott

Military O.R. and Applications I

Sponsor: Military Applications

Sponsored Session

Chair: Michael Hirsch, ISEA TEK, 620 N. Wymore Rd., Ste. 260, Maitland, FL, 32751, United States of America, mhirsch@iseatek.com

1 - An Algorithm for Solving the Convoy Routing Problem

Ambika Tiwari, Research Scholar, IIT Madras, DoMS, Delhi Avenue, 834, Sabarmati Hostel, Chennai, 600036, India, tiwariambika4@gmail.com, Chandrasekharan Rajendran, Hans Zeigler

The problem of routing military convoys from a specific origin to a destination adhering to certain constraints is considered. An algorithm for minimizing the sum of arrival times at destination of the convoys is proposed. Its performance with respect to that of existing algorithm is analyzed. Computational results are presented.

2 - The Spectrum of Anarchy: Algorithmic Game Theory in UAV Routing

Michael Couche, University at Buffalo, 342 Bell Hall, Buffalo, United States of America, mjcouche@gmail.com, Nagi Rakesh, Mark Karwan

Game theoretic routing approaches lend insight into the price of anarchy that occurs due to decentralization. We can model a team of UAVs using several different approaches, ranging from greedy-based routing, competitive gaming, leader-follower gaming, to cooperative gaming. A comparison of the algorithms used is presented, along with a discussion of using these approaches as a fast routing heuristic that competes with mathematical programming models.

3 - Optimization of UAV Teams

Hector Ortiz-pena, CUBRC, Genesee St, Buffalo, United States of America, hector.ortiz-pena@cubrc.org, Michael Hirsch, Moises Sudit, Mark Karwan

We develop a formulation to maximize the information gain from a team of autonomous unmanned vehicles (UxVs) to support Intelligence, Surveillance and Reconnaissance (ISR) mission objectives. The formulation is used to evaluate the Price of Anarchy.

SC02

02-Room 302, Marriott

Cyber-Physical Protection Models and Analysis

Cluster: Homeland Security

Invited Session

Chair: Feng Pan, Research Engineer, Pacific Northwest National Laboratory, P.O. Box 999 MSIN K1-85, Richland, WA, 99352, United States of America, feng.pan@pnnl.gov

Co-Chair: Guanhua Yan, Assistant Professor, Binghamton University, Department of Computer Science, Binghamton, NY, 13902, United States of America, ghyan@binghamton.edu

1 - Analytical Framework for Cyber-physical Integrated Assessment: An Overview

Matthew Oster, Pacific Northwest National Laboratory, 902 Battelle Blvd, Richland, WA, 99352, United States of America, matthew.oster@pnnl.gov, Casey Perkins

Cyber and physical security systems present a unique challenge for security analyses traditionally charged with focusing on only a singular aspect of the system, either physical or cyber. Looking at an integrated security environment requires revisiting vulnerability analysis methods and integrating previously isolated evaluations. This talk will focus on the challenge of creating an integrated modeling framework with both physical and cyber security elements to quantify hidden vulnerability.

2 - A Big Data Approach to Automating Malware Analysis

Guanhua Yan, Assistant Professor, Binghamton University, Department of Computer Science, Binghamton, NY, 13902, United States of America, ghyan@binghamton.edu, Yunus Kucuk

Thwarting the severe threat posed by the voluminous malware variants demands effective, yet efficient, techniques for malware analysis. We propose a big data framework for automated malware analysis. This framework combines various big data tools to provide a unifying and scalable solution to a wide range of malware analysis tasks, such as classification, clustering, and indexing. We will present our experience with developing this framework, as well as the research challenges ahead.

3 - A Mixed Integer Program for Securing a Cyber-physical System

Feng Pan, Research Engineer, Pacific Northwest National Laboratory, P.O. Box 999 MSIN K1-85, Richland, WA, 99352, United States of America, feng.pan@pnnl.gov, Casey Perkins, Samrat Chatterjee, Satish Chikkagoudar, Matthew Oster

Securing a modern facility has to consider both cyber and physical aspects. In this talk, we present a set of metrics for measuring facility security. Given the complexity of facilities, simulation models are often used to measure the overall security. Combining simulation results, we introduce a mixed integer programming approach to allocate security assets in both cyber and physical layers for enhancing security of a facility.

4 - Spotting Anomalies in Cyber Physical Datasets: The Case of Mobility Data

Konstantinos Pelechrinis, Assistant Professor, University of Pittsburgh, 135 N. Bellefield, IS 717B, Pittsburgh, PA, United States of America, kpele@pitt.edu, Evangelos Papalexakis, Christos Faloutsos

How can we discover latent patterns in heterogeneous CPSs datasets and classify them as anomalous or not without labeled data? We propose using tensors to model heterogeneous data and obtain latent patterns. We then propose a generic data-driven method for classifying each of the obtained patterns as normal or not. The realization of our technique is domain-specific. We showcase our method by applying it on a mobility dataset that captures locations visited by users at different times.

■ SC03

03-Room 303, Marriott

Contemporary Scheduling

Cluster: Scheduling and Project Management

Invited Session, Chair: Joseph Y.T. Leung

Distinguished Professor, New Jersey Institute of Technology, Department of Computer Science, University Heights, Newark, NJ, 07102, United States of America

1 - Improved Algorithms for Single Machine Scheduling with Release Dates and Rejections

Kangbok Lee, York College, CUNY, York College, The City University of New York, Jamaica, NY, 11451, United States of America, klee5@york.cuny.edu, Cheng He, Joseph Leung, Michael Pinedo

We consider bi-criteria scheduling problems on a single machine with release dates and rejections and both the makespan and the total rejection cost have to be minimized. We consider two scenarios: (i) minimize the sum of the makespan and the total rejection cost, and (ii) minimize the makespan subject to a bound on the total rejection cost. We summarize the results obtained in the literature and provide for several cases improved approximation algorithms and FPTASs.

2 - Integrated Production and Delivery on Parallel Batching Machines

Kai Li, Associate Professor, Hefei University of Technology, 193 Tunxi Rd, Hefei, 230009, China, hfutlk@139.com, Joseph Leung, Zhao-hong Jia

We consider an integrated scheduling problem of production and delivery on parallel batching machines. The company will earn a positive profit only if a job is delivered by its due date. A 3PL provider is used to deliver the jobs. The goal is to maximize the total profit. We show that the problem is solvable in polynomial time if the jobs have identical sizes, but it becomes unary NP-hard if the jobs have different sizes. We propose heuristics for NP-hard cases and analyze their performances.

3 - Minimizing Total Completion Time in Flow Shop with Machine Unavailability using Meta-heuristics

Hairong Zhao, Associate Professor, Purdue University at Calumet, Dept. of Math, C. S. & Statistics, Hammond, IN, 46323, United States of America, hairong@purduecalumet.edu, Yumei Huo

We consider flow shop scheduling subject to machine availability constraints. The objective is to find a schedule that minimizes total completion time. This problem is strongly NP-hard even if machines are always available. Simple bounds are derived to slightly speed up the elimination process of a branch-and-bound algorithm. Then we propose a meta-heuristic algorithm based on genetic algorithms. Computational results show that the proposed meta-heuristic performs effectively and efficiently.

4 - Application of MGSA for the Coordinated Scheduling Problem in a Two-Stage Supply Chain

Jun Pei, Assistant Professor, Hefei University of Technology, 193 Tunxi Rd, Hefei, 230009, China, feiyijun198612@126.com, Xinbao Liu

This paper investigates a products and vehicles scheduling problem in a two-stage supply chain, where jobs need to be processed on the serial batching machines of multiple manufacturers distributed in various geographic zones and then transported by vehicles to a customer. A modified gravitational search algorithm (MGSA) is proposed to solve the problem. In MGSA, several improvement strategies and the batching mechanism DP-H are introduced.

■ SC04

04-Room 304, Marriott

Gender Inspired Research

Sponsor: Women in OR/MS

Sponsored Session

Chair: Margret Bjarnadottir, Assistant Professor of Management Science and Statistics, Robert H. Smith School of Business, University of Maryland, 4324 Van Munching Hall, College Park, MD, 20742, United States of America, margret@rhsmith.umd.edu

1 - Innovative Pedagogical Interventions to Increase Retention of Women in Engineering

Susana Lai-yuen, Associate Professor, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, laiyeun@usf.edu, Grisselle Centeno

This work addresses the broad challenge of identifying practices and developing resources to help overcome evident gender equity issues in science and engineering education. Specifically, a set of pedagogical resources focused on healthcare systems and OR applications have been developed. Experiences related to development, implementation and outcomes will be discussed.

2 - Bridging the Gap: Responses to Equal Pay Legislation

David Anderson, Assistant Professor, Baruch, davidryberganderson@gmail.com, Margret Bjarnadottir

We study how firms can reduce the estimated pay gap between men and women in the most cost efficient way. We show that by intelligently increasing workers' wages who will have the greatest impact, we can meet the "Equal Pay for Equal Work" standard for less than half the cost of the naive method of increasing all female workers' wages equally. We further explore the impacts of equal cost mandates on compensation, fairness and the implications of this work on outside verification parties.

3 - Work-Life Balance for Women

Wendy Casper, The University of Texas at Arlington, Dept. of Management, Arlington, TX, United States of America, wjcasper@uta.edu, Victoria Chen

Work-life balance is important to many women. Despite this, there is little agreement about what work-life balance is. This presentation discusses the notion of balance and identifies commonly held definitions of this concept, concluding with a few ideas about how women can gain a greater sense of balance in their lives.

■ SC05

05-Room 305, Marriott

Extracting Business Value from Social Media Analytics: Techniques and Applications

Cluster: Social Media Analytics

Invited Session

Chair: Shih-Hui Hsiao, University of Kentucky, 550 S. Limestone, Lexington, KY, 40526, United States of America, shs222@uky.edu

1 - Who are the Opinion Leaders? A Relative Assessment of Opinion Leader Mining Algorithms

Shih-Hui Hsiao, University of Kentucky, 550 S. Limestone, Lexington, KY, 40526, United States of America, shs222@uky.edu, Ram Pakath

Several methods have been proposed in the Social Media Analytics literature for identifying Opinion Leaders (OL) in online social networks. In this talk, I will describe the design and implementation of, as well as preliminary findings from, an experiment that compares existing OL mining algorithms to one another in terms of solution speed and quality. This study is a prelude to a larger project that also seeks to improve upon extant procedures.

2 - Real-time Social Media Analytics in Health Care:

Discovery Knowledge from Online Communities

Yichuan Wang, Industrial & Systems Engr St, Department of Industrial and Systems Engineering, Shelby Center, Auburn University, Auburn, AL, 36849, yzw0037@auburn.edu, Yedurang Babu, Terry Byrd

Dramatic changes in business environments have galvanized firms toward searching for external knowledge from social media to complement the insufficiency of organizational resource. However, in healthcare social media sources rarely have been analyzed and used to support medical decision making. This study proposes a real-time knowledge discovery framework to support effective exploration of knowledge which has been prototypically implemented on the base of Web data from healthcare communities.

3 - The Impact of Facebook on Offline Sales: Evidence from the U.S. Automobile Industry

Yen-yao Wang, Michigan State University, N270A Business College Complex, East Lansing MI 48824, United States of America, wangyen@broad.msu.edu, Anjana Susarla, Vallabh Sambamurthy

This study examines the dynamic interactions between firm-generated content, user-generated content, and offline car sales in the U.S. automobile industry. We collected the official Facebook pages of 31 car companies in the U.S., and supplemented the data from these firms' traditional media efforts, and offline car sales from 2009 to 2014. A panel vector autoregressive (PVAR) model is conducted to examine our research framework. Implications for researchers and managers are discussed.

4 - An Investigation of Factors that Influence the Success of Social Commerce Platforms

Suning Zhu, sz0012@auburn.edu, Jiahe Song, Pei Xu

This paper introduces a descriptive framework for understanding factors that influence the success of social commerce platforms. It identifies three main classes of influencing factors (self-expression, communication, and style) and characterizes the individual factors in each class. The resultant framework can be used by researchers for reference of theories and hypothesis generation, and by practitioners for benchmarking social commerce practices.

SC07

06-Room 306, Marriott

Computational Methods in Options Pricing and Portfolio Selection

Sponsor: Financial Services

Sponsored Session

Chair: Liming Feng, Associate Professor, University of Illinois at Urbana-Champaign, 104 S Mathews Ave, Urbana, IL, 61801, United States of America, fenglm@illinois.edu

Co-Chair: Xuewei Yang, Associate Professor, Nanjing University, School of Management and Engineering, #22, Hankou Road, Gulou District, Nanjing, 210093, China, xwyang@nju.edu.cn

1 - Investor Behavior and Turbo Warrant Pricing

Xuewei Yang, Associate Professor, Nanjing University, School of Management and Engineering, #22, Hankou Road, Gulou District, Nanjing, 210093, China, xwyang@nju.edu.cn, Xindan Li, Avaniidhar Subrahmanyam

Turbo warrants are options that can be called back when underlying prices reach a threshold. We find that investors treat turbo warrants like lotteries in that they prefer those with low prices, high volatilities, and high skewness, and prefer trading them when underlying prices are near callback thresholds. As a result, turbo warrants are overpriced: during 2012, investors lost 1.82 billion HKD (US\$235 million) by trading turbo warrants written on the Hang Seng Index.

2 - Asymptotic Expansions of Discretely Monitored Barrier Options under Stochastic Volatility Models

Chao Shi, Assistant Professor, Shanghai University of Finance and Economics, 100 Wudong Road, Yangpu District, Shanghai, 200433, China, shichao@connect.ust.hk, Ning Cai, Chenxu Li

This paper proposes an algorithm for pricing discretely monitored barrier options under stochastic volatility models. It turns out that the celebrated Hilbert transform recursion algorithm proposed by Feng and Linetsky (2008) becomes the leading term and building block in our expansion formula under stochastic volatility models. Our expansions are automatic and fast. Numerical results show that our algorithm is efficient and robust.

3 - Distributions with Analytic Characteristic Functions in Financial Modeling

Runqi Hu, PhD Student, University of Illinois at Urbana-Champaign, 104 S Mathews Ave, Urbana, IL, 61801, United States of America, runqihu2@illinois.edu, Liming Feng

In this talk, we consider a class of distributions with characteristic functions that are analytic in a horizontal strip in the complex plane. Such distributions can be inverted from their characteristic functions very efficiently using simple rules with exponentially decaying approximation errors. The results can be applied in accurate valuation of options in models with jumps and stochastic volatility. Numerical examples illustrate the effectiveness of the schemes.

4 - Robust Portfolio Selection with Fixed Transaction Cost

Yufei Yang, PhD Candidate, Singapore University of Technology and Design, Pillar of Engineering Systems and Design, 8 Somapah Road, Singapore, 48732, Singapore, yufei_yang@mymail.sutd.edu.sg, Selin Damla Ahipasaoglu, Jingnan Chen

We study a robust mean-variance portfolio selection problem under fixed transaction cost. We provide a novel analysis on the portfolio composition and a closed-form formula is derived to unify various types of portfolios. We uncover the impact of the uncertainty level and fixed transaction cost to the position change of each asset.

SC07

07-Room 307, Marriott

Big Risks, Big Data

Cluster: Risk Management

Invited Session

Chair: Paul Glasserman, Columbia Business School, 3022 Broadway, Uris Hall, New York, United States of America, pg20@columbia.edu

1 - Large-dimensional Factor Modeling Based on High-frequency Observations

Markus Pelger, Assistant Professor, Management Science & Engineering, Stanford University, Huang Engineering Center, 475 Via Ortega, Stanford, CA, 94305, United States of America, markus.pelger@gmail.com

I provide a statistical theory and empirically estimate an unknown factor structure based on financial high-frequency data for a large cross-section. I develop an estimator for the number of factors and consistent and asymptotically mixed-normal estimators of the loadings and factors for a large number of cross-sectional and high-frequency observations. In an extensive empirical study of the U.S. equity market I identify four continuous and one jump factor that explain most of the variation.

2 - Price Contagion through Balance Sheet Linkages

Agostino Capponi, Columbia, Mudd 313, New York, NY, 10027, United States of America, ac3827@columbia.edu

We study price linkages between assets held by financial institutions that maintain fixed capital structures over time. Our analysis suggests that regulatory policies aimed at stabilizing the system by imposing capital constraints on banks may have unintended consequences: banks' deleveraging activities may amplify asset return shocks and lead to large fluctuations in realized returns. We show that these effects can be mitigated by encouraging banks to hold liquid, rather than illiquid, assets.

3 - Incorporating GICS and High-Frequency Data into Portfolio Allocation and Risk Estimation

Jianqing Fan, Princeton, Dept of Operations Res & Fin Eng, Princeton University, Princeton, NJ, 08544, United States of America, jqfan@princeton.edu, Alexander Furger, Dacheng Xiu

We document a striking block-diagonal pattern in the factor residual covariances of the S&P 500 constituents, after sorting the assets by their assigned GICS codes. We propose combining a location-based thresholding approach based on sector inclusion with the Fama-French and SDRP sector ETF's. We investigate the performance of our estimators in a portfolio allocation study. We provide justification for the empirical results by jointly analyzing the in-fill and diverging dimension asymptotics.

4 - Estimating the Correlation Matrix of Credit Default Swaps for Market Risk Management

Richard Neuberger, Columbia University, 1255 Amsterdam Avenue, Dept of Statistics, 10th Floor, New York, NY, 10027, United States of America, rn2325@columbia.edu, Paul Glasserman

We propose a portfolio perspective to better understand the properties of correlation matrix estimators and loss functions for market risk management. We find the commonly used latent factor model to systematically misestimate the risk of certain portfolios. The normal likelihood appears more appropriate than Frobenius' and Stein's loss. We derive specific loss functions. We assess a range of estimators using CDS data. We also study implied CDS correlations using distance-to-default processes.

■ SC08

08-Room 308, Marriott

Topics in Telecommunications

Sponsor: Telecommunications

Sponsored Session

Chair: Stanko Dimitrov, Assistant Professor, University of Waterloo, 200 University Avenue West, Waterloo, Canada, sdimitro@uwaterloo.ca

1 - On the Robust Design of Access Networks Integrating Optical Fiber and Wireless Technologies

Fabio D'Andreagiovanni, Senior Researcher, Konrad-Zuse-Zentrum für Informationstechnik, Takustr. 7, Berlin, Germany, d.andreagiovanni@zib.de, Jonad Pulaj, Axel Werner

An important recent trend in telecommunication access networks is the integration of optical fiber and wireless technologies (Fi-Wi). The design of Fi-Wi networks can be formulated as variants of Connected Facility Location Problems, including fiber connectivity and wireless coverage constraints. We consider here an uncertain version of the Fi-Wi design problem, tackling signal propagation uncertainty. We introduce a new model for it and present computational results on realistic instances.

2 - Two Terminal Reliability in a Mobile Ad-hoc Network

Timothy Matis, Professor, Texas Tech University, 2500 Broadway, Texas, United States of America, Timothy.Matis@ttu.edu, Binchao Chen, Aaron Phillips

The spatial distribution of nodes in a random waypoint model of a Mobile Ad-hoc communications networks exhibits central tendency. In this presentation, we will discuss analytical expressions for one and two hop connectivity as a function of node location.

3 - Impact of Security Concerns on Online Shopping by Device

Stanko Dimitrov, Assistant Professor, University of Waterloo, 200 University Avenue West, Waterloo, Canada, sdimitro@uwaterloo.ca, Brian Cozzarin

As various devices are used to access online stores, it is unclear if consumers' security concerns impact shopping decisions equivalently regardless of access device. In this study we characterize the impact of security concerns across device types and show that consumers with security concerns are far less likely to make purchases using a mobile device than a personal computer. Similarly, we show that individuals without security concerns are the major drivers behind mobile commerce.

■ SC09

09-Room 309, Marriott

Managing Innovation: Products, Services, Employee Attributes and Organizational Performance

Sponsor: Technology, Innovation Management & Entrepreneurship
Sponsored Session

Chair: Juliana Hsuan, Professor, Copenhagen Business School, Dept. of Operations Management, Solbjerg Plads 3, Frederiksberg, DK-2000, Denmark, jh.om@cbs.dk

1 - The Relationship Between Individual Employee Attributes and Radical Innovation

Lee Davis, Associate Professor, Copenhagen Business School, Department of Innov and Org Econ, Kilevej 14A, Frederiksberg, 2000, Denmark, ld.ino@cbs.dk, Karin Hoisl, Jerome Davis

We investigate the impact of individual employee attributes like experience, ability or motivation on radical innovation and whether the organizational context moderates this relationship. We find that the importance of individual attributes varies with organizational context.

2 - The Impact of Organizational Routines in Cumulative Innovation

Leonardo Santiago, Associate Professor, Copenhagen Business School, Department of Operations Management, Solbjerg Plads 3, Blok B 5. sal, Frederiksberg, 2000, Denmark, ls.om@cbs.dk, Julia Couto

The capacity to continuously innovate is crucial for organizations to achieve or maintain their competitive advantage. A sequence of innovations can provide to a company not just a new product or technique but also a platform of knowledge that will support their future innovations. This work investigates the way knowledge is accumulated by a company over time, associating managerial decisions to the dynamics of innovation.

3 - Product and Service Modularity Strategies Game for Mass Customization

Anu Bask, Assistant Professor, Aalto University School of Business, P.O. Box 21220, Helsinki, 00076 Aalt, Finland, anu.bask@aalto.fi, Juliana Hsuan, Mervi Rajahonka, Markku Tinnilä

Modularity has been recognized as a powerful concept for improving the efficiency and management of product design and manufacturing. However, the integrated view on product and service modularity approaches is under researched. We propose four strategies to match combinations of products and services through modularization strategies for mass customization.

4 - The Impact of Product and Service Modularity on Business Performance – A Survey of Danish Manufacturers

Thomas Frandsen, Copenhagen Business School, Dept. of Operations Management, Solbjerg Plads 3, Frederiksberg, DK-2000, Denmark, tfr.om@cbs.dk, Juliana Hsuan, Jawwad Z. Raja

Manufacturers are increasingly turning towards services and integrated solutions as a way of strengthening their competitiveness, a transition receiving growing attention in the literature. However, the relation between product and service architecture and its impact on service strategy and the performance of manufacturers is not well understood. Based on a survey of Danish manufacturers we explore the relationship between product and service modularity and their effects on business performance.

■ SC10

10-Room 310, Marriott

Online Consumer Conversion and Developer Strategy

Sponsor: E-Business

Sponsored Session

Chair: Young-Jin Lee, Assistant Professor, University of Denver, 2101 S. University Blvd, Denver, CO, 80208, United States of America, youngjin.lee@du.edu

1 - Competition Among Proprietary and Open-source Software Firms: The Role of Licensing

Wei Chen, Assistant Professor, University of Arizona, 1130 East Helen Street, McClelland Hall 430, P.O. Box 210108, Tucson, AZ, 85721, United States of America, weichen@email.arizona.edu, Kevin Zhu, Terrence August

Open-source software (OSS) firms are increasingly using service-based business models to compete with established proprietary software firms. We study a 3-way game with strategic contribution from the community and focus on how open-source licensing affects competition among an open-source originator, open-source contributor, and a proprietor competing in the same software market.

2 - An Empirical Study of Market Switching Behavior of Mobile App Developers

Hossein Ghasemkhani, Assistant Professor, Purdue University, 425 W. State Street, West Lafayette, IN, 47907, United States of America, hossein@purdue.edu, Young-Jin Lee, Karen Xie, Yong Tan

Mobile app developers switch the positioning of their apps between free and paid submarkets. They offer their previously paid apps for free to create positive network effects, and set prices on previously free apps to reap the benefits. We empirically study the developers' decision to determine the instantaneous market of their apps, and examine how it affects performance. We find that prior performance and duration in either market are significantly related to the developer's decision.

3 - How Does Communication Improve Conversion Rate on E-commerce: A Bayesian Approach

Haoyan Sun, PhD Candidate, University of Washington, Mackenzie 328, Seattle, WA, 98115, United States of America, haoyan@uw.edu, Ming Fan

We examine communication of buyers and sellers on the E-commerce platform through Instant Message (IM) to understand the ways of improving conversion rate. By casting this problem in a hierarchical bayesian framework, we are able to address the endogeneity problem where IM communication is endogenous in determining the conversion rate. Using data collected from TaoBao, China's leading C2C online marketplace, we show that communication can significantly drive the conversion rate.

4 - The World at Our Fingertips: Consumer Conversion from Search, Click-through, to Book

Karen Xie, Assistant Professor, University of Denver,
Fritz Knoebel School of Hospitality Mgmt, Denver, CO,
United States of America, Karen.Xie@du.edu, Young-Jin Lee

We examine how informational cues displayed influence consumer conversion in a sequential process of search, click-through, and booking when shopping hotels online. Using an empirical analysis of a large online travel agent site that provides information of individual searches, we find consumers are likely to click through hotels with higher consumer ratings and the industry-endorsed star rating. However, when committing to booking consumers refer to consumer ratings rather than the star rating.

■ SC11

11-Franklin 1, Marriott

Joint Session OPT/OPT Under Uncertainty: IP Methods for Stochastic Optimization

Sponsor: Optimization/Integer and Discrete Optimization
Sponsored Session

Chair: Siqian Shen, Assistant Professor, University of Michigan,
1205 Beal Avenue, Ann Arbor, MI, 48105, United States of America,
siqian@umich.edu

1 - Scenario Decomposition of Risk Averse Stochastic 0-1 Programs

Yan Deng, University of Michigan, 3730 Greenbrier Blvd,
Ann Arbor, MI, 48105, United States of America,
yandeng@umich.edu, Siqian Shen, Shabbir Ahmed

We present a scenario decomposition approach for risk averse stochastic 0-1 programs. The approach uses decomposition that processes subproblems easy to parallelize, and LP/IP techniques that combine subproblem results to yield strong valid inequalities. We also design various parallelization paradigms and demonstrate on stochastic server location problems and stochastic multiple 0-1 knapsack problems that the approach improves computational efficacy significantly.

2 - Polyhedral Study of Static Probabilistic Lot-sizing Problem

Xiao Liu, Research Associate, The Ohio State University, 210
Baker Systems Building 1971 Neil Ave, Columbus, OH, 43210,
United States of America, liu.2738@osu.edu, Simge Kucukyavuz

We explore the polyhedral structure of the static probabilistic lot-sizing problem and propose new valid inequalities. We show the relationship between the proposed inequalities and those that would be obtained by projecting the natural or the extended formulation of the deterministic lot-sizing problem for each scenario on to the space of the production variables. We show that the proposed inequalities are facet-defining under certain conditions. We report preliminary computational results.

3 - Computational Experience with a Benders Algorithm for Two-stage Stochastic Integer Programming

Ted Ralphs, Professor, Lehigh University, 200 W. Packer Ave.,
Bethlehem, PA, 18015, United States of America, ted@lehigh.edu,
Anahita Hassanzadeh

We briefly outline a Benders-type algorithm for solving two-stage stochastic programs with mixed integer recourse and describe our experience implementing the algorithm in practice, as well as its theoretical connection to bilevel optimization. Computational results with benchmark instances from the literature will be presented.

■ SC12

12-Franklin 2, Marriott

Mixed Integer Programming and Location Routing Problem

Sponsor: Optimization/Mixed Integer Nonlinear Optimization and
Global Optimization
Sponsored Session

Chair: Emre Tokgoz, Assistant Professor, Quinnipiac University,
275 Mount Carmel Ave. TH-ENR, Hamden, CT, 06518,
United States of America, Emre.Tokgoz@quinnipiac.edu

1 - Manifold Location Routing Problem

Emre Tokgoz, Assistant Professor, Quinnipiac University,
275 Mount Carmel Ave. TH-ENR, Hamden, CT, 06518,
United States of America, Emre.Tokgoz@quinnipiac.edu

A new Location Routing Problem named Manifold Location Routing Problem and the most recent developments to solve this problem will be explained in this talk.

2 - Cost Effective Energy Optimization by Solving Facility Allocation on Riemannian Manifolds

Iddrisu Awudu, Assistant Professor, Quinnipiac University,
275 Mount Carmel Ave., Hamden, CT, 06518,
United States of America, Iddrisu.Awudu@quinnipiac.edu

Delivering goods and services in an efficient (cost) and effective (value) manner is crucial to every supply chain. In this presentation, a recently developed technique for solving the Location Routing Problem on Manifold surfaces called Manifold Location Routing Problem (MLRP) is used to design a renewable energy distribution system for a single ethanol production facility. The results with the corresponding managerial insights of the model are discussed.

■ SC13

13-Franklin 3, Marriott

Multi-armed Bandits and Online Optimization

Sponsor: Optimization/Optimization Under Uncertainty
Sponsored Session

Chair: Andrew Lim, National University of Singapore/Department of
Decision Sciences, Mochtar Riady Building, BIZ1 08-69, 15 Kent Ridge
Drive, Singapore, Singapore, andrewlim@nus.edu.sg

1 - Dynamic Pricing and Product Differentiation with Cost Uncertainty and Learning

Bora Keskin, Duke University, Fuqua School of Business,
100 Fuqua Drive, Durham, NC, 27708-0120, United States of
America, bora.keskin@duke.edu, John Birge

Motivated by applications in the health insurance industry, we consider a seller who designs and sells a set of products to a population of quality-sensitive customers. The seller faces an uncertainty about production costs. We prove that, while a seller facing static cost uncertainty degrades the quality in its product offering, a dynamically learning seller improves the quality of its products to accelerate information accumulation.

2 - Efficient Experimentation via the Bootstrap

Ian Osband, Stanford University, 450 Serra Mall, Stanford, CA,
United States of America, iosband@stanford.edu,
Benjamin Van Roy

If you want to use data to make good decisions, you need good data. Often, the decisions you make influence both performance and the data collected. Balancing exploration with exploitation can be complex. We present a fully non-parametric version of Thompson sampling that uses the bootstrap to produce approximate posterior samples. We show that, under some assumptions, this simple heuristic satisfies strong performance guarantees. This algorithm performs well in simulation.

3 - Approximate Learning Trajectories for Bayesian Bandits

Michael Kim, University of Toronto, 5 King's College Road,
Toronto, Canada, mikekim@mie.utoronto.ca, Andrew Lim

It is known that the optimal policy for a multi-armed bandit problem is the Gittins index policy. For bandit problems with Bayesian learning (Bayesian bandits) however, computing the Gittins index is intractable due to the curse of dimensionality. In this talk, we introduce the concept of an approximate learning trajectory, which approximates the dynamics of future learning. We show how this can be used to simplify the DP equations, which allows for an efficient computation of the Gittins index.

4 - Bandits with Global Convex Constraints and Concave Objective

Shipra Agrawal, Researcher, Microsoft Research,
#9 Lavelle Road, Bangalore, India, ashipra@gmail.com

I will present recent advances on multi-armed bandit problems that involve arbitrary concave objective functions and convex constraints on the aggregate of decisions across time, in addition to the customary limitation on the time horizon.

■ SC14

14-Franklin 4, Marriott

New Developments in Robust and Adaptive Optimization

Sponsor: Optimization/Optimization Under Uncertainty
Sponsored Session

Chair: Dimitris Bertsimas, Professor, MIT, 77 Massachusetts Ave.,
Cambridge, MA, 02139, United States of America, dbertsim@mit.edu

1 - Multistage Robust Mixed Integer Optimization with Adaptive Partitions

Iain Dunning, PhD Candidate, MIT, 77 Massachusetts Ave,
Building E40, Cambridge, MA, 02139, United States of America,
idunning@mit.edu, Dimitris Bertsimas

We present a partition-and-bound method for multistage adaptive mixed integer optimization problems that extends previous work on finite adaptability. The method analyzes the solution to a non-adaptive problem to determine how the uncertainty set is restricting the objective, and uses this to partition the set. A lower bound is calculated, and the partitioning is repeated until a desired gap is reached. We demonstrate in computational experiments that the method produces good solutions quickly.

2 - The Role of Robustness in Modern Statistical Regression

Martin Copenhaver, MIT, 77 Massachusetts Avenue, E40-135,
Cambridge, MA, 02139, United States of America,
mcopen@mit.edu, Dimitris Bertsimas

Sparsity is a key driver in modern statistical estimation problems, yet reliably sparse solutions remain elusive. Despite this, many regularization methods often perform well in the face of noise in the data. In the domains of linear, median, and matrix regression, we characterize precisely when regularization problems correspond to simple robust optimization problems. In doing so, we contend that it is robustness, not sparsity, which is critical to the success of modern statistical methods.

3 - Robust Ambulance Deployment

Yee Sian Ng, Massachusetts Institute of Technology,
77 Massachusetts Ave, Cambridge, MA, 02139, United States of
America, yeesian@mit.edu, Dimitris Bertsimas

In Emergency Medical Systems (EMS), operators deploy a fleet of ambulances to a set of locations before dispatching them in response to emergency calls. The goal is to minimize the fraction of calls with late response times, which we formulate as a two-stage Robust Optimization model with integer recourse. We propose a practical algorithm for solving the model, and demonstrate the benefits of this approach in a realistic case study of the EMS in Washington DC.

■ SC15

15-Franklin 5, Marriott

Nonlinear Optimization Methods with Stochastic and Second Order Information

Sponsor: Optimization/Nonlinear Programming

Sponsored Session

Chair: Katya Scheinberg, Lehigh University, 200 W Packer ave,
Bethlehem, PA, 18015, United States of America, kattyas@lehigh.edu

1 - Stochastic Optimization using a Trust-region Method and Random Models

Matt Menickelly, Lehigh University, 200 W. Packer Ave.,
Bethlehem, PA, 18015, United States of America,
mjm412@lehigh.edu, Katya Scheinberg, Ruobing Chen

We propose and analyze a trust-region model-based method for solving unconstrained stochastic optimization problems. The convergence analysis relies only on requirements that random models and point estimates are sufficiently accurate with sufficiently high, but fixed, probability. We present examples of generating sufficiently accurate random models under different noise assumptions and compare with existing approaches based on sample averaging or stochastic gradients.

2 - Accelerated Proximal Quasi-newton Algorithm with Global Complexity Analysis

Hiva Ghanbari, Lehigh University, Harold S. Mohler Laboratory,
200 W. Packer Ave., Bethlehem, PA, 18015, United States of
America, hig213@lehigh.edu, Katya Scheinberg

We propose a proximal quasi-newton algorithm in the spirit of the Nesterov's accelerated scheme for solving convex composite optimization problems. We present the analysis reflecting the convergence properties of the proposed algorithm, which preserves the sublinear rate of convergence under some mild assumptions. Furthermore, we show that, under careful use of second order information, this method obtains the same rate of convergence of Accelerated Proximal Gradient Algorithm.

3 - Selective Linearization Algorithm for Multi-block Convex Optimization

Yu Du, Rutgers University, 100 Rockefeller Road, Rutgers
business school, Piscataway, NJ, 08854, United States of America,
duyu197@gmail.com, Andrzej Ruszczyński, Xiaodong Lin

We consider the problem of minimizing the multi-block structured convex non-smooth functions. We introduce the Selective Linearization (SLIN) Algorithm which iteratively solves a series of subproblems by linearizing some blocks and approaches the optimal solution. Global convergence is achieved and SLIN algorithm is proven to converge at rate of $O(1/k)$. We apply the SLIN algorithm on structured regularization applications, showing fast running time for large scale problems.

4 - Quasi-newton Methods for Nonsmooth Optimization

Nitish Shirish Keskar, Northwestern University, 2145 Sheridan
Road, Room C210, Evanston, IL, 60208, United States of
America, keskar.nitish@gmail.com, Jorge Nocedal,
Andreas Waechter

We study the behavior of quasi-Newton methods on large-scale nonsmooth optimization problems. We concentrate specifically on a modified BFGS approach and its limited memory implementation. We contrast this approach with other popular methods including Limited Memory Bundle Methods and Gradient Sampling methods and describe detailed numerical results from both academic and practical test problems. Finally, we briefly provide some new theoretical guarantees for this class of methods.

■ SC16

16-Franklin 6, Marriott

Efficient Algorithms for Large-Scale Convex Games

Sponsor: Optimization/Linear and Conic Optimization

Sponsored Session

Chair: Fatma Kilinc Karzan, Assistant Professor Of Operations Research,
Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA,
15213, United States of America, fkilinc@andrew.cmu.edu

Co-Chair: Christian Kroer, PhD Student, Carnegie Mellon University,
5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America,
ckroer@cs.cmu.edu

1 - Games People (could not) Play

Swati Gupta, MIT, 77 Massachusetts Avenue, E40-149,
Cambridge, MA, 02139, United States of America,
swatig@mit.edu

Every two-player zero-sum game has an optimal strategy that can be found by solving an LP. But this approach is not polynomial time when the number of pure strategies for each player is exponential in the input, e.g. each player plays spanning trees of a graph. We present fast algorithms to compute Nash-equilibria for these games for bilinear payoff functions using ideas from convex and combinatorial optimization and machine learning.

2 - Maximal Cooperation in Repeated Games on Social Networks

Catherine Moon, Duke University, 213 Social Sciences,
Box 90097, Durham, NC, 27705, United States of America,
csm17@duke.edu, Vincent Conitzer

Standard results on repeated games assume that defections are instantly observable. In reality, it may take some time for agents in a network to learn that a defection has occurred. How does this affect the structure of equilibria and algorithms for computing them? In games of cooperation and defection, we prove existence of a unique maximal set of forever-cooperating agents in equilibrium, give an efficient algorithm for computing it and a condition for when the equilibrium found is credible.

3 - Faster First-order Methods for Extensive-form Game Solving

Christian Kroer, PhD Student, Carnegie Mellon University, 5000
Forbes Ave, Pittsburgh, PA, 15213, United States of America,
ckroer@cs.cmu.edu, Kevin Waugh, Fatma Kilinc Karzan, Tuomas
Sandholm

We investigate first-order methods for Nash equilibrium computation in zero-sum sequential games. We introduce the dilated entropy function as a distance-generating function, and develop strong-convexity bounds on this function over convex polytopes that generalize sequential-game strategy spaces. In terms of game solving, this improves the convergence rate of several first-order methods. We instantiate these methods with our results, and show that our algorithms outperform prior algorithms.

4 - Simultaneous Abstraction and Equilibrium Finding in Games

Noam Brown, Carnegie Mellon University, 5000 Forbes Ave,
Pittsburgh, PA, 15213, United States of America,
noamb@andrew.cmu.edu, Tuomas Sandholm

The leading approach to solving infeasibly large imperfect-information extensive-form games is to solve a smaller abstract version of the game and then map the solution back to the original. However, it is difficult to know which actions should be included in the abstraction without first solving the game. We introduce a method that combines abstraction with equilibrium finding by enabling actions to be added to the abstraction at run time in points that the current abstraction deems important.

■ SC17

17-Franklin 7, Marriott

Network Optimization

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Kelly Sullivan, Assistant Professor, University of Arkansas, Fayetteville, AR, 72701, ksulliv@uark.edu

1 - A Decomposition Approach for Dynamic Network Interdiction Models

Chase Rainwater, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, AR, United States of America, cer@uark.edu, Forough Enayaty Ahangar

This work details the development of a large-scale optimization approach for solving dynamic bilevel network interdiction problems. A benders decomposition approach is proposed that utilizes constraint programming to exploit the scheduling nature of the network interdiction subproblem solved over a finite time horizon. Computational results comparing the proposed approach to traditional constraint programming and mixed-integer programming approaches are discussed.

2 - Supply Chain Design through Acquisition: A Robust Multi-objective Approach

Amin Khademi, Assistant Professor, Clemson University, 130-D Freeman Hall, Clemson University, Clemson, SC, 29634, United States of America, khademi@clemson.edu, Mariah Magagnotti, Scott Mason

Combining supply chain networks for an acquisition is a complicated process; making decisions for strategic merging of the supply chains when working with incomplete or incorrect data is even more so. Our work presents a robust optimization model that allows the decision maker to adjust for an expected degree of uncertainty, thus producing solutions that are less responsive to incorrect or incomplete data without being excessively cautious.

3 - Multiple-scenario Approach for a Dynamic Disaster Relief Routing Problem with Uncertain Social Data

Emre Kirac, PhD Candidate, University of Arkansas, Department of Industrial Engineering, Fayetteville, AR, 72701, United States of America, ekirac@email.uark.edu, Ashlea Milburn

Social media may play an important role and improve situational awareness in disaster response by providing real-time information. We present decision support models capable of considering input streams from social data when planning for disaster response. Specifically, a dynamic routing problem is presented in which social data and information from trusted sources are available and change over time. Alternative decision policies are presented and compared across a variety of request scenarios.

4 - The Wireless Network Jamming Problem Subject to Protocol Interference

Hugh Medal, Mississippi State University, Industrial & Systems Engineering, Starkville, United States of America, hugh.medal@msstate.edu

We study a wireless network jamming problem, solving it using a cutting plane approach that is able to solve networks with up to 81 transmitters. Our study yields the following insights into wireless network jamming: 1) increasing the number of channels is the best strategy for designing a robust network, and 2) increasing the jammer range is the best strategy for the attacker.

■ SC18

18-Franklin 8, Marriott

Data Mining for Healthcare

Cluster: Modeling and Methodologies in Big Data

Invited Session

Chair: Daehan Won, University of Washington, Seattle, 1415 NE Ravenna Blvd, #401, Seattle, WA, 98105, United States of America, wondae@uw.edu

1 - General Framework for Rulebased Medical Diagnosis and Decision Making

Chunyan (sally) Duan, Tongji University & University of Washington, A503, Sino-French Center, Tongji University, No.1239, Siping Road, Shanghai, 200092, China, duanchunyan87@gmail.com, Daehan Won, Ying Lin, Shuai Huang, Jianxin You, W. Art Chaovalitwongse

A new mixed integer programming model is developed to select rules with minimization of prediction errors and control the costs of the features in the framework. The Diabetes Prevention Trial-Type 1 dataset is used to evaluate and compare our model with other State-of-the-Art methods. The results show that

our model not only dramatically reduce the number of selected features and control the costs of the features, but also has a promising accuracy in medical diagnosis.

2 - Networked Data Classification with Node Selection

Daehan Won, University of Washington, Seattle, 1415 NE Ravenna Blvd, #401, Seattle, WA, 98105, United States of America, wondae@uw.edu

We present a framework for classification of networked structure data. Due to the huge size of the network, we apply a feature selection scheme. Instead of general feature selection methods, we present a node selection scheme to determine the most relevant sub-networks which might yield insightful information underlying complex networks.

3 - A Structural Model and Bayesian Estimation of New Technology Adoption

Sebastian Souyris, PhD Candidate, The University of Texas at Austin, 2110 Speedway Stop B6500, Austin, TX, 78712, United States of America, sebastian.souyris@utexas.edu, Jason A. Duan, Anant Balakrishnan, Varun Rai

We present a structural model and estimation algorithm to analyze the adoption of a new technology at individual consumer level. The model incorporates networks, e.g. geographical distance, to estimate the potential effect of word of mouth by assuming that the previous adoptions affect the predisposition of a consumer towards the technology. For inference, we use a Bayesian algorithm that overcomes the computational burden of classical estimation methods of structural models.

■ SC19

19-Franklin 9, Marriott

Application in Transportation Systems

Sponsor: Computing Society

Sponsored Session

Chair: Jingyang Xu, The Walt Disney Company, 1375 East Buena Vista Drive, Orlando, FL, 32830, United States of America, jxu7@buffalo.edu

1 - Consolidation and Last-mile Costs Reduction in Intermodal Transport

Martijn Mes, University of Twente, P.O. Box 217, Enschede, Netherlands, m.r.k.mes@utwente.nl, Arturo Pérez Rivera

We consider a carrier that transports freight periodically, using long-haul round trips from a single origin to multiple last-mile locations, and vice versa. Since the long-hauls are always traveled, the last-mile locations determine the costs of each trip. The challenge is to select, for each trip, the combination of orders which reduces costs over time. We propose an approximate dynamic programming (ADP) approach, which we illustrate using data from a Dutch intermodal carrier.

2 - A Real-time Run-curve Computation Framework for Trains with Dynamic Travel Restrictions

Jingyang Xu, The Walt Disney Company, 1375 East Buena Vista Drive, Orlando, FL, 32830, United States of America, jxu7@buffalo.edu, Daniel Nikovski, Sae Kimura

We study the problem to generate the most energy efficient run-curves subject to given travel time requirements and speed limit changes. We propose a two stage procedure framework. With derived geometric relations, the actual run-curves are generated in the real-time stage using approximate dynamic programming. Computational results show that the framework is capable to generate near-optimal run-curves in real time.

3 - Emission Oriented Multi-objective Sensor Location Model on Freeway

Ning Zhu, Assistant Professor, Tianjin University, Weijin Road, No. 92, Tianjin, China, zhuning@tju.edu.cn, Shoufeng Ma, Qinxiao Yu, Yuche Chen

In our study, an interpolation method is proposed to reconstruct the vehicle trajectory on a second-by-second base by using traffic sensors. A multi-objective traffic sensor location model is proposed aiming to estimate four major pollutants accordingly. Different numerical experiments are conducted in various freeway topological structures. It shows that the interpolated method for estimating vehicle trajectory can have a reasonable good emission accuracy.

4 - An Exact Algorithm for the Pickup and Delivery Problem with Time Windows and Scheduled Lines

Veaceslav Ghilas, PhD Student, Eindhoven University of Technology, Den Dolech 2, Eindhoven, 5612 AZ, Netherlands, v.ghilas@tue.nl, Jean - Francois Cordeau, Tom Van Woensel, Emrah Demir

The Pickup and Delivery Problem with Time Windows and Scheduled Lines (PDPTW-SL) concerns routing and scheduling a set of vehicles to serve a set of freight requests such that a part of the journey can be carried out on a scheduled public transportation line. We propose a branch-and-price algorithm for the PDPTW-SL. A path-based set partitioning formulation is used as master problem, and a variant of elementary shortest path problem with resource constraints is studied as pricing problem.

5 - Signal Timing Detection Based on "Pseudo Vehicle Trajectory" on the Spatial-temporal Map

Seyedamirali Mostafavizadeh, Graduate Research Assistant, Rutgers University, Core 736, 96 Frelinghuysen Road, Piscataway, NJ, 08854, United States of America, amirali.mostafavizadeh@rutgers.edu, Peter J. Jin

This study introduces a new CCTV video based traffic signal timing detection method. A spatial-temporal (ST) map is generated by stacking the raw pixels along scan lines defined at the middle of each lane. Vehicles leave time-accurate but space-distorted "pseudo trajectories" on ST map without the need of intensive camera calibration. A moving Hough Line Transforms (MHLT) based method is then introduced to detect straight lines (queueing) to generate the starting and ending time of red lights.

■ SC20

20-Franklin 10, Marriott

Resource Allocation and Pricing in Cloud Computing

Cluster: Cloud Computing

Invited Session

Chair: Julie Ward, Distinguished Technologist, HP Labs, 1501 Page Mill Rd, Palo Alto, CA, 94301, United States of America, jward@hp.com

1 - Cost-efficient Cloud Computing

Vivek Farias, Associate Professor, MIT, 100 Main Street, Cambridge, United States of America, vivekf@mit.edu, Muhammad Amjad, Andrew Li, Devavrat Shah

Cloud users today must navigate through a variety of pricing mechanisms, and must contend with issues such as supply/demand forecasting and the high-dimensional control problems that naturally arise when attempting to minimize cost. We study the problem of computation under a deadline. We provide a simple, scalable algorithm that requires no tuning and enjoys robust performance guarantees. Along the way, we address a generalization of the classical Secretary Problem and prophet inequalities.

2 - Results-based Pricing and Resource Allocation in Cloud Computing

Filippo Balestrieri, HP Labs, 1501 Page Mill Rd, Palo Alto, CA, 94301, United States of America, filippo.balestrieri@hp.com, Julie Ward, Bernardo Huberman

Cloud services are sold today via a resource-based model, in which customers pay per instance-period. New technologies for predicting job requirements and completion times allow Cloud providers to consider new mechanisms. We compare a resource-based model to a results-based mechanism, in which the provider offers a menu of completion times and prices to each customer for his specific job. We identify conditions under which one mechanism produces higher revenue for the provider than the other.

3 - Selling Guaranteed Completion Times on the Cloud

Andrew Li, MIT Operations Research Center, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA, 02139, United States of America, aali@mit.edu, Filippo Balestrieri, Julie Ward

In today's cloud market, users execute their own jobs without a guarantee that deadlines will be met. Instead, providers can take control of job execution and charge for guaranteed completion times, but they face the joint challenges of dynamically pricing such contracts and scheduling jobs to fulfill these contracts. We address these challenges with a revenue management formulation, and apply a fluid approximation that is computationally efficient and optimal for large systems.

■ SC21

21-Franklin 11, Marriott

Applied Operations in Health Services: Research by Bonder Scholars

Sponsor: Health Applications

Sponsored Session

Chair: Jonas Jonasson, Student, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, jjonasson@london.edu

1 - Optimal Liver Cancer Surveillance in Hepatitis C-infected Populations

Qiushi Chen, chenqiushi0812@gatech.edu, Turgay Ayer, Jagpreet Chhatwal

Every 6-month surveillance for liver cancer is currently recommended in cirrhotic hepatitis C patients, but the optimal surveillance policy remains unknown. We develop a mixed-integer programming-based framework to analyze the most cost-effective surveillance policies, and find that (1) the optimal surveillance interval should depend on patients' stage of hepatitis C and age, and (2) expanding surveillance to earlier stage of hepatitis C improves the cost-effectiveness of HCC surveillance.

2 - Ambulance Dispatching, Redeployment and Reallocation

Amir Ali Nasrollah Zadeh, Clemson University, Freeman Hall 129, Clemson University, Clemson, SC, 29634, United States of America, snasrol@g.clemson.edu, Amin Khademi, Cem Saydam, Hari Rajagopalan, Maria Mayorga

Larger cities, expensive medical cares and heavy traffics have led to an increasing number of medical emergency calls and associated costs. In this work we develop an optimization model to find near-optimal solutions to ambulance dispatching, redeployment and reallocation problem to minimize the total expected waiting time of patients. We use approximate dynamic programming to find high-quality solutions and compare our policies with current practices via a simulation model.

3 - Robust Post-donation Blood Screening under Uncertainty

Hadi El-amine, PhD Student, Virginia Tech, 250 Durham Hall Perry St., Blacksburg, VA, 24061-0118, United States of America, hadi@vt.edu, Douglas Bish, Ebru Bish

Blood product safety, in terms of being free of transfusion-transmittable infections, is crucial. Under uncertainties in testing parameters and prevalence rates, various objective functions were considered in order to determine a "robust" post-donation blood screening strategy that minimizes the risk of releasing an infected unit of blood into the blood supply.

■ SC22

22-Franklin 12, Marriott

Adaptive Sampling and Selection in Simulation, Medicine and Machine Learning

Sponsor: Applied Probability

Sponsored Session

Chair: Peter Frazier, Assistant Professor, Cornell University, 232 Rhodes Hall, Cornell University, Ithaca, NY, 14850, United States of America, pf98@cornell.edu

1 - Large Scale Parallel Ranking and Selection

Susan Hunter, Purdue University, Grissom Hall, 315 N. Grant St., West Lafayette, IN, United States of America, susanhunter@purdue.edu, Florin Ciocan, Eric Ni, Shane Henderson

We discuss a new ranking and selection procedure that provides a good-selection guarantee and is suitable for parallel implementation on large scale problems. Two implementations, one using message-passing interface (MPI) and the other using MapReduce, both perform well in a high-performance computing environment. MPI is more efficient than MapReduce in the sense that cores are more heavily utilized, but less robust to issues such as core failure that may arise in cloud computing environments.

2 - Active Learning for Conjoint Analysis

Stephen Pallone, Cornell University, 290 Rhodes Hall, Cornell University, Ithaca, NY, 14853, United States of America, snp32@cornell.edu, Peter Frazier, Shane Henderson

Conjoint analysis is a method of learning a user's preferences, where the user is offered a set of alternatives and chooses the preferred option. We model the user's preferences as being characterized by a linear classifier, but allow for noise to contaminate responses. The rate at which we learn depends on the alternatives offered. We explore different policies for offering these alternatives, such as knowledge gradient and greedy posterior entropy reduction, and analyze their performance.

3 - Optimal Online Selection of a Monotone Subsequence:**A Central Limit Theorem**

Vinh V. Nguyen, PhD Student, The Fuqua School of Business,
Duke University, 100 Fuqua Drive, Durham, NC, 27708,
United States of America, vn26@duke.edu, Alessandro Arlotto,
J. Michael Steele

Consider a sequence of n independent random variables with common continuous distribution and consider the task of choosing an increasing subsequence where the observations are revealed sequentially and must be accepted or rejected when they are first revealed. There is a unique selection policy that maximizes the expected number of selected observations. We prove a central limit theorem for this number of optimally selected observations and characterize its mean and variance for large n .

4 - A Bayesian Decision-theoretic Model of Sequential Clinical Trials with Delayed Responses

Stephen Chick, Professor, INSEAD, Technology Management
Area, Boulevard de Constance, Fontainebleau, 77300, France,
stephen.chick@insead.edu, Martin Forster, Paolo Pertile

Clinical trials are necessary for evaluating the benefit of health technologies but are quite costly, but most analysis do not account for the effect of delayed observations on optimal trial design. We take a Bayesian sequential learning approach to the economics of clinical trial design with dynamic programming. We provide structural results and apply optimal stopping time solutions to data from recent clinical trials.

■ SC23

23-Franklin 13, Marriott

Solutions for Large Markov Chains

Sponsor: Applied Probability

Sponsored Session

Chair: Mor Harchol-Balter, Professor, Carnegie Mellon University,
Computer Science Dept., 5000 Forbes Ave., Pittsburgh, PA,
United States of America, harchol@cs.cmu.edu

1 - Clearing Analysis on Phases: Distribution of Skip-free, Unidirectional, Quasi-birth-death Processes

Sherwin Doroudi, PhD Candidate, Carnegie Mellon University,
sdoroudi@andrew.cmu.edu, Mor Harchol-Balter, Brian Frailix

A wide variety of problems in manufacturing, service, and computer systems can be modeled by infinite repeating quasi-birth-death process (QBD) Markov chains with infinitely many levels and finitely many phases. Many such chains have transitions that are skip-free in level and unidirectional in phase. We present the Clearing Analysis on Phases (CAP) method, which yields the exact limiting probabilities of the states in such chains as a linear combinations of scalar bases raised to powers.

2 - M/M/C Queue with Two Priority Classes

Opher Baron, University of Toronto, 105 St. George St, Toronto,
ON, Canada, opher.baron@rotman.utoronto.ca, Jianfu Wang,
Alan Scheller-wolf

We provide the first exact analysis of a preemptive M/M/C queue with two priority classes with different service rates. We introduce a technique to reduce the 2-dimensionally Infinite Markov Chain (IMC), representing this problem, into a 1-dimensionally IMC. We derive the law for the number of low-priority jobs. Numerical examples demonstrate the accuracy of our algorithm and generate new insights. We demonstrate how our methodology solves other problems.

3 - Product-Form Solutions for a Class of Structured Multi-Dimensional Markov Processes

Jori Selen, PhD Candidate, Eindhoven University of Technology,
De Zaale, Eindhoven, Netherlands, j.selen@tue.nl,
Johan Van Leeuwen, Ivo Adan

Motivated by queueing systems with heterogeneous parallel servers, we consider a class of structured multi-dimensional Markov processes whose state space can be partitioned into two parts: a finite set of boundary states and a structured multi-dimensional set of states, exactly one dimension of which is infinite. Using separation of variables, we show that the equilibrium distribution, typically of the queue length, can be represented as a linear combination of product forms.

■ SC24

24-Room 401, Marriott

Fashion, Innovation and Technology

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Heng Xu, Associate Professor, Pennsylvania State University,
316H IST Building, University Park, PA, 16802,
United States of America, hxu@ist.psu.edu

1 - Fashion-Telling: Predicting the Future of Digital Innovations

Ping Wang, Associate Professor, University of Maryland, College
Park, 4105 Hornbake Bldg., College of Information Studies,
College Park, MD, 20742, United States of America,
pwang@umd.edu

The fusion of digital technologies and fashion makes innovation trajectories notoriously fickle and hard to predict. This study combines organizational ecology and network theories to conceptualize digital innovation ecosystems and proposes to use the ecology and structure of these ecosystems to predict the trajectories of digital technologies. The utility of this approach is illustrated in a case study, with implications to Information Systems strategy and management articulated.

2 - Making Sense of Materiality: The Case of 3d Printed Fashion

Ning Xu, Assistant Professor, Ivey Business School, Western
University, 1255 Western Road, London, ON, N6G 0N1, Canada,
nsu@ivey.uwo.ca

3D printing is increasingly embraced by fashion designers. Due to the nascent and evolving nature of 3D printing, however, there is significant uncertainty around its affordances and constraints. Drawing on qualitative data, this exploratory study shows that fashion designers seek to make sense of this emerging technology by pursuing a collective design process with multiple stakeholders. The ongoing interaction among diverse actors gives rise to innovative perceptions, practices, and products.

3 - Fashion and Text Analytics

Heng Xu, Associate Professor, Pennsylvania State University,
316H IST Building, University Park, PA, 16802,
United States of America, hxu@ist.psu.edu, Yilu Zhou

The Fashion Industry is extremely competitive in terms of adapting to fast evolving fashion trends and consumer demand. Building upon various fashion theories, we empirically examine fashion designer's evolution by studying a variety of data including fashion articles, magazines, blogs, and social media. By using text analytics, we envision the color, print, and style for upcoming trends and help retailers to stay on top of the latest fashion.

4 - Mining Social Media and Press Release for Competitive Intelligence: A Case Study on IBM

Yuan Xue, The George Washington University, 2201 G Street,
NW, Suite 515, Washington, DC, United States of America,
xueyuan@gwmail.gwu.edu, Subhasish Dasgupta, Yilu Zhou

Competitive intelligence (CI) refers to the study of competitors and competitive environment in support of decision-making. CI is usually generated by CI professionals. The recent CI trend is to collect competitor information online. We believe that social media analysis can help us to identify both direct and indirect competitors, rank competitors based on their market commonality and learn the strength and weakness of focal company.

■ SC25

25-Room 402, Marriott

E-Commerce and Digital Marketing

Sponsor: Information Systems

Sponsored Session

Chair: Dokyun Lee, Carnegie Mellon University,
United States of America, leedokyun@gmail.com

1 - Measuring Display Advertising Effects on Online Search Behavior

Vilma Todri, PhD Candidate In Information Systems, NYU, 44 W
4th St, KMC Room 8-181, New York, Ne, 10012, United States of
America, vtodri@stern.nyu.edu, Anindya Ghose

The increasing availability of individual-level data has raised the standards for measurability and accountability in online advertising. Using a novel data set with granular measurements of advertising exposures, we examine a wide range of consumer behaviors and capture the effectiveness of display advertising across channels as well as the dynamics of these effects across the purchasing funnel path of consumers. We discover rich findings with important managerial implications.

2 - The Value of Fit Information in Online Retail

Antonio Moreno-Garcia, Northwestern University, 2001 Sheridan Rd, Evanston, IL, 60208, United States of America, a-morenogarcia@kellogg.northwestern.edu, Santiago Gallino

We conduct a field experiment to quantify the value of fit information in online retail.

3 - The Effect of Music Labels on Song Popularity in Electronic Markets Without Barriers-to-Entry

Marios Kokkodis, Assistant Professor, Boston College, 34 E 10th, New York, NY, 10009, United States of America, mkokkodis@stern.nyu.edu

In this work we study the effect of music labels on song popularity in electronic markets without barriers to entry.

4 - The Moderating Effects of Product Attributes and Reviews on Recommender System Performance

Dokyun Lee, Carnegie Mellon University, United States of America, leedokyun@gmail.com, Kartik Hosanagar

We investigate the moderating effect of several product attributes on the efficacy of a recommender system for increasing conversion rate via a field experiment on one of the top North American retailer's website. Our results provide many managerial implications on when to utilize recommenders and how recommenders interact with reviews and product attributes.

■ SC26

26-Room 403, Marriott

INFORMS Undergraduate Operations Research Prize II

Cluster: INFORMS Undergraduate Operations Research Prize

Invited Session

Chair: Aurelie Thiele, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, aut204@lehigh.edu

1 - Piecewise Static Policies for Two-stage Adjustable Robust Optimization Problems under Uncertainty

Omar El Housni, Industrial Engineering and Operations Research, Columbia University, 547 Riverside Drive Apt. 1B, New York, NY, 10027, United States of America, omar.el-housni@polytechnique.edu, Vineet Goyal

We consider two-stage adjustable robust linear optimization problems under uncertain constraints and study the performance of piecewise static policies. We show that surprisingly there is no piecewise static policy with polynomial number of pieces with performance significantly better than a static policy in general. We also present a family of piecewise static policy with exponential pieces that has a significantly better performance than a static solution and admits a compact MIP formulation.

2 - Multi-step Bayesian Optimization for One-dimensional Feasibility Determination

Massey Cashore, University of Waterloo, 200 University Ave W, Waterloo, On, N2L 3G1, Canada, masseycashore@gmail.com, Peter Frazier

Bayesian optimization methods allocate limited sampling budgets to maximize expensive-to-evaluate functions. One-step-lookahead policies are often used, but computing optimal multi-step-lookahead policies remains a challenge. We consider a specialized Bayesian optimization problem: finding the superlevel set of an expensive one-dimensional function, with a Markov process prior. We compute the Bayes-optimal sampling policy efficiently, and characterize the suboptimality of one-step lookahead.

3 - Alleviating Competitive Imbalances in NFL Schedules: An Integer Programming Approach

Kyle Cunningham, Northeastern University, Healthcare Systems Engineering Institute, Boston, MA, United States of America, cunningham.k@husky.neu.edu, Murat Kurt, Niraj Pandey, Mark Karwan

While the NFL uses complex rules in scheduling its games, NFL schedules are not robust in creating a consistent competitive appeal. We propose a two-stage MILP approach to reduce competitive disadvantages in schedules arising from various sources including rest differentials due to bye-weeks and Thursday games, long streaks of road games, and short-week travel. Our results for the 2012-2015 seasons indicate that our approach can substantially improve NFL schedules in various fairness metrics.

4 - Robust Multi-Objective Clustering

Andy Zheng, Northwestern University, 1501 Leavenworth, San Francisco, CA, 94109, United States of America, azheng92@gmail.com

We propose a multi-objective method that leverages robust optimization for hierarchical clustering (rMOC). rMOC chooses clusters based on a weighted sum of data-intrinsic objective functions, determining a threshold that is most robust to uncertainties in these weights. We compare this method to the reference methods of K\$-means and Gaussian mixture models. In terms of misassignment rate, rMOC outperforms both other methods on several benchmark datasets.

5 - Optimal Resource Allocation in Breast Cancer Screening with Different Risk Groups

Magdalena Romero, Universidad Adolfo Ibañez, Santiago, Santiago, Chile, maromero@alumnos.uai.cl, Qingxia Kong, Susana Mondschein

This paper investigates how many lives can be saved from breast cancer death through optimal allocation of limited resources in public health. We build a two-stage stochastic dynamic programming model to optimally allocate a limited number of mammograms, among women with different risk levels in breast cancer, which is applied to the case in Chile. We find that simply through dividing women into 3 risk groups, we can save 88 lives per 100,000 women, compared to the current practice in Chile.

■ SC27

27-Room 404, Marriott

MCDM Methods and Applications

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Luiz Autran Gomes, Ibmecc/RJ. Rio de Janeiro – RJ, Brazil, autran@ibmeccrj.br

1 - Multi-criteria Evaluation of Sustainable Manufacturing

Jian-bo Yang, Professor Of Decision And System Sciences, Manchester Business School, The University of Manchester, Manchester, M15 6PB, United Kingdom, jian-bo.yang@mbs.ac.uk, Panitas Sureeyatanapas

Sustainable manufacturing becomes increasingly important. The paper explains how a manufacturer can maintain its business and operations in long term by combining green manufacturing, corporate social responsibility and green supply chain. It then focuses on discussing how criteria and indicators for evaluating progress to sustainable manufacturing can be established. A case study for evaluating sustainability performance in the sugar manufacturing industry of a developing country is discussed.

2 - Recent Development and Applications of Evidential Reasoning Approach for Decision Making

Dong-ling Xu, Professor Of Decision Science And Systems, Manchester Business School, The University of Manchester, Manchester, United Kingdom, ling.xu@mbs.ac.uk, Jian-bo Yang

We report the recently discovered relationship between Bayesian inference and the Evidential Reasoning approach for multiple criteria decision making under uncertainty. It is significant because it opens up new research avenues in many fields such as the extension of Bayesian inference with imperfect probability information which may not be fully reliable and the enhancement of evidence and random set theories. A few applications are reported with a focus on extracting evidence from big data.

3 - The Primary Aluminum Industry as a Complex Adaptive System

David Olson, Professor, University of Nebraska Lincoln, CBA 256, Lincoln, NE, 68588-0491, United States of America, dolson3@unl.edu

Supply chains are critically important elements of global business, involving high levels of interdependence. Supply chains have been suggested to be complex adaptive systems. Supply chains usually emerge rather than result from the purposeful design of a single controlling entity. This paper presents the global primary aluminum industry viewed from the perspective of complex adaptive systems. Unintended consequences of actor decisions in this industry in the past forty years.

4 - MCDM Methods Inspired by Prospect Theory

Luiz Autran Gomes, Ibmecc/RJ. Rio de Janeiro – RJ, Brazil, autran@ibmeccrj.br

This paper reviews attempts to develop discrete MCDM methods inspired by Kahneman and Tversky's prospect theory. After going through the first steps making use of linear prospect theory the essentials of the TODIM method and extensions are presented. The paper closes with outlining how qualitative methods of MCDM such as DEX or Verbal Decision Analysis can be combined with TODIM-based methods in order to approach complex decision making problems.

■ SC28

28-Room 405, Marriott

Market Design

Cluster: Auctions

Invited Session

Chair: Gabriel Weintraub, Professor, Columbia University, Uris Hall, New York, NY, 10027, United States of America, gyw2105@columbia.edu

1 - Incentive Issues in Paired Organ Donation

Eduardo Azevedo, Assistant Professor, Wharton, 3620 Locust Walk, Wharton, SHDH 1400, Philadelphia, PA, 19102, United States of America, eazevedo@wharton.upenn.edu, Nikhil Agarwal, Itai Ashlagi, Clayton Featherstone

In the last few years a new type of organ donation has arisen. In a paired kidney exchange two recipients with incompatible live donors receive organs from each other's live donor. Sometimes transactions involve more recipients and/or donors. While many exchanges happen in a decentralized way, others happen in large centralized exchanges. We empirically examine how agents in these markets respond to incentives and whether incentives are misaligned with social goals.

2 - Optimal Procurement Mechanisms for Differentiated Products

Gabriel Weintraub, Professor, Columbia University, Uris Hall, New York, NY, 10027, United States of America, gyw2105@columbia.edu, Daniela Saban

We study the mechanism design problem faced by a buyer that selects an assortment of differentiated products and unit prices from a set of suppliers with private costs. Then, consumers can choose their most preferred product from this set. The buyer maximizes consumer surplus; to do so, he must balance the trade-off between variety and price competition. We characterize the optimal mechanism and use these results to analyze practical mechanisms.

3 - Efficiency and Stability in Large Matching Markets

Yeon-koo Che, Columbia University, 420 West 118th Street, 1029 IAB, New York, NY, United States of America, yeonkooche@gmail.com, Olivier Tercieux

We study efficient and stable mechanisms in matching markets when the number of agents is large and individuals' preferences and priorities are drawn randomly. When agents' preferences are correlated over objects, the prevailing mechanisms are either inefficient or unstable even in the asymptotic sense. We propose a variant of deferred acceptance which is asymptotically efficient, asymptotically stable and also asymptotically incentive compatible.

4 - Market Fragmentation

Rakesh Vohra, University of Pennsylvania, 3718 Locust Walk, Philadelphia, PA, United States of America, rvohra@seas.upenn.edu, Ahmad Peivandi

Centralized markets reduce the costs of search for buyers and sellers. Their 'thickness' increases the chance of order execution at competitive prices. In spite of the incentives to consolidate, some markets, have fragmented into multiple trading venues. We argue in this paper that fragmentation is an unavoidable feature of any centralized exchange. Our argument introduces a new way to think about participation in a mechanism when the outside option is endogenous.

■ SC29

29-Room 406, Marriott

Joint Session Analytics/CPMS: Panel Discussion on OR vs Analytics: Experts Weigh in on the Case for Change

Sponsor: Analytics/CPMS

Sponsored Session

Chair: Glenn Wegryn, Principal, Analytic Impact LLC, 7555 De Mar Rd, Cincinnati, OH, 45243, United States of America, gwegryn@gmail.com

1 - Panel Discussion on OR vs Analytics: Experts Weigh in on the Case for Change

Moderator: Glenn Wegryn, Principal, Analytic Impact LLC, 7555 De Mar Rd, Cincinnati, OH, 45243, United States of America, gwegryn@gmail.com, Panelists: Robert Rose, Anne Robinson, Jack Levis, Don Kleinmuntz, Thornton May, David Dittmann, Jeffrey Camm

Operations Research? Management Science? Analytics? What's in a brand name? How has the emerging field of Analytics impacted the Operations Research Profession? Is Analytics part of OR or the other way around? Is it good, bad, relevant, a nuisance or an opportunity for the OR profession? Is OR just Prescriptive or is it something more? In this panel discussion, we will explore

these topics in a session with some of the leading thinkers in both OR and Analytics. Be sure to attend to have your questions answered on these highly complementary and valuable fields.

■ SC30

30-Room 407, Marriott

Creating and Sustaining an Analytics Advantage

Sponsor: CPMS

Sponsored Session

Chair: Peter Bell, Ivey Business School at Western University, 1255 Western Road, London, ON, N6G 0N1, Canada, pbell@ivey.uwo.ca

1 - Advanced Analytics at Verizon Wireless Supply Chain

Anne Robinson, Verizon Wireless, anne.robinson@verizonwireless.com, Mustafa Dogru

Supply Chain Advanced Analytics Team carries out projects in the areas of forecasting, inventory optimization, assortment planning, etc. We give an overview of our engagement approach with the internal business units, discuss how our models are implemented and transferred to the business, and conclude with the lessons learned.

2 - Capability Portfolio Analyses Tool (CPAT)

Pooja Dewan, BNSF Railway, Fort Worth TX 76092, United States of America, Pooja.Dewan@bnsf.com

The Capability Portfolio Analyses Tool (CPAT) delivers unparalleled insight into multi-decadal modernization planning for the Army's large ground combat fleet. This first-of-its-kind capability optimizes modernization plans while considering the complex interrelationship between performance, budgets, schedules, production capacities, etc. Over 40 studies have been completed- informing stakeholders up to Army Vice Chief of Staff, OSD, and Army Acquisition Executive levels.

3 - The Analytics Advantage: Some Reflections from Business and Policy-making

Doug Samuelson, InfoLogix, Inc., 8711 Chippendale Court, Annandale, VA, 22003, United States of America, samuelsondoug@yahoo.com

Analytics / OR / MS (or whatever we want to call it) involves injecting more intellectual rigor into decision-making. Key elements of how to do this include using the decision-makers' language, understanding their needs and time frame, and building multiple constituencies of decision-makers who trust your recommendations. This is not as obvious in practice as it sounds in summary.

4 - Sustaining an Analytics Advantage

Peter Bell, Ivey Business School at Western University, 1255 Western Road, London, ON, N6G 0N1, Canada, pbell@ivey.uwo.ca

Many claim that the use of analytics can create a competitive advantage but research suggests that any advantage created is often fleeting: most analytics is easily replicated. There are, however, examples of firms that have sustained a competitive advantage through analytics for years, even decades. How have they done this? What are the lessons for analytics leaders? This presentation will provide examples that may provide lessons on how to sustain an advantage created through analytics.

■ SC31

31-Room 408, Marriott

Interactions Between Learning and Decision Making

Sponsor: Data Mining

Sponsored Session

Chair: Theja Tulabandhula, Xerox Research Centre India, Bangalore, Bangalore, India, theja2t@gmail.com

1 - The Forest or the Trees? Tackling Simpson's Paradox with Classification and Regression Trees

Galit Shmueli, Professor, National Tsing Hua University, Institute of Service Science, 101, Sec. 2, Kuang-Fu Road, Hsinchu, 30013, Taiwan - ROC, galit.shmueli@gmail.com, Inbal Yahav

Social science research often uses observational data to study causality because randomized experiments are impossible, unethical or expensive. Simpson's paradox arises in observational causal studies, due to confounders. We propose using Classification & Regression Trees to detect Simpson's paradox in large observational data. The approach relies on the tree structure and the location of the cause vs. the confounders in the tree. We illustrate our approach on several real applications.

2 - A Statistical Learning Approach to Personalization in Revenue Management

Zachary Owen, Massachusetts Institute of Technology, 77
Massachusetts Ave, E40-149, Cambridge, MA, 02139, United
States of America, zowen@mit.edu, David Simchi-levi, Xi Chen,
Clark Piton

We develop a framework for modeling personalized decision problems which gives a data driven algorithm for revenue maximization using contextual information. We apply our method to pricing and assortment optimization. We prove a high-probability bound on the gap between the revenue of the estimated policy and the revenue generated under full knowledge of the demand distribution. We demonstrate the performance of our method on both airline seating data and simulated data.

3 - Uncovering Hidden Decision Processes through Integration of Independent Databases

Nooshin Valibeig, Northeastern University,
334 Snell Engineering, Boston, MA, 02115, United States of
America, nooshin.valibeig@gmail.com, Jacqueline Griffin

Data is a key driver in analyzing and evaluating the effectiveness of decision processes. We develop an algorithm to uncover hidden information about decision processes in resource allocation systems. Specifically, the algorithm joins event-oriented and snapshot-in-time databases to extract new knowledge about decision processes. The precision and robustness of the algorithm is quantified with simulated data. A case study with hospital patient flow data is presented.

4 - Reinforcement Learning Algorithms for Regret Minimization in Structured Markov Decision Processes

Theja Tulabandhula, Xerox Research Centre India, Bangalore,
Bangalore, India, theja2t@gmail.com, Prabuchandran K. J.,
Tejas Bodas

For several RL problems the optimal policy of the underlying Markov Decision Process (MDP) is characterized by a known structure. We develop new RL algorithms that exploit the structure of the optimal policy to minimize regret. Numerical experiments on MDPs with structured optimal policies show that our algorithms have better performance than current state of the art, are easy to implement, have a smaller run-time, can be parallelized and require less number of random number generations.

■ SC32

32-Room 409, Marriott

Special Topics in Supervised Learning: Variable Selections and Dimension Reductions

Sponsor: Data Mining

Sponsored Session

Chair: Chaojiang Wu, Drexel University, 727 Gerri LeBow Hall, 3220
Market Street, Philadelphia, PA, 19104, United States of America,
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1 - Sparse Nonlinear Feature Selection by Locally Discriminative Constraints

Chuanren Liu, Assistant Professor, Drexel University, 3220
Market St, Philadelphia, PA, 19104, United States of America,
liuchuanren@gmail.com, Kai Zhang

We present an approach to sparse nonlinear feature selection for K-nearest neighbor (KNN) classification. First, the factors for selecting feature are optimized with locally discriminative constraints, which encourage smaller distances between neighbors from the same class and larger distances between neighbors from different classes. Then, we use lasso to achieve the sparse feature selection. We also show an interesting connection between our formulation and the support vector machines (SVMs).

2 - Maximum Tangent Likelihood Estimation and Robust Variable Selection

Yichen Qin, Assistant Professor, University of Cincinnati, 2925
Campus Green Dr., Cincinnati, OH, 45221, United States of
America, yichenqin@gmail.com, Yan Yu, Yang Li, Shaobo Li

In this article, we propose a new class of likelihood function, called Tangent Likelihood function, that can be used to obtain robust estimates, termed as Maximum Tangent Likelihood Estimator (MtLE). We show that the MtLE is root-n consistent and asymptotically normally distributed. Furthermore, we consider robust variable selection based on our proposed tangent likelihood function. The proposed MtLE-Lasso can perform robust estimation and variable selection simultaneously and consistently.

3 - Pseudo Sufficient Dimension Reduction

Wenbo Wu, University of Oregon, Lundquist College of Business,
Eugene, OR, 97403, United States of America,
wuwenboug@gmail.com

We propose a new concept of pseudo sufficient dimension reduction based on an underlying relationship between ridge regression and measurement error regression. With such a connection, we propose a general sufficient dimension reduction estimation procedure to obtain an estimate from a different subspace instead of the targeted population parameter space. Variable selection based on pseudo estimate works effectively for both highly correlated predictors and for the small n large p problem.

4 - Structured Multitask Feature Selection

Fei Wang, Associate Professor, University of Connecticut,
371 Fairfield Way, Unit 4155, Storrs, CT, 06269,
United States of America, fei_wang@uconn.edu

Identification of important features for specific tasks is an important problem in modern data analytics. In this talk, I will focus on the multitask feature selection problem, where multiple related tasks are considered simultaneously and the important features for each task is selected. I propose a structured optimization approach, where similar tasks share similar important feature set. I applied the proposed approach for risk factor identification in Comprehensive Geriatric Assessment.

■ SC33

33-Room 410, Marriott

Statistics and Optimization Methods for Pain Management

Sponsor: Health Applications

Sponsored Session

Chair: Jay Rosenberger, Associate Professor, University of Texas at
Arlington, Box 19017 UT, Arlington, TX, 76019,
United States of America, jrosenbe@uta.edu

1 - Iterative Data Imputation for Adaptive Pain Management

Yeqing Li, University of Texas Arlington, P.O. Box 19017,
Arlington, TX, 76019, United States of America,
yeqing.li@mavs.uta.edu, Junzhou Huang

Pain management is a major global health problem. Many efforts have been devoted to developing data-driven decision models. However, the raw data is usually subject to various levels of missing. The missing values in data limit the quality and quantity of data and additionally limit the performance of the decision models. To address this problem, we proposed an iterative data imputation algorithm, which can accurately recover various kinds of missing values.

2 - Inverse Probability of Treatment Weighting for Adaptive Interdisciplinary Pain Management

Victoria Chen, The University of Texas at Arlington, Dept. of Ind.,
Manuf., & Sys. Engr., Campus Box 19017, Arlington, TX, 76019,
United States of America, vchen@uta.edu, Li Zeng,
Aera Leboulluec, Robert Gatchel

We present a process based on the inverse probability of treatment weighting method to address the endogeneity while estimating state transition and outcome models for a two-stage adaptive interdisciplinary pain management program. First, a method is developed for independent treatments then a general method is developed for correlated treatments.

3 - Two-stage Feature Selection for Efficient Modeling of Pain Management Data

Rohit Rawat, University of Texas Arlington, P.O. Box 19017,
Arlington, TX, 76019, United States of America,
rohit.rawat@mavs.uta.edu, Michael Manry

We use data from a pain management study in which treatment variables and two pain intensity metrics were recorded in two treatment stages. Data sets for the 235 subjects had 899 features for stage one and 1889 for stage two. A two-stage feature selection algorithm was developed that fits a piecewise linear network to the data, and removes useless inputs. We prevent overfitting through the use of random probes and regularization. The method results in smaller datasets and reduced testing error.

4 - Two-stage Stochastic Programming for Adaptive Interdisciplinary Pain Management

Gazi Iqbal, University of Texas Arlington, P.O. Box 19017, Arlington, TX, 76019, United States of America, gazimddaud.iqbal@mavs.uta.edu, Jay Rosenberger, Victoria Chen, Robert Gatchel, Na Wang

This research uses a two-stage stochastic programming method to optimize personal adaptive treatment strategies to improve current and future pain outcomes. A piecewise linear approximation method is developed to approximate non-convex quadratic functions. Equivalent deterministic mixed integer linear programs are developed to optimize treatment strategies for patients.

■ SC34

34-Room 411, Marriott

Design and Analysis of Adaptive Health Interventions

Sponsor: Health Applications

Sponsored Session

Chair: Diana Negoescu, Assistant Professor, University of Minnesota, 111 Church St. SE, Minneapolis, MN, United States of America, negoescu@umn.edu

1 - Optimal Timing of Drug Sensitivity Testing for Patients on 1st-line Tuberculosis Treatment in India

Sze Suen, Stanford University, 117 Encina Commons, Stanford, CA, 94305, United States of America, ssuen@stanford.edu

We seek to determine the optimal time to administer drug sensitivity testing (DST) for first-line tuberculosis treatment patients in India to improve health outcomes and reduce costs. Using a POMDP model, we find that India should revise the protocol to provide DST during the first month of treatment in areas of average or high MDR TB prevalence and transmission, and may wish to consider individually tailored DST regimens in low transmission, low MDR prevalence areas to reduce financial costs.

2 - Cost-effectiveness of HIV Preexposure Prophylaxis for Injection Drug Users in the United States

Cora Bernard, Stanford University, Department of Management Science and Eng, Huang Engineering Center, Stanford, CA, 94305, United States of America, clb210@stanford.edu, Eran Bendavid, Margaret L. Brandeau, Keith Humphreys, Mark Holodniy, Christopher Weyant, Douglas K. Owens, Jeremy D. Goldhaber-fiebert

Recent CDC guidelines recommend HIV preexposure chemoprophylaxis (PrEP) for adults who are active injection drug users (IDUs) in the US. However, the potential population health benefits and costs of this policy remain unclear. We developed a dynamic HIV epidemic model to evaluate oral PrEP (Truvada) for IDUs in the US. We find that PrEP for IDUs can provide substantial health benefits for the entire US population, but at the current cost of Truvada is a very expensive intervention.

3 - Diagnostic Sequences for Evaluating Post-stroke Atrial Fibrillation: A Cost-effectiveness Analysis

Sepehr Nemati, Postdoctoral Fellow, Ivey School of Business, University of Western Ontario, 1255 Western Road London, London, Canada, Sproon@ivey.uwo.ca, Lauren Cipriano, Luciano Spasato

Patients with atrial fibrillation and a history of stroke are at higher risk of stroke. It has been shown that sequentially combining cardiac monitoring methods might detect atrial fibrillation in nearly a quarter of patients with stroke or transient ischemic attack. However, the cost-effectiveness of these strategies remains unknown. We propose a decision analytic model to evaluate the costs, benefits, and cost-effectiveness of various post-stroke atrial fibrillation diagnostic strategies.

4 - Analysis of Electronic Health Record Based Depression Trajectory and Monitoring

Ying Lin, University of Washington, Box 352650, Seattle, WA, 98195-2650, United States of America, linyeliana.ie@gmail.com, Shuai Huang, Shan Liu

Depression is a common, complex and dynamic mental disorder. We established a trajectory-based framework for depression diagnosis/prognosis adaptable to population heterogeneity using electronic health record data. We analyzed patterns in the depression trajectories of a treatment population and proactively probed new trajectories for monitoring treatment outcomes. A five-group trajectory pattern was found using clustering, recursive partitioning, and collaborative degradation model.

■ SC35

35-Room 412, Marriott

OR and Homeland Security: Social and Organizational Concerns

Sponsor: Public Sector OR

Sponsored Session

Chair: Paul Kantor, Prof, Rutgers, 96 Frelinghuysen Dr, Piscataway, NJ, United States of America, paul.kantor@rutgers.edu

1 - Is Secure and Usable Smartphone Authentication Asking too Much?

Janne Lindqvist, Rutgers, 96 Frelinghuysen Dr, Piscataway NJ, janne@winlab.rutgers.edu

Smartphones are a convenience, but they present also considerable security and privacy risks. Using your smartphone gives access to snapshots of your whole life. In this talk, we will discuss smartphone user authentication issues and solutions. This talk is based on work published in IEEE Computer May 2015, (w/ Dr. Alexander De Luca), IEEE Pervasive Computing Jan/Mar 2015 (w/ Gradeigh D. Clark), and other published works by Dr. Lindqvist's group on usable and secure authentication.

2 - Vertical Data Integration for Homeland Security: The Moynihan Principle

Paul Kantor, Prof, Rutgers, 96 Frelinghuysen Dr, Piscataway, NJ, United States of America, paul.kantor@rutgers.edu

The disparate parts of DHS have complex legacy information systems. To achieve full potential decision makers at every level need access to the data, and they must have confidence that it is the same data that their subordinates and their superiors are seeing. While technically possible, this is a disruptive departure from the hierarchical and stovepiped systems that are in place now. We discuss some technical and cultural challenges that hinder the development of such a much-needed system.

3 - Fusing Disparate Threat Reports

John Hollywood, Senior Operations Researcher, RAND Corporation, 1200 South Hayes Street, Arlington, VA, 22202, United States of America, jshollywood@gmail.com

We discuss a nonlinear programming approach to fusing disparate, including openly conflicting, intelligence reports about a potential threat. The method yields estimates of threat level probabilities that are as conservative (i.e., uncertain, in an information-theoretic sense) as possible given what has been reported about a subject. It may be implemented using off-the-shelf Microsoft Excel Solver, which is important for operations centers that typically lack high-end solvers.

4 - The Challenge of Maritime Cyber Security

Fred Roberts, CCICADA, 96 Frelinghuysen Rd, Piscataway, NJ, United States of America, froberts@dimacs.rutgers.edu

The vulnerabilities to cyber attacks of today's marine transportation system have not been well studied. This paper explores vulnerabilities of shipboard systems, oil rigs, cargo, and port operations and explores some suggested remedies.

■ SC36

36-Room 413, Marriott

Threats to Life and Limb

Sponsor: Public Sector OR

Sponsored Session

Chair: Arnold I Barnett, Professor, MIT, E62-568, MIT, Cambridge, MA, 02139, United States of America, abarnett@mit.edu

1 - Insights from Anomalies in the Age-crime Curves for Homicide

Alfred Blumstein, University Professor, Heinz College, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, ab0q@andrew.cmu.edu

The age-crime curve is the age-specific ratio of arrests to population $[A(a)/N(a)]$ that rises quickly to a peak at about age 18 and then declines more slowly. This curve displayed a particularly anomalous pattern between 1985 and 1993, thereby suggesting some distinctive activity during that period. The insights by looking at features of those changes provided strong indications of the factors contributing to the homicide growth during that period.

2 - A “Unified Field Theory” of Accidental Death Risk?

Arnold I Barnett, Professor, MIT, E62-568, MIT, Cambridge, MA, 02139, United States of America, abarnett@mit.edu

We consider cross-national mortality risk tied to accidents in various forms of transport, and also unintentional deaths from other causes like industrial accidents. We relate these risk metrics to national life expectancies absent these accidents (e.g. from diseases), and inquire whether an underlying factor akin to IQ explains common patterns of dispersion for various causes of accidental death risk.

3 - Modeling the HIV Treatment Cascade

Edward Kaplan, Beach Professor Of Operations Research, Yale University, School of Management, 165 Whitney Avenue, New Haven, CT, 06511, edward.kaplan@yale.edu, Gregg Gonsalves

Only a quarter of HIV-infected persons in the US have undetectable viral loads. Increasing the number virally suppressed requires increasing the throughput of the HIV “treatment cascade” from infection to diagnosis, linkage to care, and retention in care; and also time spent suppressed. Using available data, we estimated stage times and progression probabilities in the treatment cascade, enabling identification of bottlenecks and a basis for increasing the number virally suppressed.

4 - Dynamic Games of Drug Legalization: Death and Taxes?

Jonathan Caulkins, Professor, Carnegie Mellon University, Heinz College, 5000 Forbes Ave, Pittsburgh, PA, 15237, United States of America, caulkins@andrew.cmu.edu

Several states and countries have legalized marijuana; others contemplate legalizing cocaine. These actions alter incentives for other jurisdictions to change their policies, creating a giant dynamic game. This paper discusses insights from viewing this as a dynamic game and associated insights about limitations of game theoretic analysis for informing policy.

■ SC37

37-Room 414, Marriott

Health Care Modeling and Optimization III

Contributed Session

Chair: Amir Mousavi, PhD Candidate, The George Washington University, Washington, DC, United States of America, amousavi@gwu.edu

1 - Implementing Night-shift Scheduling System for Residents in Aichi Medical University Hospital

Mari Ito, Nanzan University, 18 Yamazato-Cho, Showa-Ku, Nagoya, Japan, d13mm002@nanzan-u.ac.jp, Akira Imamura, Takuya Ito, Rina Nakayama, Aino Onishi

We develop a support system for generating a night-shift scheduling for residents in Aichi Medical University Hospital. We formulate the problem as a weighted constraint satisfaction problem using weights decided by Analytic Hierarchy Process. We implement the system on a standard PC and obtain better schedules within a few seconds.

2 - Scheduling System for the Resident Training Program in Aichi Medical University Hospital

Aino Onishi, Nanzan University, 18 Yamazato-cho, Showa-ku, Nagoya, Japan, m14ss008@nanzan-u.ac.jp, Akira Imamura, Rina Nakayama, Mari Ito, Takuya Ito

We develop a system that makes monthly rotation schedule of training program of the residents. We formulate the problem as a 0-1 integer programming problem, and solve it using CPLEX. The system is in trial use in the hospital, and the schedule obtained improves the quality of the resident training.

3 - Improving Timeliness in Lung Cancer Diagnosis Process

Hyo Kyung Lee, UW Madison, 1513 Engineering Drive, Madison, WI, 53706, United States of America, hlee555@wisc.edu, Raymond Osarogiagbon, Xinhua Yu, Nicholas Faris, Fedoria Rugless, Jingshan Li, Feng Ju

Lung cancer diagnosis procedure is a series of complex and fragmented investigation, resulting in undesirable delays in wait times. Bottleneck analysis method is applied to identify the waiting time whose reduction can lead to the largest improvement in the overall efficiency of lung cancer diagnosis procedure. The impact of reducing waiting times on the timeliness of lung cancer diagnosis process is quantified and the severities are compared to provide a way to alleviate wait time delays.

4 - Appointment Scheduling and Overbooking to Improve Patient Access and Reduce Patient Backlog

Linda Laganga, Vp Of Quality Systems, Mental Health Center of Denver, 4141 East Dickenson Place, Denver, CO, 80302, United States of America, linda.laganga@mhc.org, Stephen Lawrence

Patient no-shows continue to trouble outpatient clinical service delivery. We continue our piloting and implementation of scheduling models developed in our earlier research to develop new techniques to assist clinics in meeting their goals to improve patient flow and reduce backlog in scheduling. We utilize medical practice experience to develop realistic estimates of costs and their effect on the selection of high-performing scheduling alternatives.

5 - Scheduling Physicians to Improve Emergency Room Efficiency

Amir Mousavi, PhD Candidate, The George Washington University, Washington, DC, United States of America, amousavi@gwu.edu, Hernan Abeledo, Jesse Pines

Shift schedules of emergency room physicians may span several months and involve rules such as rest periods between consecutive shifts and balancing different types of shifts fairly across physicians. Schedules must consider the individual exceptions, preferences, availability and hired hours of each provider. Our goal is to create schedules that also improve patient flow by taking physician performance into account. We present integer programming models that were tested at the GWU hospital.

■ SC38

38-Room 415, Marriott

Panel Discussion: Relevant OM / MS Research: Why? What? How?

Cluster: Business Model Innovation

Invited Session

Chair: Chris Tang, Edward Carter Professor of Business, UCLA, 110 Westwood Plaza, Los Angeles, CA 90095, United States of America, chris.tang@anderson.ucla.edu

1 - Relevant OM / MS Research: Why? What? How?

Moderator: Chris Tang, Edward Carter Professor of Business, UCLA, 110 Westwood Plaza, Los Angeles, CA 90095, United States of America, chris.tang@anderson.ucla.edu, Panelists: Kalyan Singhal, Teck Ho

Three editors (Management Science, Manufacturing & Service Operations Management, and Production & Operations Management) will share their thoughts on ways to conduct relevant research in OM / MS by examining three fundamental questions: “why?”, “what?” , and “how?”

■ SC39

39-Room 100, CC

New Directions in Marketing - Operations Interface

Cluster: Operations/Marketing Interface

Invited Session

Chair: Vahideh Abedi, Assistant Professor, California State University Fullerton, Fullerton, United States of America, vabedi@exchange.fullerton.edu

1 - Attention, Reward and Customer Strategies for Sustainable Growth

Kalyan Raman, Professor, Northwestern University, Medill School, Evanston, IL, United States of America, kalyraman@gmail.com, Vijay Viswanathan

The key aspects of human behavior are governed by three fundamental neurobiological processes and their interaction: attention, reward and memory. The study of human behavior commonly focuses on attention or reward/aversion as independent functions. This project studies how these processes interact at the systems level and maps a functional relationship between them. We specifically focus on variables for reward/aversion as empirically measured with a neuroscience-based keypress paradigm that quantifies variables from relative preference theory and variables implicated in attention as measured by signal detection theory.

2 - Managing Sales of a New Product Though Competing Brokers

Rahul Bhaskar, Professor, California State University, Fullerton,
800 north college boulevard, fullerton, ca, 92834, United States of
America, rbhaskar@fullerton.edu, Vahideh Abedi

A new product typically rely on sales efforts of brokers to enhance sales. Customers make their purchase decision not only based on the word of mouth they have received from other customers about the product, but also based on the collective information received from the brokers. Therefore, brokers act synergistically to generate sales while competing. We develop an analytical framework for this sales process and show how it can facilitate important managerial decision making.

3 - Simultaneous vs. Sequential Crowdsourcing Contests

Lu Wang, Rotman School of Management, 105 St. George Street,
Toronto, Canada, Lu.Wang12@Rotman.Utoronto.CA, Ming Hu

In a crowdsourcing contest, innovation is outsourced from an open crowd. We consider two alternative mechanisms for an innovative product involving multiple attributes. One is to run a simultaneous contest, where the best solution is selected from the single solution simultaneously submitted by each contestant. The other is to run multiple sequential sub-contests, with each dedicated to one attribute. While both mechanisms have their own advantages, either could win over depending on parameters.

4 - To Tier or Not to Tier: A Comparative Analysis of Different Loyalty Program Structures

Amir Gandomi, Assistant Professor, Ryerson University,
350 Victoria Street, Toronto, ON, M5B 2K3, Canada,
agandomi@ryerson.ca, Amirhossein Bazargan, Saeed Zolfaghari

This study analyzes the effectiveness of two common loyalty program structures, namely, linear and multi-tier structures. Using a game theoretic approach, we formulate the market conditions under which different structures are more profitable. Market conditions are characterized by the proportion of members who are active and the degree to which they are forward-looking. The binary logit model is used to capture the customers' buying behavior in a multiple-period setting.

SC40

40- Room 101, CC

Behavioral Operations I

Contributed Session

Chair: Bo Hu, Research Staff, Xerox Corp, 800 Phillips Road, Webster,
NY, 14580, United States of America, bo.hu@xerox.com

1 - Bidding Decision in Land Auction using Prospect Theory

Xinwang Liu, Professor, Southeast University, Si Pai Lou 2,
Nanjing, 210096, China, xwliu@seu.edu.cn

With the background of land auction practice in China, we consider the preferences of the decision-makers in land bidding decisions with the multi-attribute additive utility and reference point in cumulative prospect theory. Three land auction models are proposed based on the appearance time of the land auctions: the simultaneous model, the time sequential model and the event sequential model. A case study illustrates the processes and results of our approaches.

2 - Decision Behavior in Humanitarian Logistics – The Effect of Stress on Operational Decisions

Maximilian Burkhardt, PhD Candidate, WHU Otto Beisheim
School of Management, Burgplatz 2, Vallendar, Germany,
maximilian.burkhardt@whu.edu, Stefan Spinler

We examine the influence of cognitive biases under stress in disaster relief situations. Although the effect of various biases in operational decisions has been analyzed, the specific effect of stress on decision behavior has been out of focus. Time pressure and high-stakes involved serve as relevant stressors in this context. For the required empirical support we aim at conducting experiments with different subject groups, such as business students and humanitarian practitioners.

3 - Apply Behavioral Economics in Designing Services

Bo Hu, Research Staff, Xerox Corp, 800 Phillips Road, Webster,
NY, 14580, United States of America, bo.hu@xerox.com,
Yu An Sun, Julien Bourdaillet

We use data to find biases in choosing voluntary benefit packages. Behavioral experiments are designed to tests hypothesis in correct those biases.

SC41

41-Room 102A, CC

Joint Session MSOM-Health/HAS/Practice: Operations Management of Emergency Services II

Sponsor: Manufacturing & Service Oper Mgmt/
Healthcare & HAS Operations

Sponsored Session

Chair: Shane Henderson, Professor, Cornell University, Rhodes Hall,
Ithaca, NY, 14853, United States of America, sgh9@cornell.edu

1 - The Minimum Expected Penalty Relocation Problem for the Computation of Ambulance Compliance Tables

Thije Van Barneveld, PhD-student, Centrum Wiskunde en
Informatica, Science Park 123, Amsterdam, Netherlands,
t.c.van.barneveld@vu.nl

We study the ambulance relocation problem in which one tries to retain the ability to respond to possible future incidents quickly. For this purpose, we consider compliance table policies. To compute efficient compliance tables, we introduce the Minimum Expected Penalty Relocation Problem (MEXPREP), in which one has the ability to control the number of waiting site relocations. Moreover, different performance measures related to response times, e.g., survival probabilities, can be incorporated.

2 - Optimizing Aircraft Configuration for Air-ambulance Service Provider in Ontario

Pieter Van Den Berg, Delft University of Technology, Mekelweg 4,
Delft, 2628 CD, Netherlands, P.L.vandenBerg@tudelft.nl,
Shane Henderson, Karen Aardal

Ornge provides air-ambulance services to patients in the province of Ontario. For this service, both fixed wing aircraft and helicopters are used. The fixed wing aircraft have a wider range but are restricted to land on airports. Helicopters, on the other hand, are more flexible in landing sites. Currently, Ornge operates a 24/7 flat schedule. We apply both simulation and optimization techniques to find good configurations of the aircraft and helicopters for both day and night.

3 - Optimality of the Closest-idle Policy in Advanced Ambulance Dispatching

Sandjai Bhulai, VU University Amsterdam, De Boelelaan 1081a,
Amsterdam, 1081 HV, Netherlands, s.bhulai@vu.nl,
Caroline Jagtenberg, Rob Van Der Mei

In ambulance dispatching it is commonly believed that the 'closest idle ambulance' rule is the best choice. We present two alternatives to this classical rule and show that significant improvements can be obtained. The first alternative is based on a Markov decision problem, and the second is a heuristic that can handle regions with large numbers of ambulances. The heuristic reduces the fraction of late arrivals by 18% for a large emergency medical services region in the Netherlands.

4 - An Information-based Bound on the Performance of Ambulance Redeployment Policies

Kenneth Chong, PhD Student, Cornell University,
257 Rhodes Hall, Ithaca, NY, 14853, United States of America,
kcc66@cornell.edu, Shane Henderson, Mark Lewis,
Huseyin Topaloglu

Ambulance redeployment is the practice of strategically relocating idle ambulances in real time to improve coverage of future demand. We present an upper bound on the performance that can be attained by any redeployment policy. Our approach involves formulating the redeployment problem as a stochastic dynamic program, considering an information relaxation of this problem, and penalizing policies that violate nonanticipativity constraints.

■ SC42

42-Room 102B, CC

Joint Session MSOM-Health/HAS: Healthcare Analytics and OptimizationSponsor: Manufacturing & Service Oper Mgmt/
Healthcare & HAS Operations

Sponsored Session

Chair: Anahita Khojandi, Assistant Professor, University of Tennessee, Knoxville, TN, United States of America, khojandi@utk.edu

1 - Estimating Lipid Management Guidelines' Risk Value of a Life Year on TreatmentMurat Kurt, Merck Research Labs, 351 N. Summeytown Pike,
North Wales, PA, 19454, United States of America,
murat.kurt7@gmail.com, Niraj Pandey, Mark Karwan

Statins reduce the risk of heart attack and stroke with adverse side effects, but how to quantify these effects to help physicians make treatment decisions remains to be an open question. We gauge these adverse effects for patients with Type 2 diabetes from a central policy maker's point of view by formulating a dynamic decision model in which the objective is to minimize the risk of a first major cardiovascular event where time spent on treatment is penalized by a perceived risk increase. We seek penalty factors that make published lipid management guidelines as close as possible to optimal. We present computational results using clinical data and derive insights.

2 - Predicting No-show Behavior of Patients at a Mental Health ClinicFan Wang, University of Arkansas, 4207 Bell Engineering Center,
Fayetteville, AR, United States of America,
fxw005@email.uark.edu, Shengfan Zhang

Mental health clinics have relatively high no-show rates of patients, which reduce provider productivity and clinic efficiency. This study presents two approaches for no-show prediction: a logistic regression model and an artificial neural network. The models are formulated using multiple factors including visit type, ICD-9 classification, insurance type, lead time to visit, no-show history, month, weekday and hour. The predictive performances are evaluated based on AUC values.

3 - Optimizing Dynamic Interventions in Sleep StudiesMaryam Zokaenikoo, Graduate Research Assistant, University of
Tennessee, 1700W. Clinch Ave., Apt. 505, Knoxville, TN, 37916,
United States of America, mzokaenikoo@vols.utk.edu, Anahita
Khojandi, Oleg Shylo

We discuss a mathematical framework that takes advantage of the technological advances in wearable neuro-headsets to provide an objective, reliable, inexpensive and scalable approach to sleep interventions. This framework is based on semi-Markov decision models that rely on general signal processing methods for continuous sleep assessment.

■ SC43

43-Room 103A, CC

Joint Session RMP/PPSN: Socially Responsible Revenue Models

Sponsor: Revenue Management and Pricing & PPSN

Sponsored Session

Chair: Ioana Popescu, INSEAD, 1 Ayer Rajah Avenue, 138676,
Singapore, Singapore, ioana.popescu@insead.edu**1 - Is It Enough? Evidence from a Natural Experiment in India's Agricultural Markets**Kamalini Ramdas, kramdas@london.edu, Nicos Savva,
Chris Parker

Does access to timely and accurate information provided through ICT applications have additional impact over and above access to mobile phones, in improving market efficiency? Using data from the Reuters Market Light text message service in India that provides daily price information to market participants and a natural experiment where bulk text messages were banned unexpectedly, we find that this information reduces crop price dispersion by about 12%, over and above access to mobile phones.

2 - Certainty Equivalent Planning for Multi-product Batch DifferentiationYang Wang, UC Berkeley, IEOR Dept., Berkeley, CA, 48109,
United States of America, yangwang0803@berkeley.edu,
Philip Kaminsky, Stefanus Jasin

Motivated by a problem in biopharmaceutical manufacturing, we consider a discrete time finite horizon inventory problem where several retailers place orders to meet stochastic demand, and in each period, the sum of order quantities across retailers must be a multiple of a standard batch size. We propose several easy-to-

implement heuristics using certainty equivalence and derive their performance bounds analytically.

3 - Bridging the Gap between for Profit and Social Responsibility StrategiesEnno Siemsen, Associate Professor, University of Minnesota, 321
19th Ave S, Minneapolis, MN, 55455, United States of America,
siemsen017@umn.edu, Lisa Jones-christensen,
Sridhar Balasubramanian

This field experiment compares two different for-profit market entry strategies with a philanthropic strategy in terms of how each influences consumer behavior in base-of-the-pyramid communities. We analyze reactions to a water purification product offered at three price points (moderate discount, deep discount, and free) in rural Malawi.

4 - Revenue Models for Providing Clean Energy at the Bottom of the PyramidIoana Popescu, INSEAD, 1 Ayer Rajah Avenue, 138676,
Singapore, Singapore, ioana.popescu@insead.edu,
Bhavani Shanker Uppari, Serguei Netessine

One in every five people does not have access to electricity, relying mostly on kerosene for light. Solar technologies are healthier and offer greater value, yet they require significant one-time investments which are not affordable to people living on \$2/day. We develop a consumer behavior model that accounts for income variability and liquidity constraints specific to bottom of the pyramid markets, and investigate alternative revenue models, based on a case study in Rwanda.

■ SC44

44-Room 103B, CC

Revenue Optimization and Related Methodologies

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Michael Katehakis, Professor And Chair, Rutgers University,
100 Rockefeller Road, Room, Piscataway, NJ, 08854,
United States of America, mnk@rutgers.edu**1 - An Inventory System with Multiple Demand Classes**Min Wang, Assistant Professor, Drexel University, 3220 Market
St, Gerri C. LeBow Hall 740, Philadelphia, PA, 19104,
United States of America, mw638@drexel.edu

We consider a single-product inventory system with multiple demand classes. Inventories are replenished using a (R, Q) policy and are rationed among demand classes according to a threshold policy. We establish structural results for the key performance measures and develop an efficient algorithm for computing the policy parameters.

2 - Optimal Pricing for a GI/M/k/N Queue with Several Customer Types and Holding CostsEugene Feinberg, Distinguished Professor, Stony Brook
University, Department of Applied Mathematics & Stat,
Stony Brook, NY, United States of America,
eugene.feinberg@stonybrook.edu, Fengshu Yang

This paper deals with optimal pricing for a GI/M/k/N queueing system with several types of customers. A price for a new arrival depends on the number of customers in the system. In addition, the system incurs costs caused customer delays. The holding costs are non-decreasing and convex with respect to the number of customers in the queue. This paper describes average-reward optimal, canonical, bias optimal, and Blackwell optimal policies for this pricing problem.

3 - Efficient Markov Models for Dynamic Pricing ProblemsLaurens Smit, Leiden University, Niels Bohrweg 2, Leiden,
Netherlands, laurens@pipe.nl, Flora Spiessma, Michael Katehakis

We model revenue problems as a two dimensional Markov chain, where the arrival rate of customers depend on the charged price. We consider processes that satisfy down entrance state or the restart entrance state classes of quasi skip free processes. We derive explicit solutions and bounds for the steady state probabilities of both processes, and show that these methods work fast and efficiently. In addition we present a procedure to decompose Markov processes into separate thinned processes.

4 - Models and Problems of Dynamic Pricing in the Multi-armed Bandit FrameworkWesley Cowan, Rutgers University, 110 Frelinghuysen Rd.,
Piscataway, NJ, United States of America,
c.wes.cowan@gmail.com, Michael Katehakis

After a brief review of basic issues of dynamic pricing under partial information on the underlying demand distributions, we provide new models that address some of these issues. A main contribution is a new model and solutions for problems that involve unobserved lost sales.

■ SC45

45-Room 103C, CC

Revenue Management in Online Advertising

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Hamid Nazerzadeh, University of Southern California, Bridge Memorial Hall, 3670 Trousdale Parkway, Los Angeles, CA, 90089, United States of America, hamidnz@marshall.usc.edu

1 - Recent Results in Internet Advertising Allocations

Nitish Korula, Research Scientist, Google, New York, nitish@google.com, Morteza Zadimoghaddam, Hossein Esfandiari, Vahab Mirrokni

Advertising provides the economic foundation of the Internet. Internet advertising applications motivate a host of optimization problems with unique challenges and as such, there is a large body of literature on optimizing various aspects of ad allocations. I will survey some of the recent work in this field, with special focus on two problems: Designing algorithms that work well in both adversarial and stochastic settings, and algorithms that balance multiple system objectives.

2 - Multi-stage Intermediation in Online Internet Advertising

Ozan Candogan, University of Chicago, Booth School of Business, Chicago, United States of America, ozan.candogan@chicagobooth.edu, Santiago Balseiro, Huseyin Gurkan

We consider a setting where an advertiser tries to acquire impressions from an ad exchange, through a chain of intermediaries. We characterize equilibrium profits of intermediaries as a function of their position in the chain. We consider three value distributions for the advertiser: (i) exponential, (ii) Pareto, (iii) uniform. We establish that in (i) all intermediaries have the same profit, whereas in (ii) and (iii) respectively downstream/upstream intermediaries have higher profits.

3 - Adverse Selection and Auction Design for Internet Display Advertising

Nick Arnosti, Stanford University, Stanford, CA, United States of America, narnosti@stanford.edu, Marissa Beck, Paul Milgrom

We model an online display advertising environment with brand advertisers and better-informed performance advertisers. We consider a mechanism which assigns the item to the highest bidder only when the ratio of the highest bid to the second highest bid is sufficiently large. For fat-tailed match-value distributions, this mechanism captures most of the gains from good matching and improves match values substantially compared to the common practice of setting aside impressions in advance.

4 - Deals or No Deals: Contract Design for Selling Online Advertising

Hamid Nazerzadeh, University of Southern California, Bridge Memorial Hall, 3670 Trousdale Parkway, Los Angeles, CA, 90089, United States of America, hamidnz@marshall.usc.edu, Vahab Mirrokni

I will discuss some of the challenges in maximizing revenue of online advertising market. I will explain preferred deals: a new generation of contracts for selling display advertising that allow publishers to offer their inventory to "first look" buyers before the inventory is made available to other buyers (advertiser) in the general auction. I present algorithms for deal recommendation and show that deals can obtain significantly higher revenue than auctions.

■ SC46

46-Room 104A, CC

Managing Professional Services

Sponsor: Manufacturing & Service Oper Mgmt/Service Operations

Sponsored Session

Chair: Morvarid Rahmani, Assistant Professor, Georgia Tech, morvarid.rahmani@scheller.gatech.edu

1 - The Design of Multi-stage Service Processes

Ioannis Bellos, Assistant Professor, George Mason University-ISOM Area, Enterprise Hall, 4400 University Drive, MS 5F4, Fairfax, VA, 22030, United States of America, ibellos@gmu.edu, Stelios Kavadias

Motivated by the practices of design firms we build on the customer journey concept, which describes services as multi-stage processes. We develop a parsimonious model and we analyze the provider's decisions on the amount of effort she exerts at each stage of the process and the overall price she charges.

2 - Skill and Capacity Management in Large-scale Service Marketplaces

Eren Cil, University of Oregon, 1585 East 13th Avenue, Eugene, OR, United States of America, erencil@uoregon.edu, Achal Bassamboo, Gad Allon

We characterize the optimal skill screening mechanism of a firm moderating a large-scale service marketplace where the ability of a service provider to cater customers, who can be of two classes, varies. We show that when the values that a service provider generates for each customer class are independent, the firm may need to refuse some of the service providers via its screening mechanism whereas this is never optimal when these values are perfectly correlated.

3 - Pricing Diagnosis-based Services when Customers Exhibit Sunk Cost Bias

Guangwen Kong, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55414, United States of America, gkong@umn.edu, Sampath Rajagopalan, Chunyang Tong

We build a model to shed light on how sunk-cost effect influences the SP's choice of pricing scheme. We provide an analysis on how the sunk cost effect influences a monopolistic SP's choice of pricing scheme, and then examine the impact of sunk-cost effects in a competitive setting. Further, we consider customers with differing levels of sophistication (being naïve or sophisticated) and investigate how a mixture of customer types further impacts the choice of pricing scheme.

4 - Balancing Experience in Fluid Teams: Team Familiarity, Partner Diversity and Performance

Sarang Deo, Assistant Professor, Indian School of Business Hyderabad, ISB Hyderabad, Gachibowli, Hyderabad, TS, 500032, India, sarang_deo@isb.edu, Kamalini Ramdas, Zeynep Aksin, Jonas Jonasson

We use data from London Ambulance Service to study the impact of partner diversity of new paramedics on their operational performance. We find that the greater diversity in prior partners directly improves performance for an unstandardized process. For a more standardized process, this effect is moderated by a new recruit's total experience. We explore the implications of our results for team formation strategies by balancing the benefits of partner diversity with those of team familiarity.

■ SC47

47-Room 104B, CC

Incentives and Investment in Renewable Energy and Energy Efficiency

Sponsor: Manufacturing & Service Oper Mgmt/Sustainable Operations

Sponsored Session

Chair: Owen Wu, Indiana University, 1309 E. 10th Street, Bloomington, IN, 47405, United States of America, owenwu@indiana.edu

1 - Impact of Electricity Pricing Policy on Renewable Energy Investments and Carbon Emissions

Safak Yucel, PhD Candidate, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, safak.yucel@duke.edu, Gurhan Kok, Kevin Shang

We investigate the impact of electricity pricing policy (i.e., flat pricing versus peak pricing) on renewable energy investments and carbon emissions. We find that flat pricing generally leads to a higher investment level and lower carbon emissions. Furthermore, our results indicate that the pricing policy that leads to higher investments may not reduce carbon emissions. We also study the effects of subsidy policies on the investments and emissions.

2 - Robustness of Renewable Energy Support Schemes

Stefan Spinler, Professor, WHU-Otto Beisheim School of Management, Burgplatz 2, Vallendar, 56179, Germany, stefan.spinler@whu.edu, Ingmar Ritzenhofen, John Birge

Renewable portfolio standards (RPS), feed-in-tariffs (FIT), and market premia (MP) are widely used policy instruments to promote investments in renewable energy sources (RES). Regulators continuously evaluate these instruments along the main electricity policy objectives of affordability, reliability, and sustainability. We assess these policies using a long-term dynamic capacity investment model and compare their robustness in the light of uncertain RES feed-in and ambiguous future regulation.

3 - Feed-in Tariff Versus Rebate for Renewable Generation

Ruben Lobel, Operations and Information Management Department at The Wharton School of the University of Pennsylvania, Jon M. Huntsman Hall 3730 Walnut Street, Office 568, Philadelphia, PA, 19104, United States of America, rlobel@wharton.upenn.edu, Vlad Babich

We compare two types of subsidies used to stimulate renewable energy generation: a feed-in tariff and an upfront rebate. The former guarantees a steady cash flow over the long term, while the latter reduces the upfront capital requirement. We show how uncertainty and strategic customer behavior determines policy efficiency.

4 - Energy Efficiency and Demand Response on a Production Line

Eric Webb, Graduate Student, Indiana University, 1309 E. 10th Street, Bloomington, IN, 47405, United States of America, ermwebb@indiana.edu, Owen Wu

Demand response (DR) programs incentivize industrial firms to halt production during times of peak electricity demand. We consider a firm faced with the option of investing in energy efficiency (EE) improvements at individual machines on the production line. When viewed in isolation, EE incentives may not be enough to induce the firm to invest in the socially optimal level of EE, due to the loss of DR revenue after installation. We suggest a new policy for EE incentives in light of DR.

SC48

48-Room 105A, CC

Energy and Commodity Merchant Operations

Sponsor: Manufacturing & Service Oper Mgmt/IFORM
Sponsored Session

Chair: Nicola Secomandi, Associate Professor, Carnegie Mellon Tepper School of Business, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, ns7@andrew.cmu.edu

Co-Chair: Selvaprabu Nadarajah, Assistant Professor Of Information And Decision Sciences, College of Business, University of Illinois at Chicago, 601 S Morgan Street, 24th Floor, Chicago, IL, 60607, United States of America, selvan@uic.edu

1 - Electricity Derivative Trading with Private Information on Price Distributions

Eddie Anderson, University of Sydney, Business School, Sydney, Australia, edward.anderson@sydney.edu.au, Andy Philpott

When trading forward contracts, firms try to hedge risk, but at the same time want to benefit from superior price forecasting. We model a negotiation between generator and retailer on forward contracts when both have private information on the probability of different price outcomes. Both firms submit a schedule of prices and quantities, and the market clears. Can a firm gain by looking at the offers that the other player makes in order to improve its own estimate of the real probabilities?

2 - Optimal Production and Shortfall Hedging

Liao Wang, Department of Industrial Engineering and Operations Research, Columbia University, S.W. Mudd Building, Room 315, 500 West 120th Street, New York, NY, 10027, United States of America, lw2489@columbia.edu, David D. Yao

Over a given time horizon, we study the one-time production quantity decision at the beginning, and the real-time risk-hedging strategy throughout the horizon. The objective is to minimize the shortfall from a given target profit, and we derive the joint optimal solution to both production and hedging. In addition, we characterize the efficient frontier, and quantify the improvement in risk-return tradeoff achieved by the shortfall hedging.

3 - Least Squares Monte Carlo: Duality Perspective and Energy Real Option Application

Selvaprabu Nadarajah, Assistant Professor Of Information And Decision Sciences, College of Business, University of Illinois at Chicago, 601 S Morgan Street, 24th Floor, Chicago, IL, 60607, United States of America, selvan@uic.edu, Nicola Secomandi

Least squares Monte Carlo (LSM) is a common approximate dynamic programming approach. We provide a duality perspective on a version of this approach, which leads to an equivalent formulation of this approach as a relaxed approximate linear programming (ALP) model. We provide both theoretical and numerical support for the use of LSM rather than ALP. Our numerical study deals with merchant ethanol production, an important energy application.

SC49

49-Room 105B, CC

Operations Management and Marketing

Sponsor: Manufacturing & Service Oper Mgmt/Supply Chain
Sponsored Session

Chair: Xingwei Lu, University of Pennsylvania, The Wharton School, Philadelphia, United States of America, xingwei@wharton.upenn.edu

Co-Chair: Xuanming Su, The Wharton School, University of Pennsylvania, Philadelphia, United States of America, xuanming@wharton.upenn.edu

1 - A Tractable Discrete Choice Model - Beyond Logit

Aydin Alptekinoglu, Penn State, Smeal College of Business, University Park, PA, 16802, United States of America, aydin@psu.edu, John Semple

We explore the mixed (random coefficients) and heteroscedastic versions of the Exponential Choice (EC) model. EC has attractive analytical features like closed-form choice probabilities, logconcave likelihood, and more realistic cross-price elasticities compared to multinomial logit. Allowing heteroscedasticity in error terms, and allowing random coefficients with normal distribution, retain closed-form choice probabilities but not some of the other properties.

2 - How Should a Retailer Share Demand Information with the Supplier?

Qi Annabelle Feng, Professor, Purdue University, 100 S. Grant St., West Lafayette, IN, United States of America, annabellefeng@purdue.edu, J. George Shanthikumar

We consider a supplier selling through a retailer who possesses private demand information. The retailer can choose to share a Bayesian plausible demand signal with the supplier. We define the notion of information accuracy and analyze the structure of demand information to understand the retailer's incentive of information sharing and its effect on supply chain performance.

3 - Minimum Advertised Price Policy: Economic Analysis and Implications

Ozge Sahin, Johns Hopkins University, ozge.sahin@jhu.edu, Liang Ding, Roman Kapuscinski

Manufacturers frequently use Minimum Advertised Price (MAP) to protect retailers' margin and to encourage them to exert more sales effort. This paper analyzes the performance of MAP under various market situations and compares it with another vertical price restraint policy – Resale Price Maintenance. Results indicate that MAP could be beneficial to manufacturers and also to customers when the information search is costly and the consumers are moderately heterogeneous in their valuation.

4 - Revenue Management with Loyalty Programs

Xingwei Lu, University of Pennsylvania, The Wharton School, Philadelphia, United States of America, xingwei@wharton.upenn.edu, Xuanming Su

We study loyalty programs in firms with limited capacity. Based on the classic Littlewood's model, our model additionally reserves some capacity for awards and allows customers to choose between paying with cash and redeeming with points. We investigate the optimal capacity allocations and compare program designs.

SC50

50-Room 106A, CC

Procurement and Management of Complex Goods and Services

Sponsor: Manufacturing & Service Operations Management
Sponsored Session

Chair: Damian Beil, Associate Professor of Technology & Operations, Ross School of Business, University of Michigan, 701 Tappan St, Ann Arbor, MI, 48109, United States of America, dbeil@umich.edu

1 - Multi-channel Service with Heterogeneous Customers

Shiliang Cui, Georgetown University, McDonough School of Business, Washington, DC, 20057, United States of America, shiliang.cui@georgetown.edu, Yong-Pin Zhou

When firms offer multiple service channels, it gives customers a chance to choose the channel that better fits their need (cost, convenience, advice, etc.). On the other hand, firms can also use carefully designed multiple service channels to achieve customer segmentation. We study mechanisms to achieve this.

2 - Win-win Capacity Reservation Contracts in Co-manufacturing and Co-distribution Alliances

Guillaume Roels, Associate Professor, UCLA, 110 Westwood Plaza, Los Angeles, CA, 90095, United States of America, guillaume.roels@anderson.ucla.edu, Chris Tang

In some strategic alliances, a firm shares its manufacturing capacity with another, and the latter shares its distribution capacity with the former. Even though such bidirectional alliances have become common, they remain challenging to manage due to the frequent disputes over capacity allocation when demand is uncertain. In this talk, we investigate whether there exists a contractual mechanism that can mitigate the extent of these disputes while improving the profits of all participating firms.

3 - Optimal Allocation Rules with Waste Considerations

Sara Rezaee Vessal, HEC Paris, 1 Rue de la Liberation, Jouy en Josas, 78350, France, sara.rezaee-vessal@hec.edu, Sam Aflaki, Dimitrios Andritsos

We study capacity allocation of a scarce and perishable product among stock-out-averse retailers that face stochastic demand. We focus on two commonly practiced allocation mechanisms and—using a dynamic model—characterize the conditions under which each allocation mechanism performs superior from a waste and profit point of view.

4 - Using Transparency to Manage the Sourcing of Complex Non-routinized Services

Jacob Chestnut, PhD Candidate, Ross School of Business, University of Michigan, 701 Tappan Avenue, Ann Arbor, MI, 48109, United States of America, jacobpc@umich.edu, Damian Beil

Complex services such as non-routine litigation are often billed on an hourly basis, creating opportunities for the service provider (e.g., outside counsel) to drive up costs for the buyer (e.g., in-house counsel) through the inefficient use of time and resources (e.g., partner versus associate level work). The buyer can manage these costs with greater front-end transparency, about the work to be performed; however this transparency comes at a cost. We study this tradeoff.

■ SC51

51-Room 106B, CC

MSOM Student Paper Competition Finalists - I

Sponsor: Manufacturing & Service Operations Management
Sponsored Session

Chair: Goker Aydin, Indiana University, 1309 East Tenth Street, Bloomington, IN, 47405, United States of America, ayding@indiana.edu

Co-Chair: Karan Girotra, Associate Professor, INSEAD, Boulevard de Constance, Fontainebleau, 77300, France, Karan.GIROTRA@insead.edu

Co-Chair: Sameer Hasija, Assistant Professor, INSEAD, 1 Ayer Rajah Avenue, Grange Heights, Singapore, Sameer.Hasija@insead.edu

1 - MSOM Student Paper Competition Finalists Sessions INFORMS 2015

The MSOM Student Paper Competition is awarded annually by the Manufacturing & Service Operations Management Society at the INFORMS Annual Meeting for papers judged to be the best in the field of operations management.

■ SC52

52-Room 107A, CC

Social Network Analysis

Sponsor: Service Science
Sponsored Session

Chair: Dr. Joanna F. DeFranco, Assistant Professor Of Software Engineering, The Pennsylvania State University, 30 East Swedesford Road, Malvern, PA, United States of America, jfd104@psu.edu

1 - Social Network Dynamics in Software Development Teams

Adrian Barb, The Pennsylvania State University, asb16@psu.edu, Dr. Joanna F. DeFranco

We present a social network analysis of the communication of 112 developers in seven software development teams distributed around the world. The project was conducted between October 2005 and October 2006 and includes communications among team members with different roles varying from architect to integrator over six development iterations. A social network analysis was performed to evaluate the progression of communication over this period during a collaborative software development project.

2 - Exploring Networks of Faculty Paper Co-authorship

Regina Collins, New Jersey Institute of Technology, regina.s.collins@njit.edu, Nancy Steffen-fluhr

This research, funded by an NSF Advance grant, examined the hypothesis that women STEM faculty suffer low retention rates due to their relative isolation within the social and informational networks of their organizations. To test this, a network based on co-authorship of scholarly papers was created and analyzed from a social network perspective, examining network attributes including female faculty's centrality in these networks.

3 - Reconciling Infinite Choice and Zero Effort: Applying Data Science to Rejuvenate the TV Experience

Venu Vasudevan, Senior Director, Arris, Venu.Vasudevan@arris.com

TV's long reign has been driven by its ability to be both simple and entertaining. Yet the proliferation of web technologies has ushered a 'viewers choice' era - where viewers seek more control over the TV experience (when/where/for how long/). This talk is about the use of data science to address TV's next challenge - that of finding the right balance of simplicity and richness (both from viewer and advertiser point of view).

4 - Social Discovery Builds the Social Network

Richard Friedman, Cto Meetme, MeetMe, 518 Kings Dr, Cherry Hill, NJ, 08003, United States of America, richfriedman@gmail.com

Social Networking is the broadest of terms representing any online service that facilitates some form of communication between a network of friends, colleagues, and personal contacts. Social Discovery, on the other hand, can be defined as the creation of the social network. It is the discovery of people through content and conversation that leads to building a network related to a topic or a purpose. We will cover from discovery, interest, conversation, connection, network, and platform.

■ SC53

53-Room 107B, CC

Bounded Rationality, Social Preferences, and Risk Management in Behavioral Operations

Sponsor: Behavioral Operations Management
Sponsored Session

Chair: Kay-Yut Chen, Professor, University of Texas Arlington, 701 West Street, Arlington, United States of America, kychen@uta.edu

1 - The Behavioral Traps of Making Multiple, Simultaneous, Newsvendor Decisions: An Experimental Study

Shan Li, Assistant Professor, Zicklin School of Business, Baruch College, City University of New York, 55 Lexington Ave, New York, NY 10010, United States of America, Shan.Li@baruch.cuny.edu, Kay-Yut Chen

We conducted an experimental study to compare behaviors of newsvendors who manage one versus two independent stores. We find that ordering decisions are closer to optimal quantities in one-store treatment. More interestingly, we discover a significant correlation between order quantities of individuals only in the two-store setting. We propose the concept of decision segmentation reinforcement and develop a behavior model to capture multiple interacting simultaneous decisions.

2 - Process-driven Discussion in Team-based Decision Making for Operational Risk Management

Karen Zheng, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, yanchong@mit.edu, Retsef Levi, Shujing Wang

We experimentally study how different group discussion processes affect the outcome of team-based decision making in a risk management context. Members in each team in the experiment are provided private information about the status of the risk. The team will make the optimal decision only if all private information is shared. We manipulate the structure of discussion among team members to study how it affects information sharing within the team.

3 - Pay-it-forward: Theory, Experiments, and Managerial Implications

Narayanan Janakiraman, Asst Professor, University of Texas at Arlington, 701 S. West Street, Arlington, 76019, United States of America, janakira@uta.edu, Zhiyong Yang, Kay-Yut Chen

We study the pay-it-forward (PIF) phenomenon, where a person who received a stranger's kindness would act similarly kind to a future stranger. Using lab experiments, we find that the recipient's PIF likelihood depends on firms' pricing strategies, expectation of further PIF from the receiver, and social distances between the giver and the receiver. We explain the findings in a behavioral model, and develop a price optimization framework to enhance firms' profitability in this context.

4 - Contract or Trust? An Experimental Study Based on VMI Setting

Dezhen Si, Tsinghua University, Shunde Building, Beijing, China, sidezhen@126.com, Zuo-jun Max Shen, Xiaobo Zhao

We conduct experiments to study decision behaviors in trust game and contract game under a VMI setting. We recruit both strangers and acquaintances as subjects to participate in our experiments. The results show that preferences such as reciprocity and fairness exist in the games, and as a result, acquaintances in the trust game perform the best. We also develop behavioral models to explain the findings.

■ SC54

54-Room 108A, CC

Uncertainty in Demand Response – Identification, Estimation, and Learning

Cluster: Tutorials

Invited Session

Chair: Josh Taylor, Assistant Professor, University of Toronto, 10 King's College Rd., SF 1021C, Toronto, ON, M5S3G4, Canada, josh.taylor@utoronto.ca

1 - Uncertainty in Demand Response – Identification, Estimation, and Learning

Josh Taylor, Assistant Professor, University of Toronto, 10 King's College Rd., SF 1021C, Toronto, ON, M5S3G4, Canada, josh.taylor@utoronto.ca, Johanna Mathieu

Demand response from flexible electric loads such as electric vehicles, air conditioners and smart home appliances represents a vast, clean and potentially high-performance resource for the electric power system, but loads are highly uncertain. In this tutorial, we survey techniques for managing load uncertainty in demand response for three problem types: identifying load models, estimating load states and learning these features in conjunction with deploying the loads for demand response.

■ SC55

55-Room 108B, CC

Applications of DEA

Cluster: Data Envelopment Analysis

Invited Session

Chair: Kankana Mukherjee, Babson College, Wellesley, Massachusetts, kmukherjee@babson.edu

1 - Analysis of Technological Gap of Agricultural Productivity among Sub-Saharan African Countries

Olajide Abraham Ajao, PhD, Ladoke Akintola University of Technology, Agricultural Economics Department, Ogbomos, Nigeria, oajao57@lautech.edu.ng, Ogunniyi Laudia Titilola, Abdulrasheed Mutolib

The study compared the productivity differences of technical efficiency and technological gap ratios in SSA agriculture by adapting metafrontier DEA approach using cross-country panel input-output data obtained from the FAO. It was found that the metafrontier scores varied widely among the countries and also, the regional differences in the production technologies was observed

2 - Capacity Utilization and Energy Efficiency in Indian Manufacturing

Kankana Mukherjee, Babson College, Wellesley, MA, United States of America, kmukherjee@babson.edu

This study uses Data Envelopment Analysis and data from the Annual Survey of Industries, India, to measure capacity utilization and explores the relationship between an energy efficiency index and a capacity utilization index for each of the energy intensive industries in India over the period 1998-99 through 2007-08.

3 - The Analysis of Productivity Pattern of Cereals in Nigeria (1995 - 2006)

Ogunniyi Laudia Titilola, Ladoke Akintola University of Technology, Agricultural Economics Department, Ogbomos, Nigeria, titiogunniyi@yahoo.com, Olajide Abraham Ajao, Gbenga Fanifosi

This study analysed the productivity pattern of cereals in Nigeria between the periods of 1995-2006 using Data Envelopment Analysis to estimate total factor productivity(TFP)index. A decomposition of TFP measures revealed that productivity is due largely to technological change over the reference period and the technical efficiency indexes showed Taraba state and the Federal Capital Territory(FCT) to be consistently efficient and lie on the best - practice frontier.

4 - Economic Measures of Capacity Utilization: A Nonparametric Cost Function Analysis

John Walden, Economist, NOAA/NMFS/NEFSC, 166 Water St., Woods Hole, MA, 02543, United States of America, john.walden@noaa.gov, Subhash Ray

Capacity utilization (CU) is an important economic metric which conveys information about a firm's output level. We adopt the methods proposed by Ray (2014) to estimate cost based CU using DEA for a group of commercial fishing vessels which are characterized by a multi-input, multi-output technology. Results show the cost minimizing output level and CU for vessels operating in the years 2007-2012, and how these have changed in the light of recent regulatory shifts.

5 - Technical Efficiency Gains from Two Land Management Options in Maize Farming, Southwestern Nigeria

Luke Olarinde, Dr, Ladoke Akintola University of Technology, Department of Agricultural Economics, PMB 4000, Ogbomos, Oy, 210001, Nigeria, loolarinde@lautech.edu.ng

This study investigated the contribution of two Land management (LM) options (crop protection and crop management practices) to technical efficiencies (TEs) in Maize farming in Southwestern Nigeria. Data Envelopment Analysis (DEA) results (for the TE gains) indicate slight differences in the TEs of farms in the two LM options.

■ SC56

56-Room 109A, CC

New Directions in Locational Analysis

Sponsor: Location Analysis

Sponsored Session

Chair: Dmitry Krass, Rotman School of Management, 105 St.George Street, M5S 3E6, Canada, Krass@rotman.utoronto.ca

1 - The Big Tetrahedron Small Tetrahedron Method for Three Dimensional Location Problems

Rina Nakayama, Nanzan University, 18 Yamazato-cho, Showa-ku, Nagoya, Japan, m14ss007@nanzan-u.ac.jp, Zvi Drezner, Atsuo Suzuki, Tammy Drezner

We extend the Big Triangle Small Triangle method to three dimensions. We call it the Big Tetrahedron Small Tetrahedron method. We apply it to three dimensional location problems such as three dimensional Weber problem with Attraction and Repulsion (WAR) and time space location problems.

2 - Locating a New Facility to Maximize its Voronoi Region

Dmitry Krass, Rotman School of Management, 105 St.George Street, M5S 3E6, Canada, Krass@rotman.utoronto.ca, Jonathan Lorraine

Consider a set of competing facilities in a planar region where demand is continuously distributed and the trading area of each facility is its Voronoi cell (all points closest to the facility). We wish to add a new facility that will capture as much demand as possible. We develop a fast solution method based on Big Triangle-Small Triangle approach. The method is applicable to both uniform and non-uniform demand distributions. Applications to real-life facility sets will be demonstrated.

3 - Planning Service Maintenance under Disruption Threats

Mozart Menezes, Associate Professor, Kedge Business School-Bordeaux, 680 Cours de la Libération, Bordeaux, 33405, France, mozart.menezes@me.com, Dmitry Krass

We investigate the situation where facilities serving nodes may have service disrupted forcing nodes to be served by facilities providing service at higher cost. Disruption threats can be reduced when facilities undergo maintenance at a cost. The decision maker also incurs cost for repairing facilities and for maintaining facilities. We focus on the trade-off between planned maintenance versus allowing facilities to continue operation but risking a much higher cost when disruption happens.

■ SC57

57-Room 109B, CC

Energy Technology, Climate Change, and Uncertainty

Sponsor: ENRE – Energy II – Other (e.g., Policy, Natural Gas, Climate Change)

Sponsored Session

Chair: Erin Baker, University of Massachusetts, MIE Department, 220 ELAB, Amherst, MA, United States of America, edbaker@ecs.umass.edu

1 - Equilibrium vs. Optimality: Trading in Renewable Energy CertificatesEkundayo Shittu, George Washington University, Washington, DC, United States of America, eshittu@email.gwu.edu,
Linus Nyiwul

We propose the harmonization of independent renewable energy credit markets, and study their impacts on a firm's energy technology choice and capacity decisions. The industry is struggling with this issue right now, and we inform this policy debate by comparing market mechanisms in which each participant independently maximizes their targets. We find that while there are optimal market conditions, the equilibrium is not only unstable, the overall efficiency gains are not always positive either.

2 - Managing Climate Risks with Carbon Mitigation: A Stochastic Programming Approach with Merge

Delavane Diaz, Stanford University, Huang Engineering Center, Stanford, CA, 94305, United States of America, delavane@stanford.edu, Geoffrey Blanford

Carbon policy is fundamentally about risk management – balancing the costs of reducing emissions and the benefits of avoided climate change, both of which are uncertain due to incomplete scientific understanding and complex interactions. This paper presents a framework for decisionmaking under uncertainty in MERGE, examining optimal carbon mitigation given uncertainty about the physical climate system and climate damages. This work provides insight into managing downside risks of climate change.

3 - An Approximate Dynamic Programming Algorithm for Unit Commitment with Energy Storage

Mort Webster, mdw18@psu.edu

We present a novel formulation of a stochastic unit commitment model including energy storage using approximate dynamic programming. We demonstrate that the non-linear dynamics of energy storage lead to different optimal strategies for using storage as compared with the typical linear formulation used in most UC models.

4 - An Approach to Deep Uncertainty in Climate Change: Robust Portfolio Decision Analysis

Erin Baker, University of Massachusetts, MIE Department, 220 ELAB, Amherst, MA, United States of America, edbaker@ecs.umass.edu, Valentina Bosetti, Ahti Salo

We advance the concept of Robust Portfolio Decision Analysis and apply it to analyzing public energy technology R&D portfolios in response to climate change. We consider 3 sets of expert elicitations over 5 energy technologies. We identify technology projects that are in all, none, or some of the non-dominated portfolios, where non-dominated is defined in terms of multiple priors. We discuss the implications for value of information and for generating new alternatives with high option value.

■ SC58

58-Room 110A, CC

Resiliency and Reliability Optimization of Electric Power Systems

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Frank Felder, Associate Research Professor, Rutgers University, 33 Livingston Ave, New Brunswick, NJ, 08901, United States of America, ffelder@rci.rutgers.edu

Co-Chair: David Coit, Professor, Rutgers University, coit@rci.rutgers.edu

1 - Long-Term Mitigation for Improved Restoration in Power Networks

Emily Heath, Graduate Student, Rensselaer Polytechnic Institute, 110 8th St., Troy, NY, 12180, United States of America, heathe@rpi.edu, Thomas Sharkey, John Mitchell

This research looks at how the best mitigation plan can be selected for a power network using a ranking and selection procedure. The power system is modeled using the direct current (DC) model, and a performance measure is developed to

measure how a mitigation plan can contribute to the rapid restoration of the network following a disruption. We discuss the computational challenges of using the DC model, and compare results using a flow-based model on the same network.

2 - Combined Natural Gas and Electric System Operation with Wind Energy

Dan Hu, Iowa State University, 3004 Black Engineering Bldg, Ames, IA, United States of America, danhu@iastate.edu, Sarah Ryan

We formulate a model of a combined natural gas and electric power system including wind energy. A two-stage stochastic programming model for day-ahead scheduling is proposed with uncertainty in wind power production. Joint optimization of gas delivery and electricity production, with the ability to store natural gas, help to maintain equilibrium in the combined system while meeting demand with high reliability and low cost.

3 - An Adjustable Robust Optimization Approach to Provision of Interruptible Load

Qi Zhang, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, qi.zhang13@gmail.com, Michael F. Morari, Ignacio E. Grossmann, Jose M. Pinto, Arul Sundaramoorthy

In modern electricity markets, large electricity consumers can sell operating reserve by providing capacities to reduce their electricity load upon request. Providing such interruptible load can be very lucrative; however, one does not know in advance when load reduction will actually be requested. In this work, an adjustable robust optimization approach is applied to model this uncertainty, using affine decision rules that allow recourse decisions in the resulting scheduling problem.

■ SC59

59-Room 110B, CC

Just the Facts: Empirical Patterns in Strategy

Cluster: Strategy Science

Invited Session

Chair: Myles Shaver, University of Minnesota, 321-19th Ave S, Suite 3-365, Minneapolis, MN, 55455, United States of America, Mshaver@umn.edu

1 - How Competition Affects the Governance of R&D Projects: Evidence from Biotechnology Clinical Trials

Mazhar Islam, Drexel University in Philadelphia, PA, mui27@drexel.edu

Although almost all biotechnology firms participate in R&D alliances, we highlight that when one looks at a more micro-level of analysis – drug compounds within a therapeutic area – the majority of projects are done internally. Using a unique data set of clinical trials in 24 therapeutic areas in the U.S. biotechnology industry between 1996 and 2008, we show that biotechnology firms prefer internal organization absent competition from other biotechnology firms in the therapeutic area. With greater competition, we observe that these firms are more likely to utilize non-equity alliances compared to internal development – presumably to speed time to market within a competitive arena. We present two contingencies that aid in identifying the mechanism underlying this empirical finding – scope of applicability of the drug compound and the biotechnology firm's previous success with drug development projects.

2 - Innovation and Competition among Different Size Firms

Siddharth Sharma, PhD Candidate, Strategic Management, Robert H. Smith School of Business, University of Maryland, MD, United States of America, siddharth@rhsmith.umd.edu, Wilbur Chung

We examine the Consumer Electronics trade show (CES) as a microcosm of competitive interaction among different size firms. In this dense space, firms seek to position their booths to maximize exposure during this punctuated event. While industry heavy weights occupy key spots and little known ones are in the periphery, we still observe that firms of quite different sizes can be neighbors. We expect smaller firms armed with an innovation to seek out larger firms. We develop a simulation model with different size firms that have differing probability and value of innovations. Once their innovation draw is known, firms chose where to locate on a two-dimensional space with heterogeneous demand and look to maximize their demand. Firms compete by locating adjacent to others to capture some of their neighbors' demand. But locating with others can also generate externalities – agglomeration economies – that may offset competition. We compare the simulation's predictions versus actual booth locations. The setting and resulting simulation provide insights into the competitive dynamics underlying industry evolution.

3 - Have You Been Served? The Relationship between Corporate Social Responsibility and Lawsuits

Rob Salomon, rsalomon@nyu.edu

Does corporate social responsibility (CSR) protect firms against lawsuits? We conduct a study of 1047 firms from 46 countries over the period 2002 to 2011. We find, surprisingly, that CSR is positively associated with lawsuits. However, the relationship between CSR and lawsuits is moderated by advertising spending. Firms with high CSR that advertise heavily are buffered from lawsuits. Those firms with high CSR that maintain a low advertising profile, as well as those that focus their CSR efforts on social and environmental responsibility, tend to suffer more lawsuits. These results suggest that as a firm increases its CSR activities, it also increases its exposure to lawsuits, but differentiated products and good governance counter the increased risk. We posit that the positive relationship between CSR and lawsuits is likely a function of putting stakeholder concerns above shareholder concerns. The findings call for more research on the contingencies that affect the business case for CSR.

■ SC60

60-Room 111A, CC

Case Competition II

Sponsor: INFORM-ED

Sponsored Session

Chair: Palaniappa Krishnan, Associate Professor, University of Delaware, 212 Townsend Hall, 531 S. College Avenue, Newark, DE, 19711, United States of America, baba@udel.edu

1 - Temporary Staffing at Christie's

Qing Li, Associate Professor, HKUST, Department of ISOM, HKUST, Hong Kong, Hong Kong - PRC, imqli@ust.hk

The case is based on an actual challenge faced by Christie's Hong Kong, the Hong Kong subsidiary of the renowned auction house. For its biannual auctions, the company needs to hire 200 to 300 temporary sales assistants and assign them to different positions on different days. The human resources team believes that the current manual process of hiring and assignment is labor intensive and is unable to cope with sudden changes. They are looking to streamline the process and use decision tools.

2 - Distributions Strategies at Yaka Pharmaceuticals

Kathleen Iacocca, University of Scranton, 439 Brennan Hall, Scranton, PA, United States of America, kathleen.iacocca@scranton.edu

Yaka Pharmaceuticals, a large North American pharmaceutical manufacturing company, is considering changing their distribution strategy. Yaka Pharmaceuticals has four distribution options. The first option is the buy-and-hold contract, which was used by Yaka Pharmaceuticals and their distributors until recently. They moved away from this contract because the government issued a new law – the Sarbanes-Oxley Act, restricting the channel-stuffing accounting practice and distributor's investment buying. Since then the Fee-for-Service (FFS) contract, initiated by the Big-Three distributors – AmerisourceBergen, Cardinal Health, and McKesson – has been the contract that is in place. Under the FFS contract, Yaka pharmaceuticals pays a fee to the distributors for their distribution services while everything else remains more or less the same as under the buy-and-hold contract. Executives at Yaka Pharmaceuticals are not happy with the additional fee for almost the same service they previously received free of charge. The third option is to work with 3rd party logistics service providers on distribution. Although it looks promising, Yaka may be traveling down uncharted waters as the 3rd party logistics providers are just emerging in the pharmaceutical industry and have yet to be widely accepted. Finally, a consulting company suggested the Fee-for-Distribution contract, which allows Yaka pharmaceuticals to work with existing distributors but under a different relationship which resembles that of a third party logistics contract.

■ SC61

61-Room 111B, CC

Optimal Power Flow in Electric Power Systems I

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Andy Sun, Assistant Professor, Georgia Institute of Technology, 755 Ferst Drive, Atlanta, GA, 30332, United States of America, andy.sun@isye.gatech.edu

1 - Graph-theoretic Convexification of Power Optimization Problems

Javad Lavaei, Assistant Professor, UC Berkeley, 4121 Etcheverry Hall, University of California, Berkeley, CA, 94720, United States of America, lavaei@berkeley.edu, Ramtin Madani

The objective is to design efficient algorithms for finding a near-global solution of a power optimization problem. Our approach is based on the notions of OS-vertex sequence and treewidth in graph theory, matrix completion, and low-rank

optimization. We apply our results to the highly non-convex optimal power flow problem. We offer several simulations on the nationwide Polish grid, for which we find near-global feasible solutions with global optimality guarantees of at least 99.9%.

2 - Computational Advances for Moment-based Relaxations of Optimal Power Flow Problems

Daniel Molzahn, Dow Postdoctoral Fellow, University of Michigan, 1301 Beal Avenue, Room 4234A, Ann Arbor, MI, 48109, United States of America, dan.molzahn@gmail.com, Ian Hiskens

Optimal power flow (OPF) is the key problem in operating electric power systems. A hierarchy of "moment-based" relaxations globally solves many non-convex OPF problems for which existing relaxations fail. After showing the capabilities of the moment relaxations, this presentation demonstrates how to exploit sparsity and selectively apply the higher-order relaxation to globally solve large problems. Other computational advances, including a mixed SDP/SOCP relaxation, are also discussed.

3 - Strong Socp Relaxations for the Optimal Power Flow Problem

Andy Sun, Assistant Professor, Georgia Institute of Technology, 755 Ferst Drive, Atlanta, GA, 30332, United States of America, andy.sun@isye.gatech.edu, Burak Kocuk, Santanu Dey

We propose three strong SOCP relaxations for the AC OPF problem. One of these relaxations is based on a new bilinear extended formulation of OPF. These three relaxations are incomparable to each other and two of them are incomparable to the standard SDP relaxation. Extensive computational studies show that these relaxations have several advantages over existing convex relaxations and provide a practical approach to obtain feasible OPF solutions with extremely good quality in real-time operation.

■ SC62

62-Room 112A, CC

Biofuel Supply Chain and Market Analysis

Sponsor: ENRE – Environment I – Environment and Sustainability

Sponsored Session

Chair: Guiping Hu, Assistant Professor, Iowa State University, 3014 Black Engineering, Ames, IA, 50011, United States of America, gphu@iastate.edu

1 - An Optimization Model for Precision Farm Management Considering Water Resources

Qi Li, Iowa State University, 0076 black engineering, Ames, IA, 50011, United States of America, qili@iastate.edu, Baskar Ganapathysubramanian, Guiping Hu

An optimization model is formulated to study precision farm management. Genotype and phenotype of each crop are considered. In addition, soil fertility, water holding capability, and land slope have been incorporated. A case study for central valley in California has been conducted to validate the model considering the water constraints.

2 - A Bottom-up Equilibrium Model for Emerging Advanced Biofuel Market

Leilei Zhang, Iowa State University, 3004 Black Engineering, Ames, IA, 50010, United States of America, leileizh@iastate.edu, Yihsu Chen, Guiping Hu

We develop a bottom-up equilibrium model to study the interactions among the stakeholders in the biofuel supply chain. We analyze the effects of substitution on farmers' land allocation, biofuel production, blending, and market prices under a variety of market structures. Policies impacts are analyzed on biofuel markets and social welfare.

3 - A Real Options Approach to Study Investment Timing for Cellulosic Biofuels

Yihua Li, Iowa State University, 3004 Black Engineering, Ames, IA, 50010, United States of America, yihuali@iastate.edu, Chung-li Tseng, Guiping Hu

We present a real options approach to evaluate the investment of a new technology to produce cellulosic biofuels subject to construction lead times and uncertain fuel price. We conduct a case study on Iowa, in which the decision maker finds the optimal investment timing subject to production and distribution constraints.

4 - A New Approach for Optimal Electricity Planning and Dispatching with Hourly Time-scale Air Quality

Paul Kerl, Georgia Tech, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, paul.kerl@gmail.com, Valerie Thomas

Energy production from coal, natural gas, oil and biomass generates air pollutants and health impacts. Pollutant exposure depends on the relative location to power plants and atmospheric conditions which vary by hour, day and season. We have developed a method to evaluate pollutant formation from source emissions which we integrate with an electricity production model. In a case study of Georgia we show how to reduce health impacts by shifting production during select hourly periods.

■ SC63

63-Room 112B, CC

Doing Good with Good OR II

Cluster: Doing Good with Good OR

Invited Session

Chair: Itai Ashlagi, MIT, 100 Main st, Cambridge, Ma, 02139, United States of America, iashlagi@mit.edu

Co-Chair: Lisa Maillart, Swanson School of Engineering, Hall Pittsburgh, PA, lisa.maillart@engr.pitt.edu

1 - Finding Patterns with a Rotten Core: Data Mining for Crime Series Detection

Tong Wang, Graduate Student, MIT, 70 Pacific Street, Apt. 242A, Cambridge, MA, 02139, United States of America, tongwang@mit.edu

We worked with the Cambridge Police Department to build a model that can automatically detect crime series, which analysts spend hours per day doing it manually. NYPD is currently working with our code, aiming to incorporate it into a custom software package they are developing which can assist in their daily job. This project has received widespread media attention.

2 - Infusion Center Process Improvement and Patient Wait Time Reduction

Mengnan Shen, Georgia Tech, Atlanta, GA, United States of America, motion0720@gatech.edu, Xiaoyang Li, Allen Liu, James Micali, Jisu Park, Yunjie Sun, Emilie Wurmser, Sung Keun Baek

Winship experienced long wait times and low patient satisfaction. Combining data analytics, stakeholder interviews, queuing network principles, and detailed simulation analysis, we improved flow, communication, and visibility throughout the process. Winship implemented our suggestions, resulting in a 28% reduction in patient wait times from check-in to chair, a 8.5% increase in patient satisfaction, and a 6 patients/day increase in throughput.

3 - Using Operations Research to Improve the Health of Patients with Type 2 Diabetes

Yuanhui Zhang, NC State, United States of America, yuanhui.zhang@gmail.com

We developed OR models for policy evaluation and robust optimization of clinical regimens for glycemic control for patients with type 2 diabetes. We used the models to address controversial questions including: whether protocols based on new medications are more effective than standard regimens. A publication from this work received substantial press and may help inform treatment recommendations in the future.

■ SC64

64-Room 113A, CC

Joint Session DAS/ENRE: Decision Analysis Applications in Oil and Gas

Sponsor: Decision Analysis & ENRE

Sponsored Session

Chair: Brad Powley, Senior Consultant, Strategic Decisions Group, 745 Emerson Street, Palo Alto, CA, 94301, United States of America, bpowley@sdg.com

1 - Defining Prospects for Decision Analysis

Ahren Lacy, Decision Analysis Advisor, Chevron, 1400 Smith St, #31-128, Houston, TX, 77007, United States of America, Ahren@chevron.com

The prospect is the building block of decision analysis. We express our belief about the likelihood of a prospect's occurrence (by assigning a probability), and we express our preference should we obtain it (often using a monetary value

measure). Clarity of action in a complex decision requires careful selection of distinctions in order to define useful prospects. The author will discuss several real-world applications in oil and gas projects where clear distinctions led to clarity of action.

2 - A Probabilistic Analysis of Drilling Strategies in Unconventionals

Robert Hammond, Decision Analyst, Chevron, 1400 Smith St, Houston, TX, United States of America, rhammond@chevron.com

This talk will focus on a probabilistic decision analysis of drilling strategies in an unconventional oil and gas play that has sporadic areas with low chances of drilling success. The analysis helped determine the optimal drilling strategy, including whether to drill multiple wells from a single surface location, which reduces development costs and environmental footprint, or a spaced well approach, which in some cases can be used to avoid drilling issues and additional development costs.

3 - Meta-modeling in Decision Analysis: A Case Study

Brad Powley, Senior Consultant, Strategic Decisions Group, 745 Emerson Street, Palo Alto, CA, 94301, United States of America, bpowley@sdg.com, Eric Bickel

A sophisticated physical model, despite representing an organization's best thinking, may be excluded from a decision analysis because it cannot complete a requisite number of runs in a reasonable amount of time. When facing such a situation, we created a statistical model of a hydrocarbon reservoir model based on a handful of previous runs, and used it to conduct a probabilistic simulation on project economics. This talk introduces that approach, and discusses its merits and challenges.

4 - A Cognitive Decision Room for High-stakes Decision Making

Jeffrey Kephart, IBM, T. J. Watson Research Center, Yorktown Heights, NY, 10598, kephart@us.ibm.com, Debarun Bhattacharjya

We have built a cognitive room in which decision makers use a combination of speech and gesture to interact with a multi-agent system of decision and information agents. We overview the hardware and software infrastructure of the cognitive room, describe a set of interacting decision agents, and illustrate via several examples how the room enables human decision makers to make better, more informed decisions in the context of high-stakes decisions in domains such as mergers and acquisitions.

■ SC65

65-Room 113B, CC

Systems Engineering and Decision Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Robert Bordley, Expert Systems Engr Professional, Booz-Allen-Hamilton, 525 Choice Court, Troy, MI, 48085, United States of America, Bordley_Robert@bah.com

1 - Limits to Rationality in Systems Engineering

George Hazelrigg, Deputy Division Director, National Science Foundation, Civil, Mech. & Mfg Innovation, 4201 Wilson Boulevard, Arlington, Va, 22230, United States of America, ghazelri@nsf.gov

Rationality is a worthwhile goal in any engineering activity enabling optimization and averting poor choices. But attempts to create a rational framework for systems engineering fail at the time the second person is assigned to the project. We outline the limits to rationality in systems engineering and illustrate consequences. Systems design approaches can have destructive impacts on system design. This paper presents simple procedures to avoid such problems.

2 - Improving Systems Engineering Trade-Off Studies

Greg Parnell, Professor, University of Arkansas, Department of Industrial Engineering, Fayetteville, AR, 72701, United States of America, gparnell@uark.edu

Today's complex systems involve significant uncertainties, multiple stakeholders with conflicting objectives, and growing affordability concerns. SE trade-offs arise throughout the system life cycle. Surprisingly many of the published trade-off studies do not have a strong mathematical foundation, do not provide an integrated assessment of value and risk, and many do not even consider uncertainty. We report on a book project to provide best practices using decision analysis.

3 - Making Product Development Decisions with Decision Analysis

Dennis Buede, President And Executive Director, Innovative Decisions, 8230 Old Courthouse Road, Suite 460, Vienna, VA, 22182, United States of America, dbuede@innovatedecisions.com

Formal decision processes during system design are commonly called trade studies or analyses of alternatives (AoAs). This paper will give an overview of the process for systems engineering and product development, describe the many kinds of trade studies that should be undertaken, relate decision analysis to these trade studies and discuss complexities of system design about which decision analysts should be aware. Numerous real world examples will be given along the way.

4 - Obtaining Engineering Design Targets in the Presence of Uncertainty

Robert Bordley, Expert Systems Engr Professional,
Booz-Allen-Hamilton, 525 Choice Court, Troy, MI, 48085, United
States of America, Bordley_Robert@bah.com, Steve Pollock

A typical systems engineering process selects a design concept to meet the customer's stated objectives. To implement this concept, design targets are assigned to various engineering teams. It is important that target assignments explicitly recognize uncertainty about what is technically feasible and about the customer's objectives. This paper addresses the problem of determining optimal design targets (and the associated design margins) using a decision analytic approach.

■ SC66

66-Room 113C, CC

Aviation Applications Section: Best Student Presentation Competition 2

Sponsor: Aviation Applications

Sponsored Session

Chair: Bo Zou, University of Illinois at Chicago, 2095 Engineering
Research Facility, 842 W. Taylor Street (M/C 246), Chicago, IL,
60607-7023, United States of America, bzou@uic.edu

1 - Quantifying Delay Propagation through Crew Connections

Keji Wei, Dartmouth College, Thayer School of Engineering,
Hanover, NH, United States of America,
Keji.Wei.TH@dartmouth.edu, Vikrant Vaze

The purpose of this study is to investigate delay propagation through airline crew pairings. In order to solve the crew pairing sub-problem, we develop a heuristic that combines column generation with branch-and-bound for computational speedup and solution accuracy. Based on multiple criteria that serve as a proxy for the extent of delay propagation through crew pairing, we build learning hyper-models to generate crew pairings that are similar to those in the real world crew pairing samples.

2 - A Strategic Prioritization Approach to Airline Scheduling during Disruptions

Prateek Srivastava, Graduate Student, University of Texas at
Austin, 204 E. Dean Keeton Street, Stop C2200 ET, ETC II 5.160,
Austin, TX, United States of America, prateekrs@utexas.edu

Whenever the arrival capacity of an airport reduces due to bad weather, the FAA uses a Ration By Schedule approach to allocate arrival slots to airlines. The major drawback of this approach is that it does not take the airline operations into account. In our study, we consider a framework in which airlines can prioritize their flights at different airports based on their needs. We show through simulations on historical data that significant cost benefits are achieved using this framework.

3 - Characterizing the Tradeoff between Planned and Operational Costs in Robust Crew Scheduling

David Antunes, University of Coimbra, Portugal, dantunes@uc.pt,
Antonio Antunes, Vikrant Vaze

To mitigate disturbances created by delays in an airline's network, we develop a robust crew scheduling model. Input delay profiles were built using real-world data. To avoid the implementation and customization challenges associated with the well-established crew pairing models, and tractability challenges associated with adding robustness features to them, we use an integer programming model that's easy to solve using commercial software and reduces the need for calibrations and fine-tuning.

■ SC67

67-Room 201A, CC

Advances in Network Design

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Michael Hewitt, Loyola University Chicago, 820 N. Michigan
Ave, Chicago, IL, 60611, United States of America, mhewitt3@luc.edu

1 - The Price of Discretizing Time in Service Network Design

Luke Marshall, Georgia Institute of Technology,
North Ave NW, Atlanta, GA, United States of America,
luke.jonathon.marshall@gmail.com, Natasha Boland,
Martin Savelsbergh, Michael Hewitt

When solving transportation problems using time-expanded networks, the choice of discretization has a strong impact on solution quality; the choice trades off solution accuracy to solution time. We empirically investigate this trade-off to be able to make a more informed choice.

2 - Real-time Dynamic Load Planning for Less-than-truckload Motor Carriers

Belgacem Bouzaïene-ayari, Research Staff, Princeton, 113A
Sherrerd Hall, Princeton University, Princeton, NJ, 08540, United
States of America, belgacem@princeton.edu, Warren Powell

LTl motor carriers need to plan the flows of shipments and trailers over time to minimize costs while meeting service commitments. These decisions need to be made dynamically, responding to current and forecasted shipments. We present a novel formulation that allows us to solve large problems while obtaining high quality solutions. This approach enables us to optimize balance in a network where loaded movements might be handled with company drivers, purchased transportation and intermodal.

3 - Solving Large-scale Service Network Design Problems

Michael Hewitt, Loyola University Chicago, 820 N. Michigan Ave,
Chicago, IL, 60611, United States of America, mhewitt3@luc.edu,
Martin Savelsbergh

In this talk we will discuss how aggregation techniques can be used to solve large-scale service network design problems. We will discuss methods for two dimensions of the service network design problem that contribute to its size: (1) the precision with which time is modeled, and, (2) the number of shipments to be delivered. We will present the results of an extensive computational study based on instances derived from a large, U.S. Less-than-truckload transportation company.

4 - Dynamic Shortest-path Interdiction

Jorge A Sefair, Arizona State University, 699 S. Mill Ave. BYENG
330, P.O. Box 878809, Tempe, AZ, 85287-8809, United States of
America, jorge.sefair@asu.edu, Cole Smith

We study a dynamic network game between an attacker and a user. The user seeks a shortest path between a pair of nodes, and the attacker seeks to interdict a subset of arcs to maximize the user's shortest-path cost. The attacker can interdict arcs any time while the user travels the network, and the user can respond by altering its chosen path. We propose an optimal dynamic-programming algorithm as well as upper and lower bounds based on interdiction and robust optimization.

■ SC68

68-Room 201B, CC

Joint Session TSL/Public Sector: Transportation Disruption Management

Sponsor: Transportation, Science and Logistics & Public Sector

Sponsored Session

Chair: Kash Barker, Associate Professor, University of Oklahoma, 202
W Boyd St, Rm. 124, Norman, OK, 73019, United States of America,
kashbarker@ou.edu

1 - Management of Water and Transportation Networks during Flood Disasters

Mehdi Nourinejad, University of Toronto, Civil Engineering
Department, University of Toronto, Toronto, ON, M5S 1A4,
Canada, mehdi.nourinejad@mail.utoronto.ca

Flood disaster death tolls can be reduced through in-time evacuation planning. An optimal evacuation schedule takes into account the route and intensity of the water flow. Evacuation priority should be given to regions prone to being overflowed faster than others. To enhance evacuation planning, water flow can be managed through appropriate reservoir design to create a time lag for evacuation. A model is developed that simultaneously considers evacuation planning and reservoir design.

2 - Freight Transportation Network Recovery Based on Interdependent Impact

Mohamad Darayi, mdarayi@ou.edu, Kash Barker,
Nazanin Morshedlou

Freight transportation networks, considered a means to enable the flow of commodities and to facilitate economic productivity, are prone to natural and human-made hazards. This research pursues an approach to improve restoration order decision making based on the broader perspective of their impact to multiple industries and multiple regions.

3 - Stochastic Resilience Modeling with Bayesian Kernel Methods: Application to Inland Waterway Networks

Hiba Baroud, Vanderbilt University, 400 24th Avenue South,
Nashville, TN, 37205, United States of America,
hiba.baroud@vanderbilt.edu, Kash Barker

This work applies a Bayesian kernel approach to model the resilience of infrastructure systems. The approach quantifies the resilience of transportation systems under the uncertainty of disruptive events given data describing the characteristics of the infrastructure system and disruption scenario. The model is deployed in an application to an inland waterway transportation network for which the recovery of disrupted links represented by sections of the river is

analyzed.

4 - Effective and Equitable Supply of Gasoline to Impacted Areas in The Aftermath of a Natural Disaster

Rajan Batta, Suny Distinguished Professor, University at Buffalo (SUNY), 410 Bell Hall, Buffalo, United States of America, batta@buffalo.edu, Changhyun Kwon, Xiaoping Li

Supply chain disruptions of hazmat commodities, such as gas shortages, have resulted from the post-natural disaster conditions as seen during and after Hurricane Sandy, 2008, China winter storms and the 2010 Chilean earthquake. We develop a transportation logistics model aimed at providing feasible and cost-effective solutions to alleviate the impact of gasoline shortage.

■ SC69

69-Room 201C, CC

Facility Logistics I

Sponsor: TSL/Facility Logistics

Sponsored Session

Chair: Sadan Kulturel-Konak, Professor, Pennsylvania State University, Berks Campus, Reading, PA, 19609, United States of America, sadan@psu.edu

1 - Distribution Operations with Item Location Uncertainty

Jennifer Pazour, Assistant Professor, Rensselaer Polytechnic Institute, 110 Eighth Street, Troy, NY, 12180, United States of America, pazouj@rpi.edu

Item location uncertainty can occur in a number of environments, including sea-based, healthcare, and retail logistics environments. Yet, such existence has been ignored in existing warehouse and distribution decision making models. Thus, we develop analytical models to study the impact of item location uncertainty on order-fulfillment policies and logistics performance measures.

2 - Optimal Assignment of Airport Baggage Unloading Zones to Outgoing Flights

Marc Goetschalckx, marc.goetschalckx@isye.gatech.edu, Pratik Mital, Edward Huang

In this work, the airport outbound baggage assignment problem is modeled as a Vector Assignment Problem (VAP). VAP is a new category of optimization problems which belongs to the class of Assignment Problems (AP), but has unique properties which make it harder to solve. A real airport case study is presented, to which the optimization models developed are applied. The performance of the optimization models is compared to typical heuristics used in the literature to solve this problem.

3 - Using Real-time Employee Location to Make Hospital Transport Assignments

Dale Masel, Associate Professor, Ohio University, 270 Stocker Center, Athens, OH, 45701, United States of America, masel@ohio.edu, Connor McMahon, Seth Hostetler

In a hospital, employees who are responsible for transporting patients and equipment are a critical resource for patient care and efficient operations. Getting patients to appointments on time is essential for preventing delays at the labs and clinics in the hospital. By knowing where each transporter is located when a request is received, their time to reach a patient who needs to be transported can be determined. This allows assignments to be made more effectively, reducing patient waiting.

4 - Zone Based Dynamic Facility Layout Problem

Sadan Kulturel-Konak, Professor, Pennsylvania State University, Berks Campus, Reading, PA, 19609, United States of America, sadan@psu.edu

In this study, a zone-based Dynamic Facility Layout Problem (DFLP) is under consideration to design manufacturing and logistics facilities considering material handling infrastructure. A hybrid approach is proposed to solve the problem and promising numerical results are presented for a comprehensive set of test problems from the literature.

■ SC70

70-Room 202A, CC

RAS Roundtable: Part I Railroad Operations Efficiency and Recovery

Sponsor: Railway Applications

Sponsored Session

Chair: Erick Wikum, Principal Scientist, Tata Consultancy Services, 1000 Summit Drive, Milford, OH, 45150, United States of America, erick.wikum@tcs.com

1 - Railroad Operations Efficiency and Recovery

Erick Wikum, Principal Scientist, Tata Consultancy Services, 1000 Summit Drive, Milford, OH, 45150, United States of America, erick.wikum@tcs.com, Jeffrey Guelker, Bob Gutman, Clark Cheng

In the railroad industry, achieving efficient operations and developing the capability to recover from inevitable disruptions are key to both customer service and financial performance. In this session, the first of two, panelists from the railroad industry worldwide explore how to define and measure efficiency and recovery and share case studies and a vision for the role OR/MS and analytics has played and can play in operational efficiency and recovery.

■ SC71

71-Room 202B, CC

Public Transportation Modeling

Sponsor: TSL/Urban Transportation

Sponsored Session

Chair: Nicholas Lowmes, University of Connecticut, 261 Glenbrook Rd, U-3037, Storrs, Co, 06269, United States of America, nlowmes@engr.uconn.edu

1 - Optimizing Transit Network Design for Equity

Kelly Bertolaccini, Ph. D. Candidate, University of Connecticut, 260 Glenbrook Rd, Storrs, CT, 06269, United States of America, klb06003@engr.uconn.edu, Nicholas Lowmes

The equitable provision of public transit services is a major concern for planners worldwide, yet few tools are currently available for those seeking to incorporate equity into their transit network designs. This research proposes a method for directly incorporating equity into the stop grouping and stop sequencing components of the Transit Network Design Problem. An iterative process is used to combine the stop sequencing and grouping models to design equitable, multi-route transit systems.

2 - Integrated Planning of Park-and-Ride Facility and Transit Service

Ziqi Song, Assistant Professor, Utah State University, 4110 Old Main Hill, Logan, UT, 84322-4110, United States of America, ziqi.song@usu.edu

This research proposes an integrated planning framework to strategically locate park-and-ride (P&R) facilities and optimize transit service frequency simultaneously. P&R users' route choice behavior is explicitly considered and a link-based multimodal user equilibrium model is established. The optimal P&R facility and transit service design problem is formulated as a mathematical program with complementarity constraints, and a solution algorithm based on the active-set approach is used.

3 - Evaluating Zoning Strategies for Demand Responsive Transit Systems

Mahour Rahimi, University of Massachusetts, Amherst, 139 Marston Hall, 130 Natural Resources Rd., Amherst, MA, 01003, United States of America, mrahimi@umass.edu, Eric Gonzales

DRT systems often divide their service area into smaller regions in order to simplify operations. However, this management strategy can create inefficiencies. This paper develops an analytical formulation to explain the relation between agency cost and zoning strategies. The two main objectives are to understand when a service area needs to be divided into smaller regions to reduce the total costs of a DRT system and how the split should be done in order to be the most cost effective.

4 - Effects of Real-time Information Services over the Performance of Transit Systems

Ricardo Giesen, Assistant Professor, Pontificia Universidad Catolica de Chile, Vicuna Mackenna 4860, Macul, Santiago, Chile, giesen@ing.puc.cl, Emilio Nacelle, Leandro Segura, Matías Estrada, Antonio Mauttone

We study the influence of real-time information services over the performance of bus transit systems from the users' perspective. Six variants of passenger behavior models representing different degrees of information availability are proposed and embedded into a simulation framework. We perform a comprehensive set of experiments, using a small city. The impact of different assumptions concerning information availability is analyzed in terms of user travel time.

■ SC72

72-Room 203A, CC

Panel Discussion: IoT-enabled Data Analytics: Opportunities, Challenges and Applications

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Kaibo Liu, Assistant Professor, UW-Madison, 1513 University Avenue, Madison, 53706, United States of America, kliu8@wisc.edu

1 - Panel Discussion: IoT-enabled Data Analytics: Opportunities, Challenges and Applications

Moderator: Kaibo Liu, Assistant Professor, UW-Madison, 1513 University Avenue, Madison, 53706, United States of America, kliu8@wisc.edu, Panelists: Benoit Montreuil, George Q. Huang, Soundar Kumara, Diego Klabjan

The goal of this session is to push the frontier in IoT application and the enabled data analytics research. The session provides a forum where participants can describe current research, identify important problems and areas of application, explore emerging challenges, and formulate future research directions.

■ SC73

73-Room 203B, CC

Quality Engineering

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Trevor Craney, Shell, Houston, TX, United States of America, Trevor.A.Craney@shell.com

1 - Integrated Approach for Field Reliability Prediction Based on Accelerated Life Testing

Mingxiao Jiang, Medtronic, 7000 Central Ave NE, Fridley, United States of America, mingxiao.jiang@medtronic.com

To predict field reliability using analytic modeling, several important reliability activities should be conducted, including FMEA, stress and usage condition analysis, PoF, ALT, and cumulative damage modeling if needed. This paper builds an integrated process and comprehensive modeling framework, especially with cumulative damage rules when the certain field stresses are random processes. An engineering product is provided as an application of proposed method.

2 - The Constant Shape Parameter Assumption in Weibull Regression

Steve Rigdon, Professor, Saint Louis University, 3545 Lafayette Ave, Salus 481, Saint Louis, MO, 63104, United States of America, srigdon@slu.edu, Georgia Mueller

The usual assumption in Weibull regression is that the scale parameter is a function of the predictor variables and the shape parameter is constant. We consider the problem of estimating parameters in the presence of a nonconstant shape parameter and the effect of assuming a constant shape parameter when it really isn't constant. The misspecification of a constant shape parameter leads to loss of power for tests of the slope parameters and inaccurate prediction intervals.

3 - Model Specification and Confidence Intervals for Voice Communication

Sara Wilson, NASA Langley Research Center, Mail Stop 131, Hampton, VA, 23681, United States of America, sara.r.wilson@nasa.gov, Robert Leonard, David Edwards, Kurt Swieringa, Jennifer Kibler

The performance of a system often depends on the accuracy of information transferred via voice communications. This paper presents a case study from a human-in-the-loop experiment using a simulated flight environment that required a complex voice clearance issued by Air Traffic Control to a flight crew. The lognormal and loglogistic distributions are found to model the time required for voice communication, and extensive investigation of outliers was performed to identify procedural anomalies.

4 - Determining Test Sample Size for Reliability Demonstration Retesting after Product Design Change

Andre Kleyner, Global Reliability Engineering Leader, Delphi Electronics & Safety, 2151 E. Lincoln Rd, M.S. CTC4E, Kokomo, IN, 46902, United States of America, andre.v.kleyner@delphi.com, David Elmore, Ben Zion Boukai

Last minute design changes after completed product testing is a common occurrence. It is also common for a redesigned product to be retested to demonstrate compliance to the original reliability requirements. This paper discusses the application of Bayesian techniques to reduce the sample sizes required for retesting after design change. The proposed method helps to reduce the test sample size while demonstrating the required reliability and helping to reduce the cost of product development.

■ SC74

74-Room 204A, CC

IEEE Intelligent Systems Invited Panel Discussion on Healthcare Intelligence

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Hui Yang, Associate Professor, Pennsylvania State University, 310 Leonhard Building, Industrial and Manufacturing Eng., State College, PA, 16801, United States of America, huy25@psu.edu

1 - Panel Discussion on Healthcare Intelligence: Turning Data into Knowledge

Moderator: Hui Yang, Associate Professor, Pennsylvania State University, 310 Leonhard Building, Industrial and Manufacturing Eng., State College, PA, 16801, United States of America, huy25@psu.edu, Panelists: W. Art Chaovalitwongse, Kwok Leu Tsui, Jing Li, Oguzhan Alagoz

This panel brings a panel of distinguished experts to share their perspectives and answer questions pertaining to data sciences, operation research and healthcare research. Panelists are: Dr. TSUI Kwok Leung, City University of Hong Kong; Dr. Oguzhan Alagoz, University of Wisconsin-Madison; Dr. W. Art Chaovalitwongse, University of Washington; Dr. Jing Li; Arizona State University.

■ SC75

75-Room 204B, CC

Advanced Manufacturing Systems and Planning

Cluster: Advanced Manufacturing

Invited Session

Chair: Jun-Qiang Wang, Professor, Northwestern Polytechnical University, Box 554, No. 127 West Youyi Road, Department of Industrial Engineering, Xi'an, 710072, China, wangjq@nwpu.edu.cn

1 - Real-time Data Driven Visual Decision Support System for the Factory Floor

Mohammad Rahdar, Iowa State University, 133 University Village, Unit F, Ames, IA, 50010, United States of America, rahdar@iastate.edu, Guiping Hu, Dave Sly, Lizhi Wang

The manufacturing industries face significant challenges in operational planning due to the uncertainties in demand, lead-time, logistic, etc. This study aims to improve the efficiency of the production planning system and provide the visibility of real-time operations. The decision support system can access real-time data and use the models and analytical techniques to support the manufacturing decision making.

2 - Data-based Scheduling System for Semiconductor Wafer Fabrication Facility

Li Li, Professor, Tongji University, No.4800, Cao'an Road, Shanghai, China, lili@tongji.edu.cn

Based on the analysis of the differences and relations between traditional and data-based scheduling methods, we propose a data-based scheduling framework and discuss how to implement it for a semiconductor manufacturing system. Then we introduce the state-of-the-art research on the key technologies of data-based scheduling and point out their development trends. Finally, we develop a data-based scheduling prototype system and also use some examples to demonstrate the superiority of the system.

3 - Cloud Manufacturing Ecosystem – Scheduling and Evolving

Shengkai Chen, Zhejiang University, School of Mechanical Engineering, 38# Zheda Road, Hangzhou, China, 372927638@qq.com, Shuiliang Fang, Haoke Peng

In the Cloud Manufacturing Ecosystem, a benign mode and methodology for massive services schedule is required, in order for the collaboration within the whole Industry Chain. This paper studied the data of the resources and services, and modeled the services scheduling problem in the chain. With the Big Data analysis on the Cloud Platform, optimal assessment/schedule methods were developed, which could gradually evolve the ecosystem to an optimal situation.

4 - Initiative Scheduling Mode for Physical Internet-based Manufacturing System

Jun-Qiang Wang, Professor, Northwestern Polytechnical University, Box 554, No. 127 West Youyi Road, Department of Industrial Engineering, Xi'an, 710072, China, wangjq@nwpu.edu.cn, Guo-qiang Fan, Shu-dong Sun, Ying-feng Zhang

We categorize scheduling as passive scheduling and initiative scheduling, depending on who takes the initiative and controls the decision-making of scheduling in physical internet-based manufacturing systems. Focusing on initiative scheduling mode, we model a p-shaped framework for scheduling elements, analyze the decentralized operation mode, explore the individual and organizational scheduling behaviors among enabling units. Finally we discuss some future research directions.

■ SC76

76-Room 204C, CC

Design of Experiments and Statistical Analysis for Simulation

Sponsor: Simulation

Sponsored Session

Chair: Feng Yang, Associate Professor, West Virginia University, P.O.Box 6070, Morgantown, United States of America, Feng.Yang@mail.wvu.edu

Co-Chair: Hong Wan, Associate Professor, Purdue University, 315 N. Grant Street, GRIS 327, West Lafayette, United States of America, hwan@purdue.edu

1 - Simulation Experiments Involving Stochastic Optimization Models for Disaster Relief

Susan Sanchez, Professor, Naval Postgraduate School, Operations Research Dept, 1411 Cunningham Rd, Monterey, CA, 93943, United States of America, smsanche@nps.edu, Emily Craparo, Maxine Gardner

Stochastic optimization approaches have been used for determining effective disaster relief operations, but may not fully capture the uncertainty that is inherent in these disasters and the demands that result. We use large-scale design of experiments to more fully investigate the effect of variability on the solution of a two-stage mixed-integer stochastic optimization model that explores using UAVs as logistics assets when planning the Navy's logistics response to natural disasters.

2 - Sequential Experimental Designs for Stochastic Kriging

Xi Chen, Assistant Professor, Industrial and Systems Engineering at Virginia Tech, 1145 Perry St., Blacksburg, VA, 24061, United States of America, xchen.ise@vt.edu

In this work, we establish a sequential experimental design framework for applying Stochastic Kriging (SK) to predicting performance measures of complex stochastic systems. We show how the integrated mean squared error of prediction decreases as additional simulation runs are allocated sequentially, and derive some efficient sequential design strategies from these analytic results. The performance of the proposed sequential design strategies is demonstrated through numerical examples.

3 - Block-coordinate Strong for Large Scale Simulation Optimization

Hong Wan, Associate Professor, Purdue University, 315 N. Grant Street, GRIS 327, West Lafayette, United States of America, hwan@purdue.edu, Wenyu Wang

STRONG is a response surface methodology (RSM) based algorithm that iteratively constructs linear or quadratic fitness model to guide the searching direction within the trust region. For high-dimensional problem, this paper modify the Block Coordinate Descent framework to fit the STRONG algorithm, and propose an algorithm which guarantees to converge to a stationary point. This is the first result establishing the BCD framework in high dimensional simulation optimization problems.

■ SC77

77-Room 300, CC

Supply Chain Management III

Contributed Session

Chair: Pengyu Chen, PhD Student, Huazhong University of Science & Technology, 1037 Luoyu Road, Wuhan, China, andychen@hust.edu.cn

1 - Control and Emergence in Supply Networks

Anand Nair, Michigan State University, 632 Bogue St., East Lansing, MI, United States of America, nair@broad.msu.edu, Ilaria Giannoccaro, Thomas Choi

In this paper we consider the supply network of Honda as the focal firm and develop an empirically-informed NK simulation model to examine how varying levels of control influence performance of supply networks.

2 - A Study on Internet of Things and Supply Chain Agility

Bo Li, Ashland University, 401 College Ave, Ashland, OH, United States of America, bli@ashland.edu

Internet of Things (IoT) changes our daily life and business world, thus supply chain managers must answer the question about how IoT can improve their supply chain performances. This research develops a conceptual model with simulation demonstration, to study the relationship among IoT, supply chain agility, and supply chain performances.

3 - Orders and Reciprocity in the Technology Supply Chain

Heejong Lim, Purdue University, 403 W. State Street, West Lafayette, IN, United States of America, limh@purdue.edu, Ananth Iyer

Motivated by the semiconductor and the LCD industry, we incorporate the reciprocal game in a dyadic (buyer-supplier) supply channel. In our model, the buyer's anticipated reciprocal behavior influences the seller's order so as to protect the seller during the oversupply period. We provide an analysis under different level of reciprocity following accepted economic models in order to explore the impact on order size and channel coordination. Insights from practice are then provided.

4 - Vertical Integration in Two-tier Decentralized Supply Chain

Pengyu Chen, PhD Student, Huazhong University of Science & Technology, 1037 Luoyu Road, Wuhan, China, andychen@hust.edu.cn, He Xu

We study a supply chain with three types of firms (i.e. suppliers, manufacturers and integrated firms). Integrated firms can sell parts and final products while suppliers and manufacturers can sell only one of them. We find the conditions under which integrated firms sell parts to other manufacturers and investigate how prices and social wealths are affected. We also answer the question when two individual firms prefer to vertically merging.

■ SC78

78-Room 301, CC

Supply Chain Risk Management I

Contributed Session

Chair: Lisa Yeo, Assistant Professor, Loyola University Maryland, 4501 N. Charles St., Sellinger Hall 306, Baltimore, MD, 21210, United States of America, mlyeo@loyola.edu

1 - Perspectives on Supply Chain Corruption and Risk Management

Xiaoqing Liu, PhD Candidate, The University of Auckland, 12 Grafton Road, Auckland City, Auckland, 1010, New Zealand, xiaoqing.liu@auckland.ac.nz, Tiru Arthanari

Research on supply chain risk management is still immature and of increasing importance. Corruption from the perspective of supply chains largely lacks research. We propose a conceptual framework for managing corruption risk in supply chains. Case studies help verify and establish factors. System dynamics modelling clarifies complex relationships. We anticipate exploring how corruption risks modify supply chain risk factors and performance, and how to safeguard supply chains against such risks.

2 - An Examination of the Impact Supplier Flexibility and Reliability on Supply Chain Resilience

Masoud Kamalahmadi, Student, North Carolina A&T State University, 1601 E. Market St, Greensboro, NC, 27411, United States of America, Mkamalah@aggies.ncat.edu, Mahour Mellat Parast

In this paper, the impact of supplier flexibility and reliability on supply chain resilience is examined. We develop a mathematical model to minimize the impact of two types of supply chain disruptions (supply disruption and environmental disruption), and propose strategies for supplier selection and allocation to minimize supply chain risks and costs. Risk of delivery reliability is also examined in this study.

3 - Assessing the Relationship of Supply Chain Risk Management to Quality Management

Tyler Florio, East Carolina University, College of Business,
Greenville, NC, 27858, United States of America,
floriot11@students.ecu.edu, Scott Dellana

This research explores the relationship between an organization's supply chain risk management maturity (SCRMM) and quality management (QM) practices. QM practices and SCRMM were measured using a survey questionnaire of organizations in the USA. ISO 9001 status was also determined. Preliminary results suggest that ISO 9001 is not related to SCRMM, while QM is related to SCRMM. Organizations with more mature quality management programs appear to also have more mature risk management programs.

4 - Mitigating Contagion Risk in Supply Chains

Alireza Azimian, Wilfrid Laurier University, 55 Hickory St,
E, Waterloo, ON, N2J 3J5, Canada, azim9110@mylaurier.ca,
Hamid Noori, Marc Kilgour

Rivals often benefit from each other's failures because of demand shifts; however some incidents may adversely affect an entire industry causing all firms to suffer. We explore whether investment in the safety measure of the rivals who just comply with minimum standards can be employed as a risk mitigation strategy.

5 - Information Security Investments: Better Together?

Lisa Yeo, Assistant Professor, Loyola University Maryland, 4501
N. Charles St., Sellinger Hall 306, Baltimore, MD, 21210, United
States of America, mlyeo@loyola.edu, Erik Rolland, Bora Kolfal,
Raymond Patterson, Hooman Hidaji

Security breaches are often the result of the weakest link in a chain of related businesses; a firm may have strong security practices and yet still experience a loss due to a weaker business partner. We propose allocating some firm resources to a supplier in order to improve that supplier's security posture with possible positive spillover to a competitor. In a symmetric duopoly setting, where demand reacts to breach notification, we find the conditions in which a shared supplier is desirable.

■ SC79

79-Room 302, CC

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - Provalis Research – How to Analyze Big Text Data with Provalis Text Analytics Tools

Normand Peladeau, CEO, Provalis Research

Provalis Research will showcase its integrated collection of text analytics software. QDA Miner is an easy to use qualitative and mixed methods software that meets the needs of researchers performing qualitative data analysis and would like to code more quickly and more consistently larger amounts of documents. It offers high level computer assistance for qualitative coding with innovative text search tools that help users speed up the coding process as well as advanced statistical and visualization tools. Users with even bigger text data, can also take advantage of WordStat. This add-on module to QDA Miner can be used to analyze huge amounts of unstructured information, quickly extract themes, find trends over time, and automatically identify patterns and references to specific concepts using categorization dictionaries.

2 - SAS Education Practice – Introduction to SAS Data Mining

Tom Bohannon, Analytical Consultant, SAS,
tom.bahannon@sas.com, F. Michael Sped, PhD,
Analytical Consultant, SAS, mike.speed@sas.com

This introduction covers the basic skills required to assemble analysis flow diagrams using the rich tool set of SAS Text Mining. Also, participants will be shown how unstructured data can be converted into numeric data that can be utilized for pattern discovery and predictive modeling. Simple example will be used to illustrate the basic concepts of text mining.

Sunday, 4:30pm - 6:00pm

■ SD01

01-Room 301, Marriott

Military O.R. and Applications II

Sponsor: Military Applications

Sponsored Session

Chair: Michael Hirsch, ISEA TEK, 620 N. Wymore Rd., Ste. 260,
Maitland, FL, 32751, United States of America, mhirsch@iseatek.com

1 - Efficient Information Distribution in the Presence of Unknown Cognitive Capacity in HRI

Siddhartha Mehta, Research Assistant Scientist, University of
Florida, 1350 N. Poquito Rd., Shalimar, FL, 32579, United States
of America, siddhart@ufl.edu, Monali Malvankar,
Eduardo Pasillao

In military applications, unmanned aerial vehicles (UAVs) remotely operated by a ground crew may require significant human interaction. UAVs share information with human operators to perform geographically-dispersed priority-based tasks within a specified time. Asymmetric information including cognitive capacity and efficacy exists within the groups of operators. We develop a model incorporating asymmetric information to optimally share information by maximizing efficiency of the entire system.

2 - Robust and Adaptive Optimization Applied to Operator Task Scheduling

Luca Bertuccelli, UTRC, 411 Silver Lane, East Hartford, 06107,
United States of America, bertudlf@utrc.utc.com,
Taimoor Khawaja, Cali Fidopiastis

This work is concerned with human-in-the-loop decision making when the human is interacting with robust scheduling systems. We provide a comprehensive literature review of the area of robust optimization as applied to human-in-the-loop scheduling. We then demonstrate the impact of uncertainty in scheduling problems solved in both a "one-shot" optimization and a receding horizon framework with a simulated user-in-the-loop.

3 - A Bayesian Framework for Integrating Human and Machine Perceptions

Emily Doucette, Air Force Research Laboratory,
101 W. Eglin Blvd., Eglin AFB, United States of America,
emily.doucette@us.af.mil

Current methods for human-autonomy interaction are largely implemented through rigid schemes that transfer control between humans and autonomy. The authors propose a generalizable framework utilizing Bayesian estimation and decision theory that incorporates the concepts confidence and consequence in all agents in a human-autonomous system to yield a decision structure for heterogeneous teams, where a human supervisor is aided by a risk-based representation of the target state estimate.

4 - A Framework Supporting the Separation of Cognitive Performance from Execution Environment

Katie McConky, Assistant Professor, Rochester Institute of
Technology, 81 Lomb Memorial Dr, Rochester, NY, 14623,
United States of America, ktmeie@rit.edu, Moises Sudit,
Hector Ortiz-pena

This project aims to enhance a decision maker's mission planning capabilities by providing decision aids that predict anticipated human performance based on civil, environmental and physical conditions. A framework is presented that isolates human performance factors from environmental and situational mission characteristics that facilitates the ability to estimate the capability of units to accomplish tasks to expected standards under specified conditions.

■ SD02

02-Room 302, Marriott

OR and Homeland Security 1: Data Driven Decisions

Cluster: Homeland Security

Invited Session

Chair: Paul Kantor, Prof, Rutgers, 96 Frelinghuysen Dr, Piscataway, NJ, United States of America, paul.kantor@rutgers.edu

1 - Detecting and Locating GPS Jamming

Jeff Coffed, Senior Marketing Manager, Exelis Inc., 400 Initiative Drive, Rochester, NY, 14606, United States of America, Jeffrey.Coffed@exelisinc.com, Joe Rolli

GPS has become a ubiquitous service supporting critical infrastructure. Its signal is susceptible to service blockages due to jamming. Recognizing this threat, Exelis set out to develop technology that identifies and locates jamming sources. The system can be located around high-risk areas to instantaneously sense and locate jamming sources. Users will receive pin-point geolocation information in order to respond. We will share information about the threat, the technology and test results.

2 - Walk through Metal Detectors at Sports Stadiums

Christie Nelson, Postdoctoral Associate, CCICADA, Rutgers University, 96 Frelinghuysen Rd, 4th Floor, CoRE Building, Piscataway, NJ, United States of America, Christie.L.Nelson.PHD@gmail.com, Paul Kantor, Fred Roberts, Dennis Egan, Brian Ricks, Michael Tobia, Brian Nakamura, Ryan Whytlaw, Michael Young

Experimental designs are presented for walk through metal detectors (WTMDs) in stadium settings. Experiments were created to understand how WTMDs perform in real settings, typically outdoors, as opposed to idealized indoor lab scenarios. Experiments were then carried out at sports stadiums. Because of the large number of experimental factors involved, a combinatorial experimental design approach was taken.

3 - A Differential Privacy Mechanism for Graph Problems Protecting Confidential Network Data

William Pottenger, Rutgers University, 96 Frelinghuysen Road, CoRE Building, Piscataway, NJ, 08854, United States of America, billp@dimacs.rutgers.edu, Kunikazu Yoda

Graph problems are important for homeland security since most critical infrastructure such as a power grid can be modeled by a graph. Such network data often contains highly sensitive information and a publicly released summary must not give hints to terrorists who might exploit the data in developing targets. We present a differential privacy mechanism for graph problems whose solutions reveal useful global information while not revealing significant confidential individual information.

4 - Fusion Learning by Individual-to-Clique (FLIC): Efficient Approach to Enhancing Individual Inference

Minge Xie, Professor, Rutgers University, 501 Hill Center, Piscataway, United States of America, mxie@stat.rutgers.edu

Learning from multiple studies can often be fused together to yield a more effective inference. We present a new approach, named "Fusion Learning by Individual-to-Clique (FLIC)", to enhancing inference of an individual study through adaptive combination of confidence distributions obtained from its clique (namely similar studies). Drawing inference from the clique allows borrowing strength from similar studies to enhance the inference. It can also substantially reduce computational expense.

5 - The Unaccompanied Alien Children Challenge: Applying Queuing Theory to Improve Logistics in Immigration

Javier Rubio-Herrero, Rutgers University, Piscataway, NJ, United States of America, javier.rubioherrero@rutgers.edu

The recent wave of unaccompanied alien children that crossed the border of the United States posed a very important logistic challenge for the US DHS and US DHHS. In this presentation, Queuing Theory is presented as an option to forecast the performance of facilities aimed at carrying pre-screenings of these immigrants before their final placement in shelters. We present a mathematically tractable queuing model, illustrate its capabilities, and discuss opportunities that this approach offers.

■ SD03

03-Room 303, Marriott

Application of Scheduling Theory

Cluster: Scheduling and Project Management

Invited Session

Chair: Zhixin Liu, University of Michigan-Dearborn, 19000 Hubbard Drive, Dearborn, MI, United States of America, zhixin@umich.edu

1 - Optimization Based Production Scheduling with Batching

Lixin Tang, Professor, Northeastern University, Institute of Industrial Engineering and, Logistics Optimization, Shenyang, 110819, China, lixintang@mail.neu.edu.cn

We discuss the production scheduling problems with batching decision arising from steel, petrochemical and non-ferrous metal industry. For general problems, complexity and optimal solution properties are analyzed; polynomial time algorithm for solvable cases, and approximation algorithm with theoretical analysis for NP-hard problems are proposed. For complicated problems, row-column generation algorithm, LR&CG based dual algorithm, and improved Benders decomposition algorithm are proposed.

2 - An Optimization Model for Loan Collection

Ping He, Zhejiang University, 866 Yuhangtang Rd, Hangzhou, China, phe@zju.edu.cn, Zhongsheng Hua, Zhixin Liu

This paper studies how to make efficient collection decisions over consumer term-loan accounts. Since a loan's onset, an account experiences state transition across ages. We model the state transition of loan accounts using a Markov transition matrix, and provide optimization method to determine the collection action at each state and age for each consumer type that maximizes the lender's expected value. Managerial insights and general rules for consumer loan collection are recommended.

3 - Two-Agent Scheduling on a Single P-Batching Machine with Equal Processing Time and Non-Identical Job

Jun-Qiang Wang, Professor, Northwestern Polytechnical University, Box 554, No. 127 West Youyi Road, Department of Industrial Engineering, Xi'an, 710072, China, wangjq@nwpu.edu.cn, Cheng-wu Zhang, Yingqian Zhang, Guo-qiang Fan, Joseph Leung

We schedule two agents on a single parallel-batching machine. For the linear weighted sum model, we presented an approximation algorithm and analyze the absolute/asymptotic worst-case ratio. For the restriction model, no approximation algorithm with a finite bound exists, unless $P = NP$. We propose two polynomial-time heuristic algorithms using two restriction-solving strategies. For the non-domination model, we define a boundary of Pareto-optimal set. The proposed heuristics outperform NSGA-II.

4 - Vessel and Containing Planning in Feeder Lines

Yu Wang, PhD Candidate, Dept. of IELM, HKUST, Rm 5567, Academic Building, Clear Water Bay, Kowloon, 999077, Hong Kong - PRC, ywangbi@connect.ust.hk, Xiangtong Qi

We consider the vessel and container planning problem in feeder lines. A feeder vessel sequentially visits n ports, collecting containers from each port and transporting to hub port. The route of the vessel is pre-defined. The optimal serving policy for the vessel to load and unload under stochastic demand is investigated. The process is described as a Markov decision process, which aims to maximize the expected revenue. Furthermore, the optimal loading and unloading policy is derived.

■ SD04

04-Room 304, Marriott

Special Panel on 20th Year Anniversary of WOMRS: Strategies for Advancing Women in OR/MS

Sponsor: Women in OR/MS

Sponsored Session

Chair: Guzin Bayraksan, Associate Professor, The Ohio State University, Integrated Systems Engineering, Columbus, OH, 43209, United States of America, bayraksan.1@osu.edu

1 - Special Panel on 20th Year Anniversary of WOMRS: Strategies for Advancing Women in OR/MS

Moderator: Guzin Bayraksan, Associate Professor, The Ohio State University, Integrated Systems Engineering, Columbus, OH, 43209, United States of America, bayraksan.1@osu.edu, Panelists: Laura Mclay, Margarit Khachatryan, Paula Lipka, Candace Yano

This special panel will look back at the 20 years of Women in OR/MS. Then, it will focus on strategies for advancing women in OR/MS. Topics include how to recruit and retain women students and faculty in Operations Research and Management Science, academic and industrial leadership.

■ SD05

05-Room 305, Marriott

Tutorial: Collecting and Analyzing Twitter Data with Python

Cluster: Social Media Analytics

Invited Session

Chair: Chris Marks, MIT, 50 Memorial Drive, Cambridge, MA, 02139, United States of America, cemarks@mit.edu

1 - Tutorial: Collecting and Analyzing Twitter Data with Python

Chris Marks, MIT, 50 Memorial Drive, Cambridge, MA, 02139, United States of America, cemarks@mit.edu, Tauhid Zaman

We present a few methodologies and working libraries in Python that enable an analyst to retrieve information through the Twitter API and provide quick-turn exploratory analyses. These analyses include spatial analyses of data with geo-location, network analyses, and analyses of the timeline and scale of information cascades.

■ SD06

06-Room 306, Marriott

Asset Returns and Portfolio Management

Sponsor: Financial Services

Sponsored Session

Chair: Xianhua Peng, Assistant Professor, Hong Kong University of Science and Technology, Department of Mathematics, Hong Kong, Hong Kong - PRC, maxhpeng@ust.hk

1 - Three Fund Portfolio Rules and the Mean-variance-skewness Frontier

Luis Chavez-bedoya, Professor, ESAN University, Alonso de Molina 1652, Surco, Lima, Lima 33, Peru, lchavezbedoya@esan.edu.pe, John Birge

Assuming that asset returns follow a generalized hyperbolic (GH) distribution, we study the optimal solution of a particular portfolio optimization problem and relate it to common three-fund rules and to the mean-variance-skewness frontier of Mencia and Sentana (2009). Finally, we describe the optimal portfolio in terms of the location, dispersion and skewness parameters of the GH distribution.

2 - Jumps in Equity Returns Before and During the Recent Financial Crisis: A Bayesian Analysis

Haowen Zhong, Department of Industrial Engineering and Operations Research, Columbia University, 500 West 120th Street, New York, United States of America, hz2193@columbia.edu, Cindy Yu, Steven Kou

We attempt to answer two questions in this talk. (i) How did jumps in equity returns change after the 2008-2009 financial crisis? (ii) Can the performance of affine jump-diffusion models be improved if jump sizes are with tails heavier than those of the normal distribution?

3 - Separating Skilled and Unskilled Fund Managers by Contract Design

Sang Hu, Risk Management Institute, National University of Singapore, 21 Heng Mui Keng Terrace, Icub Building #04-03, Singapore, rmihsa@nus.edu.sg, Steven Kou, Xuedong He

Foster and Young (2010) shows that it is very difficult to design performance fee contracts that reward skilled fund managers while screening out unskilled fund managers. We show that (1) if there is a liquidation boundary, meaning that the fund investors liquidate their stake as soon as the fund returns hit the boundary, and (2) the fund manager has to use his/her own money to set up a deposit to offset the potential losses from investors, then skilled and unskilled managers can be separated.

4 - Optimal Exit Time from Casino Gambling: Why a Lucky Coin and a Good Memory Matter

Xuedong He, Assistant Professor, Department of Industrial Engineering and Operations Research, Columbia University, xh2140@columbia.edu, Xunyu Zhou, Sang Hu, Jan Obloj

We consider a dynamic casino gambling model and study the optimal strategy of a gambler with cumulative prospect theory (CPT) preferences. We develop a systematic and analytical approach to finding the gambler's optimal strategy, illustrate how Markovian strategies can be strictly improved by reviewing the betting history or by tossing an independent coin, and explain that the improvement generated by using randomized strategies results from the lack of quasi-convexity of CPT preferences.

■ SD07

07-Room 307, Marriott

Systemic Risk in Financial Networks

Cluster: Risk Management

Invited Session

Chair: Luitgard Veraart, Associate Professor, London School of Economics and Political Science, Houghton Street, London, WC2A 2AE, United Kingdom, L.Veraart@lse.ac.uk

1 - Control of Interbank Contagion under Partial Information

Andreea Minca, Cornell University, Ithaca, United States of America, acm299@cornell.edu

We consider a core-periphery financial network in which links lead to the creation of projects in the outside economy but make banks prone to contagion risk. The controller seeks to maximize the value of the financial system under partial information. Our results show that the value of the system depends on the connectivity in a non-monotonous way. It may be optimal to increase the rate of intervention in the peripheral banks rather than in core banks.

2 - The Joint Impact of Bankruptcy Costs, Fire Sales and Cross-holdings on Systemic Risk

Kerstin Awiszus, Leibniz Universität Hannover, Welfengarten 1, Hannover, 30167, Germany, awiszus@stochastik.uni-hannover.de, Stefan Weber

The paper presents a comprehensive model of a banking system that integrates network effects, bankruptcy costs, fire sales and cross-holdings. For the integrated financial market we prove the existence of a price-payment equilibrium and design an algorithm for the computation of the greatest and the least equilibrium. The number of defaults corresponding to the greatest price-payment equilibrium is analyzed in several comparative case studies.

3 - Systemic Risk Measures

Zachary Feinstein, Assistant Professor, Washington University in St. Louis, 1 Brookings Drive, CB 1042, St. Louis, MO, 63130, United States of America, zfeinstein@wustl.edu, Birgit Rudloff, Stefan Weber

We propose a framework for measuring systemic risk in terms of capital endowments of the financial firms. Their construction requires two ingredients: a cash flow or value model that assigns to the capital allocations of the entities in the system a relevant stochastic outcome, and an acceptability criterion, i.e. those outcomes that are acceptable from the point of view of a regulatory authority. Systemic risk is measured by the set of allocations of capital that lead to acceptable outcomes.

4 - A Bayesian Methodology for Systemic Risk Assessment in Financial Networks

Luitgard Veraart, Associate Professor, London School of Economics and Political Science, Houghton Street, London, WC2A 2AE, United Kingdom, L.Veraart@lse.ac.uk, Axel Gandy

We study the interbank market as a network in which the nodes represent banks and the directed edges represent interbank liabilities. In practice, the network of interbank liabilities is not fully observable. We present a Bayesian methodology to deal with this lack of information when performing stress tests on such interbank networks.

■ SD08

08-Room 308, Marriott

Surveillance

Sponsor: Telecommunications

Sponsored Session

Chair: Fabio D'Andreagiovanni, Senior Researcher, Konrad-Zuse-Zentrum für Informationstechnik, Takustr. 7, Berlin, Germany, d.andreagiovanni@zib.de

1 - An Efficient Branch-column-cut Algorithm for Capacitated Survivable Network Design

Richard Chen, Principal Member Of Technical Staff, Sandia National Laboratories, 7011 East Ave, Livermore, CA, 94550, United States of America, rlchen@sandia.gov, Cynthia Phillips

We consider a capacitated survivable network design problem that requires a feasible multicommodity flow to exist after any k edge failures. Existing approaches generate violated inequalities based on static failure scenarios. We present new valid inequalities that dynamically cover all failure scenarios pertaining to a given vulnerability. We then present a branch-column-cut algorithm and empirical studies on SNDlib and random instances to demonstrate the effectiveness of our approach.

2 - A Satellite Detection and Ranging System

Yupo Chan, University of Arkansas at Little Rock, 2801 S University Ave., Little Rock, AR, 72204-1099, United States of America, yxchan@ualr.edu, A. S. M. Sarwar Zahan, Po-hao Adam Huang, Edmond Wilson

A satellite detection and ranging system is proposed to track CubeSats for close-up operations. Two existing, promising signal-processing/image-processing algorithms have been identified. The first is for tracking satellites flying in formation. The second algorithm is used for tracking satellites for close-up operations such as inspection or docking, or simply being out of control. These two algorithms are modified and improved for deployment in the austere environment of outer space.

3 - A Network Server Assignment Problem under Attacks

Abdullah Konak, Professor, Penn State Berks, Tulpehocken Road, P.O. Box 7009, Reading, PA, 19610, United States of America, konak@psu.edu, Larry Snyder, Sadan Kulturel-Konak

We present the problem of server assignment in telecommunications networks to maximize the availability of critical network services under the presence of deliberate attacks. The problem is formulated as a bi-level optimization problem with two decision makers, the network designer and the attacker, on unreliable networks. A game theory-based genetic algorithm is proposed to solve the problem, and the convergence property of the proposed algorithm is discussed.

4 - A Biased Random-Key Genetic Algorithm for the Capacitated Minimum Spanning Tree Problem

Mauricio Resende, Principal Research Scientist, Amazon.com, 333 Boren Ave N, Seattle, Wa, 98109, United States of America, resendem@amazon.com, Efrain Ruiz, Maria Albareda, Elena Fernández

We describe a biased random-key genetic algorithm (BRKGA) for the capacitated minimum spanning tree (CMST) problem. We explore several solution encodings as well as different strategies for some steps of the algorithm. Computational experiments are presented showing the effectiveness of the approach: Seven new best-known solutions are presented for the set of benchmark instances used in the experiments. This paper was published in *Computers & Operations Research*, vol. 57, pp. 95-108, 2015.

distributed unevenly across the industry, with lower-end hotels and hotels not catering to business travelers being the most affected.

2 - Endogenous Slant and Revision in Online Production: The Case of Wikipedia

Feng Zhu, Harvard University, Harvard Business School, Soldiers Field, Morgan Hall 431, Boston, MA, 02163, United States of America, fzh@hbs.edu, Yuan Gu, Shane Greenstein

The diffusion of the Internet and digital media has increased the number of opportunities for individuals to collaborate with each other. One feature of this production model is that participants self-select into the production process. In this paper, we examine the potential ideological segregation in the crowd-sourced production model using data from Wikipedia. Our finding suggests that contributors with different ideologies engage in active dialogues with each other through their edits.

3 - Shopping in the Multi-screen World: How the Browsing Device Matters in Online Shopping

Quan Wang, PhD Student, Carnegie Mellon University, 4716 Ellsworth Ave, Apt. 514, Pittsburgh, PA, 15213, United States of America, quanw@andrew.cmu.edu, Beibei Li, Kaiquan Xu

Nowadays people are living in a multi-screen world where they move between devices such as smartphone, tablet, and PC on a regular basis. Understanding the multi-screen behavior becomes imperative for business practitioners as well as researchers. Using a unique data set with device specific clickstream information from Alibaba, we show how the browsing channels and the sequence of browsing pages reflect a consumer's goals, which would be helpful in predicting purchase conversion.

4 - All World's a Home – Analyzing the Hotel Industry's Response to Airbnb

Uttara Ananthakrishnan, umadurai@andrew.cmu.edu, Beibei Li, Michael D Smith

Sharing economy has empowered consumers to communicate their needs with one another and thus has helped them to assume the role of both suppliers and producers seamlessly. In this paper, using a natural experiment set up and a novel dataset, we analyze how Airbnb has impacted the traditional way of conducting the hotel business. We study if the hotels have responded to the increasing Airbnbs by increasing their quality and whether this response varies across different types of hotels.

SD09

09-Room 309, Marriott

Joint Session TIME/NPD: Meet The Editors

Sponsor: Technology, Innovation Management, Entrepreneurship & NPD
Sponsored Session

Chair: Gulru Ozkan-Seely, Georgia Institute of Technology, 800 W Peachtree St NW, Atlanta, GA, United States of America, gulru.ozkan@scheller.gatech.edu

Co-Chair: Sanjiv Erat, UCSD, Gilman Drive, La Jolla, CA, United States of America, serat@ucsd.edu

Co-Chair: Jurgen Mihm, INSEAD, France, jurgen.mihm@insead.edu

1 - Meet the Editors

Sanjiv Erat, UCSD, Gilman Drive, La Jolla, CA, United States of America, serat@ucsd.edu

This interactive session aims at assisting readers and researchers in staying informed on the most important topics and the latest development in Technology, Innovation Management, Entrepreneurship and New Product Development.

SD10

10-Room 310, Marriott

Digital Platform and New Economy

Sponsor: E-Business
Sponsored Session

Chair: Beibei Li, Assistant Professor, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, beibeili@andrew.cmu.edu

1 - The Rise of the Sharing Economy: Estimating the Impact of Airbnb on the Hotel Industry

Giorgos Zervas, Boston University, zg@bu.edu, Davide Proserpio, John Byers

To what extent are Airbnb stays serving as substitutes for hotel stays, and what is the impact on the bottom line of affected hotels? We find that a 1% increase in Airbnb listings in Texas results in a 0.05% decrease in quarterly hotel revenues, an estimate compounded by Airbnb's rapid growth. We find that the impacts are

SD11

11-Franklin 1, Marriott

Recent Theoretical and Computational Advances in Mixed Integer Programming

Sponsor: Optimization/Integer and Discrete Optimization
Sponsored Session

Chair: Manish Bansal, Postdoctoral Fellow, Department of Industrial Engineering and Management Science, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, manish.bansal@northwestern.edu

1 - Feasible Versus Infeasible Intersection Points for Cut Generation

Aleksandr Kazachkov, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, akazachk@cmu.edu, Francois Margot, Egon Balas

Generalized intersection cuts offer a non-recursive paradigm for cut generation in mixed-integer linear programs using a linear program formulated from a set of intersection points. Based on computational investigations, we identify characteristics of intersection points that lead to strong cuts.

2 - Generation of Feasible Integer Solutions on a Massively Parallel Computer

Utku Koc, Assistant Prof, MEF University, Ayazaga cad no:4, Maslak Sariyer, Istanbul, Turkey, utku.koc@mef.edu.tr, Sanjay Mehrotra

We present the results of an empirical study on heuristically generating feasible solutions for unstructured mixed integer linear programs in a parallel distributed memory high performance computing environment. The starting solutions of parallel subroutines are generated by rounding the most fractional k variables of an optimal solution of the relaxation. Extensive computational results up to 512 processors suggests that the improvement due to parallelization is statistically significant.

3 - Parallel Algorithms for MIP Feasibility

Lluís Miquel Munguía, Georgia Institute of Technology, 266 Ferst Drive, Room 1343, Atlanta, GA, 30332, United States of America, lluis.munguia@gatech.edu, Shabbir Ahmed, David A. Bader, George L. Nemhauser, Yufen Shao

We present highly parallelizable methods for obtaining feasible solutions to Mixed Integer Programming (MIP) instances. The use of several relaxations allows us to leverage parallelism to successfully obtain feasible solutions to large-scale instances. We give computational results that demonstrate the effectiveness of the parallel algorithms.

4 - Facets for Continuous Multi-mixing Set with General Coefficients and Bounded Integer Variables

Kiavash Kianfar, Associate Professor, Texas A&M University, TAMU 3131, College Station, TX, 77843-3131, United States of America, kianfar@tamu.edu, Manish Bansal

Bansal and Kianfar developed facet-defining inequalities for continuous multi-mixing set where the coefficients satisfy certain conditions. We first generalize their inequalities for the continuous multi-mixing set with general coefficients and show that they are facet-defining in many cases. Next, we introduce a family of valid inequalities for the continuous multi-mixing set with general coefficients and bounded integer variables, and investigate their facet-defining properties.

SD12

12-Franklin 2, Marriott

Strong Relaxations and Computations for Mixed Integer Nonlinear Programs

Sponsor: Optimization/Mixed Integer Nonlinear Optimization and Global Optimization

Sponsored Session

Chair: Jeff Linderoth, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706-1572, United States of America, linderoth@wisc.edu

1 - Convex Hull of Two Quadratic or a Conic Quadratic and a Quadratic Inequality

Sina Modaresi, Discover/University of Pittsburgh, 2402 W Beardsley Road, Phoenix, AZ, United States of America, sim23@pitt.edu, Juan Pablo Vielma

We consider an aggregation technique introduced by Yildiran [2009] to study the convex hull of regions defined by two quadratic or by a conic quadratic and a quadratic inequality. We show how this technique can be used to yield valid conic quadratic inequalities for the convex hull of sets defined by two quadratic or by a conic quadratic and a quadratic inequality. We also show that in many cases, these valid inequalities characterize the convex hull exactly.

2 - Relaxations and Heuristics for the General Multiple Nonlinear Knapsack Problem

Luca Mencarelli, CNRS LIX, Ecole Polytechnique, Palaiseau, 91120, France, mencarelli@lix.polytechnique.fr, Claudia D'ambrosio, Silvano Martello

We consider the multiple mixed-integer nonlinear knapsack problem. These problems are very difficult to solve, both from a theoretical and a practical viewpoint. We analyze different relaxations and extend known theoretical results for the multiple linear knapsack problem. Moreover, we propose fast constructive heuristic algorithms and a local search procedure.

3 - Recent Advances in CPLEX for Mixed Integer Nonlinear Optimization

Pierre Bonami, IBM, Santa Hortensia 26, Madrid, Spain, pierre.bonami@es.ibm.com, Andrea Tramontani

We present some of the new algorithmic techniques that have been recently added to the IBM CPLEX solver to address nonlinear optimization models. We focus in particular on mixed integer second order cone programming and quadratic optimization. We present extensive computational analysis to assess the performance gain from these techniques.

4 - Strong Convex Nonlinear Relaxations of the Pooling Problem

Jeff Linderoth, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706-1572, United States of America, linderoth@wisc.edu, Jim Luedtke, Claudia D'ambrosio

We investigate convex relaxations for the pooling problem. We characterize the extreme points of the convex hull of our non-convex set, and we derive valid nonlinear convex inequalities. Computational results demonstrate that the inequalities can significantly strengthen the convex relaxation of even the most sophisticated formulations of the pooling problem.

SD13

13-Franklin 3, Marriott

Uncertainty in Energy and Natural Resource Systems

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Alexandra Newman, Professor, Colorado School of Mines, Mechanical Engineering, Golden, CO, 80401, United States of America, anewman@mines.edu

1 - Complementarity Effects Between Wind and Hydro in the Context of Power Generation Scheduling

Anderson Rodrigo De Queiroz, Assistant Professor, Federal University of Itajubá, 1303 BPS Avenue, Itajubá, MG, 37500000, Brazil, ar_queiroz@yahoo.com.br, Saulo Ribeiro Silva, Luana Marangon Lima

We present a computational model able to determine the optimal economic generation scheduling in a system with hydro, thermal and wind power plants. Our model takes into account the stochastic nature of wind speed and its complementarity with water inflows. We use sampling-based decomposition algorithms to solve such model and present results for a case study. Our analysis suggests that complementarity is relevant and should be taken into consideration during the scheduling of generators.

2 - Global Thermal Coal Optimization under Uncertainty

Ashley Arigoni, PhD Candidate, Colorado School of Mines, 1500 Illinois St, Golden, CO, 80401, United States of America, aarigoni@mymail.mines.edu

Our objective is to minimize the cost to ship thermal coal to global fill demand while respecting import and export port capacities, ship size constraints, and coal specification requirements under spot market price uncertainty. Coal blending is allowed at demand nodes to meet coal specification requirements. We develop a two-stage stochastic model in which forward purchases are made before spot market uncertainties are realized.

3 - Mitigating Uncertainties with Stochastic Decomposition: Applications in Operations Management.

Yifan Liu, University of Southern California, 3715 McClintock Ave, GER 240, Los Angeles, CA, 90089, United States of America, yifanl@usc.edu, Suvrajeet Sen

Uncertainties are common in operation and production management. In this talk, we will discuss applying stochastic decomposition for solving a wide range of operations management applications including single period multi-products inventory problem, multi-location transshipment problem and process flexibility design problem. The first two problems are modeled as two-stage stochastic linear programs while the last one contains first stage binary variables.

4 - Quantifying Uncertainty in an Optimization Model using Exponential EPI-spline Density Estimation

Michael Teter, Ltc, Colorado School of Mines, Golden, CO, 80401, United States of America, mteter@mymail.mines.edu

Using a capital budgeting optimization model, we explore fusing hard and soft information through constrained nonparametric density estimation in order to quantify the uncertainty of the future. A comparison of solutions from data sets derived from traditional distributions and those derived from epi-splines demonstrate the benefits of nonparametric density estimation. These solutions prescribe a set of technologies in which the U.S. Army should invest to maximize effectiveness.

SD14

14-Franklin 4, Marriott

Topics in Dynamic Programming

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Francesca Maggioni, Assistant Professor, University of Bergamo, Via dei Caniana n 2, Bergamo, 24127, Italy, francesca.maggioni@unibg.it

1 - ADP for Risk-Averse Markov Decision Processes using Dynamic Quantile-Based Risk Measures

Daniel Jiang, Princeton University, Sherrerd Hall, Charlton Street, Princeton, NJ, 08540, United States of America, drjiang@princeton.edu, Warren Powell

We consider Markov decision process (MDP) for which the objective is to minimize a quantile-based risk measure of the sequence of future costs. In particular, we consider dynamic risk measures constructed using the one-step quantile (VaR) and the one-step conditional value at risk (CVaR). We propose simulation-based approximate dynamic programming (ADP) algorithms, modeled after Q-learning, and apply the algorithms in the context of an application in the energy market.

2 - Generalized Sequential Assignment Problem

Arash Khatibi, University of Illinois, 201 North Goodwin Avenue, Urbana, IL, United States of America, khatibi2@illinois.edu, Sheldon Jacobson

The Sequential Stochastic Assignment Problem (SSAP) assigns sequentially arriving tasks with stochastic parameters to workers with fixed success rates so as to maximize the total expected reward. This paper uses the Secretary Problem to propose assignment policies for the SSAP, when there is no prior information on task values. This paper also discusses the Doubly Stochastic Sequential Assignment Problem (DSSAP), which is an extension of SSAP with the workers' success rates assumed to be random.

3 - Stochastic Versus Dynamic Programming for a Transportation Procurement Problem

Francesca Maggioni, Assistant Professor, University of Bergamo, Via dei Caniana n 2, Bergamo, 24127, Italy, francesca.maggioni@unibg.it, Luca Bertazzi

We consider the problem of a producer which has to ship a load to a customer at discrete times and fixed horizon. Different companies offer a transportation price with realization available at the end of the time period. A penalty is paid for the quantity that remains to be sent. We consider two variants of the problem: the minimum expected cost and the min-max total cost. We compare the performance of stochastic and dynamic programming approaches. Theoretical worst-case results are provided.

4 - Data-driven Schemes for Resolving Misspecified MDPs: Asymptotics and Error Analysis

Hao Jiang, UIUC, 104 S. Mathews Ave., Urbana, IL, United States of America, jiang23@illinois.edu, Uday Shanbhag

We consider the solution of a finite-state infinite horizon Markov Decision Process (MDP) in which both the transition matrix and the cost function are misspecified, the latter in a parametric sense. Learning-enhanced value and policy iteration schemes are proposed and shown to be convergent almost surely. Finally, we present a constant steplength misspecified Q-learning scheme and provide an error analysis.

SD15

15-Franklin 5, Marriott

Nonlinear Optimization Algorithms

Sponsor: Optimization/Nonlinear Programming

Sponsored Session

Chair: Frank E. Curtis, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, frank.e.curtis@gmail.com

1 - A Stochastic Programming Model for Nurse Staffing in Post-Anesthesia Recovery Units

Yueling Loh, Johns Hopkins University, 3400 North Charles Street, Baltimore, MD, 21218, United States of America, yueling.loh@gmail.com, Sauleh Siddiqui, Daniel Robinson

We present a stochastic programming model to determine nurse staffing requirements in Post-Anesthesia Recovery Units under high variability in patient flow and length-of-stay. We will formulate the problem as a two-stage stochastic mixed integer program and provide some numerical results.

2 - Distributed Parallel Coordinate Descent Methods for Sparse Inverse Covariance Problem

Seyedalireza Yektamaram, Lehigh University, Mohler Laboratory, 200 West Packer Ave, Bethlehem, PA, 18015, United States of America, sey212@lehigh.edu, Katya Scheinberg

In graphical models, recovering the structure of underlying graph corresponding to conditional dependencies of random variables is of great importance, which is obtained by recovering the corresponding Sparse Inverse Covariance matrix. However, as the problem size grows larger, efficiency of most solution approaches reduce significantly, thus using distributed parallel techniques becomes essential. Here we explore distributed parallel coordinate descent methods to solve this problem efficiently.

3 - A Nonconvex Nonsmooth Optimization Algorithm with Global Convergence Guarantees

Frank E. Curtis, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, frank.e.curtis@gmail.com, Xiaocun Que

An algorithm for minimizing nonconvex nonsmooth objective functions is presented. The algorithm is based on a BFGS strategy, enhanced with gradient sampling mechanisms to ensure convergence to a stationary point with probability one. An open source C++ implementation of the algorithm is also described along with results for a set of test problems.

SD16

16-Franklin 6, Marriott

New Optimization Modeling and Effective Techniques

Sponsor: Optimization/Linear and Conic Optimization

Sponsored Session

Chair: Jiming Peng, Associate Professor, University of Houston, UH, Dept of Industrial engineering, Engineering Bldg 2 221A., Houston, TX, 77204, United States of America, jopeng@Central.UH.EDU

1 - Dropconnect in Deep Learning via Lagrangian

Diego Klabjan, Professor, d-klabjan@northwestern.edu, Mark Harmon

Dropconnect is a regularization technique for deep neural nets when random weights are enforced to be zero. We present a Lagrangian-based algorithm for restricting weight values.

2 - New Global Algorithm for Linearly Constrained Quadratic Programming

Jiming Peng, Associate Professor, University of Houston, UH, Dept of Industrial engineering, Engineering Bldg 2 221A., Houston, TX, 77204, United States of America, jopeng@Central.uh.edu

How to find the global optimal solution to LCQP has been a long-standing challenge in optimization. In this talk, we introduce a new design framework for LCQP that integrates several simple effective optimization techniques such as Lagrangian methods, Alternate update method, convex relaxation, initialization and partitioning. We establish the global convergence of the algorithm and estimate its complexity. Promising numerical results for large-scale LCQPs will be reported.

3 - An Optimization Perspective on Systemic Risk

Aein Khabazian, PhD Student/research Assistant, University of Houston, UH, Dept of Industrial engineering, Engineering Bldg 2, Houston, TX, 77204, United States of America, akhabazian@uh.edu, Jiming Peng, Aida Khayatian

We consider the issue of assessing the systemic risk under uncertainty in a financial system based on the model proposed by Eisenberg and Noe, in which the interbank liabilities are assumed to be known, and the non-interbank assets are assumed to be constant. However, in real world application this information is typically unknown or subject to market fluctuation. In this regard, we develop robust optimization and worst case optimization to account for the uncertainties in the constraints.

SD17

17-Franklin 7, Marriott

Transportation Network Modeling and Optimization

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Vladimir Stozhkov, University of Florida, 2330 SW Williston Rd Apt 2826, Gainesville, FL, 32608, United States of America, vstozhkov@ufl.edu

1 - A Distributed Hierarchical Shortest Path Algorithm for Large-Scale Transportation Networks

Ala Alnawaiseh, Postdoctoral Researcher, Southern Methodist University, 3101 Dyer St., #219, Dallas, TX, 75205, United States of America, aalnawai@smu.edu, Khaled Abdelghany, Hossein Hashemi

This paper presents a distributed hierarchical shortest path algorithm for large-scale transportation networks. The algorithm integrates a network augmentation as well as a divide-and-conquer techniques to solve the all-to-all shortest path problem in a distributed fashion. Preliminary results that illustrate the superiority of the algorithm are presented.

2 - How to Design an Effective Off-hour Delivery (OHD) Program: A Network Design Perspective

Sevgi Erdogan, Faculty Research Associate, University of Maryland-NCSG, 1112 J Preinkert Field House, College Park, MD, 20742, United States of America, serdogan@umd.edu, Jiangtao Liu, Wenbo Fan, Xuesong Zhou

The OHD has been considered as an effective policy to overcome the negative externalities like congestion due to freight traffic in urban areas during business hours. This study proposes a network design approach to determine links to be restricted for truck traffic to shift truck demand to off-hours and routes to less congested areas so that the maximum benefit from an OHD program can be achieved. The approach will guide cities in implementing effective OHD programs.

3 - Evacuation Modeling and Betweenness Centrality

Chrysafis Vogiatzis, Assistant Professor, North Dakota State University, 1410 14th Avenue North, Room 202 Civil & Industrial Engineering, Fargo, ND, 58102, United States of America, chvogiat@ufl.edu

Disaster management and evacuation modeling are vital for the welfare of modern urban societies. However, it is true that evacuating large urban areas is a very difficult problem due to the large scale of operations and the dynamic nature of most hazard phenomena. In this talk, we present two novel islanding techniques with the goal of decomposing large-scale network problems to smaller ones of manageable size. Computational results are also presented to show the success of our methodologies.

4 - Variable Versus Fixed Congestion Pricing under Day-to-Day Traffic Dynamics

Zhengtian Xu, University of Florida, 511 Weil Hall, Gainesville, FL, 32611, United States of America, zhengtianxu@ufl.edu, Yafeng Yin

This paper compares the effectiveness of fixed and variable congestion pricing on evolving network flows to a target flow distribution under day-to-day traffic dynamics. Fixed pricing charges constant tolls while variable pricing updates tolls every day based on recent days' traffic conditions. The paper proves that the latter does not necessarily perform better than the former and provides conditions when this situation arises. Numerical experiments are presented to demonstrate the comparison.

5 - Vulnerability Modeling and Analysis of Complementary Transportation Systems

Liu Hong, Associate Professor, Huazhong University of Science and Technology, Room W.308, South 1, 1037#, Luoyu Road,, Wuhan, China, liu.hong.science@gmail.com, Min Ouyang, Xiaozheng He

This paper proposes a network-based approach to model and analyze the vulnerability of complementary transportation systems, with main focus on quantifying their complementary strength, assessing dynamic vulnerability and discussing critical components. Two level complementary systems are used to illustrate the tractability and effectiveness of the proposed method, including railway and airline system in China (national level), metro and bus system in Wuhan city in China (Urban level).

SD18

18-Franklin 8, Marriott

Theory and Applications of Coordinate Descent and Alternating Direction Methods

Cluster: Modeling and Methodologies in Big Data
Invited Session

Chair: Brendan Ames, Assistant Professor, University of Alabama, Department of Mathematics, Box 870350, Tuscaloosa, AL, 35487, United States of America, bpames@ua.edu

1 - Block Coordinate Stochastic Gradient Method

Yangyang Xu, University of Minnesota, Institute of Math and Application, Minneapolis, MN, United States of America, xuyang.gucas@gmail.com, Wotao Yin

Stochastic gradient (SG) can quickly solve a problem with many components in the objective to a moderate accuracy, and block coordinate descent (BCD) method can quickly solve problems with multiple (blocks of) variables. In this talk, we will introduce a block stochastic gradient (BSG) method that combines SG and BCD for problems with many components in the objective and with multiple blocks of variables. We will show its convergence and demonstrate its superiority over SG and BCD.

2 - Proximal Methods for Sparse Discriminant Analysis

Brendan Ames, Assistant Professor, University of Alabama, Department of Mathematics, Box 870350, Tuscaloosa, AL, 35487, United States of America, bpames@ua.edu

We consider the problem of simultaneously performing classification and feature selection in the high-dimension, low sample size setting, where the number of features of our data is large while the number of samples is limited. In particular, we propose an alternating direction method for performing optimal scoring-based linear discriminant analysis with a sparseness criterion, where proximal gradient methods are used to update the decision variables in the alternating direction framework.

3 - Iteration Complexity Analysis of Block Coordinate Descent Methods

Mingyi Hong, Iowa State University, 3015 Black Engineering, Ames, IA, 50011, United States of America, mingyi@iastate.edu

We provide a unified iteration complexity analysis for a family of block coordinate descent methods. We unify these algorithms under the so-called Block Successive Upper-bound Minimization framework, and show that they achieve a global sublinear iteration complexity. Moreover, for the case of block coordinate minimization where each block is minimized exactly, we establish the sublinear convergence rate of $O(1/r)$ without per block strong convexity assumption.

4 - Self Equivalence of the Alternating Direction Method of Multipliers

Ming Yan, Assistant Professor, Michigan State University, 220 Trowbridge Rd, East Lansing, MI, 48824, United States of America, yanm@math.ucla.edu

In this talk, we show that ADM applied to a primal formulation is equivalent to ADM applied to its Lagrange dual; ADM is equivalent to a primal-dual algorithm applied to the saddle-point formulation of the same problem. In addition, when one of the two objective functions is quadratic, we show that swapping the update order of the two primal variables in ADM gives the same algorithm.

SD19

19-Franklin 9, Marriott

Computational Data Analytics

Sponsor: Computing Society
Sponsored Session

Chair: Dorit Hochbaum, University of California, IEOR, "Etcheverry Hall, Berkeley, CA, 94720, United States of America, dhochbaum@berkeley.edu

1 - Improved Algorithms Solving Generalizations of Isotonic Median Regression

Cheng Lyu, University of California, 4141 Etcheverry Hall, Berkeley, CA, 94720, United States of America, chenglu@berkeley.edu, Dorit Hochbaum

Isotonic median regression (IMR) problem is a well-known statistical nonparametric regression problem. We address here generalizations of IMR for which we devise efficient algorithms. Our algorithms improve on the best previously known complexity for the special case of IMR. Some applications of independent interest of the generalized problems include total variation on a path, signal processing, and nearly-isotonic regression.

2 - Big Data Aggregation and Truncation by Pseudo-boolean Polynomials

Boris Goldengorin, C. Paul Stocker Visiting Professor, Ohio University, 283 Stocker Center, Athens, OH, United States of America, goldengorin@gmail.com

In this talk we show how to aggregate and truncate the numerical data in huge m (rows) times n (columns) tables by means of ordering the entries within their columns in a non-decreasing (non-increasing) order. The ordered columns can be represented by the corresponding permutations and differences between the neighboring entries. Our computational study shows that for complete networks containing thousands of vertices we are able to reduce the number of entries by more than 90%.

3 - Adjacency-clustering for Yield Prediction in Integrated Circuit Manufacturing (ICM)

Dorit Hochbaum, University of California, IEOR, Etcheverry Hall, Berkeley, CA, 94720, United States of America, dhochbaum@berkeley.edu, Sheng Liu

Accurate yield prediction in ICM enables early detection of processing problems. It is noted that defects tend to be clustered and a circuit likely to be defective if its neighbors are defective. This Neighborhood Effect NE is not captured in traditional spatial modeling approaches. We model the yield prediction problem with NE as a Markov Random Field model (MRF). A comparison with leading approaches (GLM and GLMM) demonstrates that MRF provides superior accuracy and time complexity.

■ SD20

20-Franklin 10, Marriott

Queueing with Redundancy for Cloud Computing

Cluster: Cloud Computing

Invited Session

Chair: Mor Harchol-Balter, Professor, Carnegie Mellon University, Computer Science Dept., 5000 Forbes Ave., Pittsburgh, United States of America, harchol@cs.cmu.edu

1 - Exact Queueing Analysis of Redundancy-d Systems

Mor Harchol-Balter, Professor, Carnegie Mellon University, Computer Science Dept., 5000 Forbes Ave., Pittsburgh, United States of America, harchol@cs.cmu.edu, Kristen Gardner, Sam Zbarsky, Alan Scheller-wolf

Recent cloud research has proposed using redundant requests to reduce latency by copying a request to multiple servers and waiting for only one copy to complete. We study the Redundancy-d system, in which each arriving job sends copies to d randomly selected servers. We provide the limiting state distribution. We also derive the exact mean response time in this system for any number of servers and any degree of redundancy.

2 - Scaling Redundancy to Many-server Systems

Kristen Gardner, PhD Student, Carnegie Mellon University, Computer Science Dept., 5000 Forbes Ave., Pittsburgh, PA, 15213, ksgardne@cs.cmu.edu, Mor Harchol-Balter, Alan Scheller-wolf, Sam Zbarsky

This talk is a continuation of the previous talk on the Redundancy-d system. Here, we study the system in the limit as the number of servers approaches infinity. We derive the full response time distribution and use this result to discuss the effect of the number of copies per job on response time.

3 - Optimal Scheduling of Partially Replicated Jobs

Rhonda Righter, Professor, University of California, Berkeley, IEOR, UC, Berkeley, CA, 94720, United States of America, righter@berkeley.edu, Mor Harchol-Balter, Esa Hyytia

We consider systems in which there is a mix of tasks that can be replicated and tasks that cannot. We explore the effect of the amount of replication on latency, and find the optimal service discipline in the presence of partial replication.

4 - Analysis and Routing in Parallel Queues with Class-based Redundancy

Leela Nageswaran, PhD Candidate, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, United States of America, lnageswa@andrew.cmu.edu, Alan Scheller-wolf

We study the performance of two parallel queues when some customers are redundant: a redundant customer joins both queues and is considered served when any one of his requests finishes service, instantly removing the other one. We examine the policy other (non-redundant) customers use to join a queue upon arrival. We find that while joining the shortest queue does not always minimize delay if the entire state information is available, it is optimal if only the queue lengths are observable.

■ SD21

21-Franklin 11, Marriott

Natural History Modeling for Medical Decision Making

Sponsor: Health Applications

Sponsored Session

Chair: Julie Hagle, Professor And Chair, University of Southern California, Epstein Dept of Indus & Sys Eng, Los Angeles, CA, 90089, United States of America, hagle@usc.edu

1 - Developing and Validating Markov Decision Processes for Chronic Diseases

Brian Denton, Associate Professor, University of Michigan, 1205 Beal Ave, Ann Arbor, United States of America, btdenton@umich.edu

Chronic diseases are the leading cause of death in many countries including the United States. Building models for chronic diseases can be challenging because of the need to characterize severity of the disease, uncertainty in disease progression, and a potentially large number of strategies for screening and treatment. In this talk I will discuss my experiences in developing Markov decision processes (MDPs) for optimization of disease screening and treatment decisions in several contexts.

2 - Challenges and Opportunities for Developing Natural History Models

Oguzhan Alagoz, UW-Madison, 3242 Mechanical Engineering Building, 1513 University Avenue, Madison, WI, 53706, United States of America, alagoz@engr.wisc.edu

Natural history of a disease, which represents the onset and progression of a disease without an intervention, provides critical inputs for operations research models in health care. In this presentation, we will share our experiences in developing natural history models for various diseases including end-stage liver diseases and breast cancer.

3 - Robust Parameter Selection for Natural History Models

Julie Hagle, Professor And Chair, University of Southern California, Epstein Dept of Indus & Sys Eng, Los Angeles, CA, 90089, United States of America, hagle@usc.edu, Suvrajeet Sen

Natural history models are often used to facilitate an understanding of the potential impact of disease screening and/or treatment options. We consider a method for calibrating a natural history model that explicitly considers uncertainties in the calibration targets. The calibration model is designed to yield a robust parameter selection, especially with respect to medical decisions that result.

4 - Modeling Ductal Carcinoma in Situ (DCIS)

Shadi Hassan Goodarzi, PhD Student, North Carolina State University, Fitts Dept of ISE, Raleigh, No, 27695, United States of America, shassan3@ncsu.edu, Julie Ivy

Ductal Carcinoma In Situ (DCIS) is arguably a direct precursor of invasive breast cancer. Approximately 14–53% of DCIS turn into IBC, after long follow-up periods. So about 47%-86% of the DCIS cases are over diagnosed and as a result, treatment can only cause harm for these patients. This framework will allow us to study the progression of DCIS into IBC more clearly and as a result aid both patients and doctors in decision making.

■ SD23

23-Franklin 13, Marriott

Queues in Heavy-Traffic: Approximations and Control

Sponsor: Applied Probability

Sponsored Session

Chair: Yunan Liu, Assistant Professor, North Carolina State University, 111 Lampe Drive, #400, Raleigh, No, 27695, United States of America, yunan_liu@ncsu.edu

1 - A Many-Server Heavy-Traffic Limit for the Overloaded $G_t/GI/n+GI$ Queue

Ahmet Korhan Aras, North Carolina State University, 307 Daniels Hall, Raleigh, NC, United States of America, akaras@ncsu.edu, Yunan Liu, Xinyun Chen, Ward Whitt

We establish a many-server heavy-traffic FCLT for key performance processes such as potential waiting time, number of abandonment and queue length for the $G_t/GI/n+GI$ queue in the overloaded regime. We obtain a stochastic differential equation driven by a Gaussian process in the limit for the scaled waiting time process. The Gaussian limit and Gaussian integral appear in the limit of the departure process which is not a Brownian motion when the service distribution is not exponential.

2 - Diffusion Approximation for Efficiency-driven Queues: A Space-time Scaling Approach

Shuangchi He, National University of Singapore, National University of Singapore, Singapore, heshuangchi@nus.edu.sg

Using a scaling approach in both space and time, we obtain a diffusion model for the virtual waiting time process in a $GI/GI/n+GI$ queue in the ED regime. Besides the commonly used scaling in space by the number of servers, we also change the time scale by using the mean patience time as the factor. This approach leads to a simple one-dimensional diffusion limit, enabling us to obtain useful performance formulas such as the distributions of the steady-state virtual waiting time and queue length.

3 - Non-markovian State-dependent Networks in Critical Loading

Chihoon Lee, Stevens Institute of Technology, Howe School of Technology Management, Hoboken, NJ, United States of America, chihoon@stat.colostate.edu, Anatolii Puhalskii

We establish a heavy traffic limit theorem for the queue-length process in a critically loaded single class queueing network with state-dependent arrival and service rates. A distinguishing feature of our model is non-Markovian state dependence. The limit stochastic process is a continuous-path reflected process on the nonnegative orthant. We give an application to a generalised Jackson network with state-dependent rates.

4 - Gaussian Limits for Many-server Queues with Arrival Dependent Services

Guodong Pang, Assistant Professor, Penn State University,
363 Leonhard Bldg, University Park, PA, 16802,
United States of America, gup3@engr.psu.edu, Yuhang Zhou

We consider many-server queues whose service time distributions depend on the arrival times. We prove heavy traffic limits for the queue length processes in the many-server regimes. We obtain Gaussian approximations for the transient distributions of queue lengths in these systems.

■ SD24

24-Room 401, Marriott

Meet the Editors

Cluster: Globalization and International Activities

Invited Session

Chair: Grace Lin, Data Analytic Technology and Applications (DATA),
Data Analytic Technology and Applications (DATA), Taipei, Taiwan -
ROC, gracelin@iii.org.tw

1 - Introduction to Journal of Quality Technology (JQT)

Fugee Tsung, Prof., HKUST, Clear Water Bay, Kowloon,
Hong Kong - PRC, season@ust.hk

JQT is the flagship journal published by American Society for Quality (ASQ); JQT has been one of the most cited journals in the areas of industrial engineering, management science, and statistics.

2 - Introduction to Journal of Industrial and Production Engineering

Kuo-Hao Chang, National Tsing Hua University, Hsinchu, Taiwan,
China, chang@mx.nthu.edu.tw

Journal of Industrial and Production Engineering (JIPE) is an international, refereed journal devoted to the publication of high quality research contributions for the industrial engineering community. Its scope includes Operations Research and Soft Computing, Quality and Applied Statistics, Manufacturing Automation and e-Business, Human Factors and HCI, Information Technology and Management, Industrial Technology and Management, Product Lifecycle Management, Production and Operations Management.

3 - Some Facts about the European Journal of Operational Research (EJOR)

Roman Slowinski, Prof., Poznan University of Technology, Pl.
Marii Skłodowskiej-Curie 5, Poznan, PL, 60-965, Poland,
roman.slowinski@cs.put.poznan.pl

The Coordinating Editor of EJOR will give some characteristics of the journal, and will explain the editorial approach to evaluation and selection of articles. He will also point out topics of OR which recently raised the highest interest.

■ SD25

25-Room 402, Marriott

Online Search, Social Network and Advertisement

Sponsor: Information Systems

Sponsored Session

Chair: Harpreet Singh, University of Texas at Dallas, 800 West Campbell Road, Richardson, United States of America, Harpreet@utdallas.edu

1 - Distances and Brands: An Empirical Analysis of Mobile Local Search

Yi-jen Ho, PhD Candidate, University of California, Irvine,
Merage School of Business, Irvine, CA, 92617, United States of
America, hoy1@uci.edu, Sanjeev Dewan

In this paper, we study mobile local search, focusing on user click-through behavior as a function of distance, search rank and brand popularity. We implement a hierarchical Bayes model on a unique data of local search data from a major mobile carrier. We find CTR is positively related to brand popularity, search rank and screen position (e.g., above or below the scroll) while negatively related to distance.

2 - A Dynamic Social Network Advertisement Allocation in a Fuzzy Multi-Segmented Environment

Yingying Kang, Principal Or Consultant, Sabre Inc.,
1409 Huntington Dr, Richardson, TX, 75080,
United States of America, eing.008@gmail.com

Advertisement is a major contribution to the revenue of social network sites. Therefore, how to optimally allocate the advertisements in the social network is significant. Advertisers tend to post ads on highly influential sites with no fixed schedule, which adds the complexity in managing the advertiser segmentation. This presentation introduces a dynamic advertisement allocation model based on the fuzzy multi-advertiser segmentation and generates the maximum revenue for

the network.

3 - Inferring Demographic Attributes of Users from Web Browsing History

Satish V, Sr. Data Scientist, Maxpoint Interactive,
3020 Carrington Mill Blvd, Morrisville, United States of America,
vsatish@gmail.com

Demographic information such as gender, age, income etc. of online users can make digital advertisements more personalized to users. However, such information not available when advertising through online ad exchange networks. In this talk we present a probabilistic framework to infer these demographic data using aggregate domain-level data and user-level web browsing behavior. Simulation and validation using ground-truth data showed the model accuracy to be over 80%.

■ SD26

26-Room 403, Marriott

Industry Job Search Panel

Cluster: INFORMS Career Center

Invited Session

Chair: Warren Hearnes, cardlytics, whearnes@cardlytics.com

1 - Industry Job Search Panel

Moderator: Warren Hearnes, cardlytics,
whearnes@cardlytics.com, Panelists: Adam McElhinney, Beverly
Wright, Aly Megahed

Do you have an interest in applying your analytical skills in industry? Come learn more about the process for landing that opportunity and what it's like to work as an operations research practitioner. The panelists will discuss their perspectives on the industry job search/interview process, typical roles and expectations for a practitioner, as well as give advice and answer questions from the audience based on their experience in a variety of verticals such as marketing, manufacturing, fin-tech, consulting, and private research. Panelists include Adam McElhinney, Director of Data Science at Uptake (Chicago), Dr. Aly Megahed, Research Staff Member at IBM Research (San Francisco), and Dr. Beverly Wright, Managing Director of the Business Analytics Center at Georgia Tech (Atlanta). The panel is moderated by Dr. Warren Hearnes, Vice President of Analytics & Data Sciences at Cardlytics (Atlanta)..

■ SD27

27-Room 404, Marriott

MCDM in Agriculture

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Jay Parsons, Associate Professor, University of Nebraska, 208A Filley Hall, P.O. Box 830922, Lincoln, Ne, 68583-0922, United States of America, jparsons4@unl.edu

1 - An Overview of Multi-criteria Decision Making Methods Applied to Agricultural Problems

Jay Parsons, Associate Professor, University of Nebraska, 208A
Filley Hall, P.O. Box 830922, Lincoln, Ne, 68583-0922,
United States of America, jparsons4@unl.edu

Examples of multiple criteria decision making in agriculture abound over many years and many topics including but not limit to: land use decisions; genetic selections; environmental trade-off assessments; irrigation applications; crop rotation analysis; and, risk-return trade-off analysis. This presentation will provide an overview of MCDM applied to agriculture with a focus on recent publications with the hope of stimulating conversation and future MCDM research in agriculture.

2 - Intensive Dairying vs. Dairy Farm Eco-Efficiency: A Study with DEA and Structural Equation Modeling

Andreas Soteriades, PhD Student, Scotland's Rural College,
SRUC, King's Buildings, West Mains Road, Edinburgh, EH9 3JG,
United Kingdom, Andreas.Soteriades@sruc.ac.uk,
Philippe Faverdin, Alistair Stott

We studied the relationship between the eco-efficiency (EE), intensification (I) and autonomy (A) of French specialized dairy farms. We created composite EE, I and A indicators with Life Cycle Analysis, Data Envelopment Analysis and Structural Equation Modeling. The results showed a significant negative relationship between EE and I; and an insignificant one between EE and A. Our findings suggest that intensive dairy production might not compromise the environment.

3 - Engineering Sustainable Complex Coevolutionary Agricultural Systems

Dr Alejandro N. Martinez-Garcia, Professor, Instituto Tecnológico del Valle de Morelia-Tecnológico Nacional de México, km 6.5 Carretera Morelia-Salamanca s/n, Col. Los Angeles, Morelia, 58100, Mexico, alejandro.martinez.garcia@gmail.com

Achieving sustainability (including food security) under the dynamic conditions of climatic change, increasing human population, and poverty reduction, while preserving the ability of ecosystems to provide the services on which humanity depends, implies the need for solving multi-objective optimization problems, under a new paradigm: sustainable complex coevolutionary systems engineering.

4 - A Multi-objective Mathematical Programming Analysis of Forest Carbon Management

Midhun Mohan (Mickey), Graduate Student Researcher, North Carolina State University, 15404 Bragaw Hall, Raleigh, NC, 27607, United States of America, mmohan2@ncsu.edu, Henrique Scolforo, Jean Chung, Juan Posse, Tiantian Shen, Bruno Kanieski, Joseph Roise, Glenn Catts, Kevin Harnish

This study analyzes the valuation and production possibilities on a working forest using Multi-objective programming, Woodstock, Timber NPV, and Carbon Storage and Sequestration, and present a forest management model for optimizing Net Present Value (NPV) and carbon sequestration at Hofmann forest.

■ SD28

28-Room 405, Marriott

Advances in Auction Theory

Cluster: Auctions

Invited Session

Chair: Benjamin Lubin, Asst. Professor, Boston University, 595 Commonwealth Ave, 621A, Boston, Ma, 02215, United States of America, blubin@bu.edu

1 - Are you going to do that? Contingent-payment Mechanisms to Improve Coordination

David C. Parkes, Professor, Harvard University, Cambridge, MA, United States of America, parkes@eecs.harvard.edu, Hongyao Ma, Reshef Meir, James Zou

We consider coordination problems, such as allocating the right to use a shared sports facility or picking the time of a meeting. Outcomes are designated as either good or bad (is the facility used, will people show up?), and the goal is to attain good outcomes. Reports in period zero about agents' uncertain values are used to design a choice set for agents in period one, defining also payments that depend on agents' actions (e.g., using the facility.)

2 - Efficient Interdependent Value Combinatorial Auctions with Single Minded Bidders

Valentin Robu, Assistant Professor, Heriot-Watt University, Edinburgh, School Eng. & Physical Sciences, EM3.15, Riccarton Campus, Edinburgh, EH144AS, United Kingdom, V.Robu@hw.ac.uk, David C. Parkes, Takayuki Ito, Nicholas R. Jennings

We study the design of efficient auctions where bidders have interdependent values, that depend on signals of other bidders. In particular, we consider a contingent bid model in which bidders may explicitly condition the value of their bids on the bids submitted by others. We derive constraints which allows the efficient second price, fixed point auction to be implemented in single-minded CAs, and present an alternative mechanism for cases in which the required single crossing condition fails.

3 - New Core-selecting Payment Rules with Better Fairness and Incentive Properties

Sven Seuken, Assistant Professor Of Computation And Economics, University of Zurich, Binzmühlestrasse 14, Zurich, ZH, 8050, Switzerland, sven.seuken@gmail.com, Benjamin Lubin, Benedikt Bönz

We introduce four "Small" rules, which are new core-selecting payment rules for combinatorial auctions. Via a Bayes-Nash equilibrium analysis, we first show for a domain with 2 goods and 3 bidders, that one of our rules outperforms the state-of-the-art Quadratic rule along all dimensions (efficiency, incentives, fairness, and revenue). We then use a computational approach to evaluate 85 different rules in a setting with 25 goods and 10 bidders, and show that our new rules still perform best.

4 - A Faster Algorithm for Computing Prices in Core-selecting Combinatorial Auctions

Benjamin Lubin, Asst Professor, Boston University, 595 Commonwealth Ave, 621A, Boston, Ma, 02215, United States of America, blubin@bu.edu, Benedikt Bunz, Sven Seuken

We present a new, faster algorithm for the computationally hard problem of pricing core-selecting combinatorial auctions. First, we provide an alternative definition of the core using weakly stronger constraints. Using these, we offer two new algorithmic techniques that 1) exploit separability in allocative conflicts between bidders, and 2) leverage non-optimal solutions. Using large auction instances we show that our algorithm is between 2 and 4 times faster than the current state of the art.

■ SD29

29-Room 406, Marriott

Baseball Analytics

Sponsor: Analytics

Sponsored Session

Chair: Sean Barnes, University of Maryland, 4352 Van Munching Hall, University of Maryland, College Park, MD, 20742, United States of America, sbarnes@rhsmith.umd.edu

Co-Chair: Margret Bjarnadottir, Assistant Professor of Management Science and Statistics, Robert H. Smith School of Business, University of Maryland, 4324 Van Munching Hall, College Park, MD, 20742, United States of America, margret@rhsmith.umd.edu

1 - The Effectiveness of Dynamic Pricing Strategies on Single-game Ticket Revenue in Baseball

Joseph (Jiaqi) Xu, The Wharton School, University of Pennsylvania, 3730 Walnut Street, Suite 500, Philadelphia, PA, United States of America, jiaqixu@wharton.upenn.edu, Peter Fader, Senthil Veeraraghavan

We develop a comprehensive demand model for single-game tickets that can be used to predict revenue associated with a particular pricing strategy over the course of sport season. We apply the model to actual sales and pricing data from an anonymous MLB franchise during a recent baseball season and evaluate the effectiveness of the dynamic pricing policy. We propose pricing heuristics and find that optimized dynamic pricing policy can improve revenue by 14.3% compared to a flat pricing policy.

2 - Pitch Sequence Complexity and Long-Term Pitcher Performance

Joel Bock, Booz Allen Hamilton, 901 15th Street NW, Washington, DC, United States of America, sauerkraut@gmail.com

Patterns of a baseball pitcher's pitch type sequencing can be learned by machine learning models trained on historical data. Individual pitch-wise predictability is connected with broader performance statistics (ERA, FIP) by a regression model that may be used to forecast player performance. Less complexity correlates with higher values of ERA and FIP. This talk outlines the analytical approach and presents results from a study of Major League Baseball pitchers covering three recent seasons.

3 - The Value of Positional Flexibility

Timothy Chan, University of Toronto, 5 King's College Road, Toronto, ON, M5S 3G8, Canada, tcychan@mie.utoronto.ca, Douglas Fearing

Drawing from the theory of production flexibility in manufacturing networks, we provide the first optimization-based analysis of the value of positional flexibility (the ability of a player to play multiple positions) for a major league baseball team in the presence of injury risk. Using publicly available data on baseball player performance, we derive novel baseball-related insights that can be generalized to the manufacturing context.

4 - A Bayesian Hierarchical Model for Modeling Called Strikes in Major League Baseball

Abraham Wyner, Professor, University of Pennsylvania, The Wharton School, University of Pennsylvania, 400 JMH, Philadelphia, Pe, 19104, United States of America, ajw@wharton.upenn.edu, Sameer Deshpande

We measure a catcher's ability to "frame" a pitch. The effect exists, but there remains debate on the effect size. We introduce a systematically constructed, parametric Bayesian hierarchical model for the probability of a called strike. Our model adjusts, accounts borrows strength from data on all participants. By sharing information across all participants we are able to accurately quantify the player's framing effect on a pitch and translate that effect into runs added across a season.

■ SD30

30-Room 407, Marriott

“Speed Networking” Coordination of Subdivisions’ Interests

Sponsor: CPMS

Sponsored Session

Chair: Doug Samuelson, InfoLogix, Inc., 8711 Chippendale Court, Annandale, VA, 22003, United States of America, samuelsondoug@yahoo.com

1 - “Speed Networking” Coordination of Subdivisions’ Interests

Doug Samuelson, InfoLogix, Inc., 8711 Chippendale Court, Annandale, VA, 22003, United States of America, samuelsondoug@yahoo.com

We imitate “speed networking” events in which couples spend ten minutes conversing, then switch partners, allowing for eight or nine such meetings. This allows subdivision officers to learn about other subdivisions with similar interests, promote coordination of sessions, reduce schedule conflicts, and possibly collaborate outside the annual meeting. All subdivision officers are encouraged to attend and participate. The organizer will arrange pairings, following participants’ preferences.

■ SD31

31-Room 408, Marriott

Data Analytics and Statistical Learning

Sponsor: Data Mining

Sponsored Session

Chair: Shouyi Wang, Assistant Professor, University of Texas at Arlington, 3105 Birch Ave, Grapevine, TX, 76051, United States of America, shouyiw@uta.edu

1 - Co-clustering Based Dual Prediction for Cargo Pricing Optimization

Yada Zhu, Research Staff Member, IBM, Thomas J. Watson Research Center, 1101 Route 134 Kitchawan Rd, Yorktown Heights, NY, 10598, United States of America, yzhu@us.ibm.com

In the air cargo business, given the features associated with a pair of origination and destination, how can we simultaneously predict both the optimal price for the bid stage and the outcome of the transaction (win rate) in the decision stage? In this paper, we propose a probabilistic framework and a COCOA algorithm to simultaneously construct dual predictive models and uncover the co-clusters of originations and destinations.

2 - An Efficient Orthogonal-polynomial-based Approach for Time Series Representation and Prediction

Shouyi Wang, Assistant Professor, University of Texas at Arlington, 3105 Birch Ave, Grapevine, TX, 76051, United States of America, shouyiw@uta.edu

We present a new efficient time series representation and prediction framework, called orthogonal-polynomial-based variant-nearest-neighbor (OPVNN) approach, for complex and highly nonlinear time series data. The proposed approach achieved the most robust prediction performance compared to the state-of-the-art time series modeling and prediction methods for the challenging respiratory motion prediction problem. It has a great potential to handle complex time series data streams efficiently.

3 - Online Social Network (OSN) Fake Account Detection System with Cluster Level Features

Danica Xiao, PhD Candidate, University of Washington, Seattle, 3900 Northeast Stevens Way, Seattle, WA, 98195, United States of America, xiaoc@uw.edu

Most online social networks (OSN) are often faced with users with undesired activities during the network’s growth and expansion. Most of them are malicious. Many of malicious activities start with fake accounts (aka “sybil accounts”) attack. This paper presents a supervised learning based system to address such challenge.

4 - Unsupervised Data Mining for Medical Fraud Detection

Tahir Ekin, Assistant Professor, Texas State University, 601 University Dr. McCoy Hall 411, San Marcos, TX, 78666, United States of America, t_e18@txstate.edu, Greg Lakomski, Rasim Muzaffer Musal

U.S. governmental agencies report that three to ten percent of the annual health care spending is lost to fraud, waste and abuse. These fraudulent transactions have direct cost implications to the tax-payers, in addition to diminishing the quality of the medical services. This talk discusses the use of unsupervised data mining approaches such as latent Dirichlet allocation for medical fraud detection. Our main objective is to identify the billing behaviors and find providers that are outliers.

■ SD32

32-Room 409, Marriott

Computational and Statistical Challenges in Big Data Genomics

Cluster: Big Data Analytics in Computational Biology/Medicine

Invited Session

Chair: Li-San Wang, Associate Professor, University of Pennsylvania, 423 Guardian Drive, 1424 Blockley Hall, Philadelphia, PA, 19104, United States of America, lswang@upenn.edu

1 - Big Data Analyses Reveal Many New Short Non-coding RNAs in Health and Disease

Isidore Rigoutsos, Professor, Computational Medicine Center, Jefferson Medical College, Thomas Jefferson University, 1020 Locust Street, Suite #M81, Philadelphia, PA, 19108, United States of America, isidore.rigoutsos@jefferson.edu

By analyzing transcriptomic datasets from healthy individuals and patients we have uncovered numerous novel regulatory non-coding RNAs. These molecules include novel microRNAs, isoforms of microRNAs, fragments of transfer RNAs (tRNAs), and other. Importantly, we find that these molecules’ composition and abundances are dependent on an individual’s race, population, and gender as well as on tissue, tissue state and disease subtype.

2 - Awsomics: A Knowledge Discovery Infrastructure Based on Annotated Genomic Data

Zhe Zhang, Bioinformatics Scientist, Children’s Hospital of Philadelphia, 3535 Market Street, Suite 1067, Philadelphia, PA, 19104, United States of America, zhangz@email.chop.edu

Knowledge discovery is adversely lagging behind data and information generation in the field of genomic research. To assist biomedical researchers to digest the overwhelming amount of genomic data, we developed a system based on Amazon Web Service. It includes an archive of curated data and results, various methods supporting integrative analysis, and a web-based toolbox. It will be a valuable resource for biomedical researchers to gain novel insights about the complicated biological systems.

3 - Quality Control of Whole Genome and Exome Data in a Large Sequencing Study of Alzheimer Disease

Adam Naj, Instructor, Department Of Biostatistics And Epidemiology, University of Pennsylvania, 423 Guardian Drive, 229 Blockley Hall, Philadelphia, PA, 19104, United States of America, adamnaj@mail.med.upenn.edu

The Alzheimer’s Disease (AD) Sequencing Project (ADSP) is an NIH project to sequence 578 familial genomes and 10,692 unrelated exomes of cases and controls to identify causal genomic variants. Here we describe extensive bioinformatics applications in a multi-center quality control effort: performing genotype calling, integrating data from multiple calling pipelines, filtering low-quality samples, and incorporating external annotation to facilitate identifying rare variants affecting AD risk.

■ SD33

33-Room 410, Marriott

Operations Research/Management for Women's Health

Sponsor: Health Applications

Sponsored Session

Chair: Soroush Saghafian, Harvard University, 79 JFK Street, Cambridge, MA, 02138, United States of America, Soroush.Saghafian@asu.edu

1 - Design of Financial Incentives for Maternity Care Safety and Quality

Beste Kucukyazici, McGill University, 1001 Sherbrooke Street West, Room 526, Montreal, QC, H3A 1G5, Canada, beste.kucukyazici@mcgill.ca, Cheng Zhu

Rate of C-section, which exposes potential harms on mothers and newborns as well as heavy economic burden, has been increasing constantly and this growth raises some concerns for the policy makers. This research focuses on optimizing the financial incentives, i.e. choosing best payment scheme and optimizing how to reimburse obstetricians under this scheme, in order to reduce the C-section rates without sacrificing birth quality while alleviating economic burden for overall health care system.

2 - Cost-Effectiveness of Malaria Preventive Treatment for HIV-Infected Pregnant Women in South Africa

Sung Eun Choi, Stanford University, 44 Olmsted Rd Apt. 121, Stanford, Ca, 94305, United States of America, sungeunc@stanford.edu, Margaret L. Brandeau, Eran Bendavid

Combined malaria and HIV infection during pregnancy increases the susceptibility of both mother and child to the negative effects of malaria, such as anemia, low birth weight, and placental malaria. A microsimulation model of HIV-infected pregnant women in sub-Saharan Africa was developed to assess the cost-effectiveness of different malaria preventive treatment approaches, including co-trimoxazole and intermittent preventive treatment in pregnancy with sulfadoxine-pyrimethamine (IPTp-SP).

3 - Mammography Screening Policies under Budgetary Restrictions

Mucahit Cevik, University of Wisconsin - Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, cevik2@wisc.edu, Oguzhan Alagoz

Cost of mammography and lack of resources in terms of number of diagnostic machines and the number of trained workforce to interpret mammograms limit the widespread use of mammography for screening in many countries. We investigate the breast cancer screening problem in a resource-constrained setting where the objective is to maximize total quality adjusted life years of the patients, and present a novel approach to obtain clinically intuitive policies.

4 - The Optimal Control of Child Delivery for Women with Hypertensive Disorders of Pregnancy

Aysegul Demirtas, Graduate Student, Arizona State University, 699 S Mill Avenue, Tempe, AZ, 85281, United States of America, ademirt2@asu.edu, Esma Gel, Soroush Saghafian

Hypertensive disorders of pregnancy (HDP) are one of the leading cause of maternal and neonatal mortality and morbidity in the world. We consider the decision problem of timing and mode of delivery for women with HDP. We formulate a discrete-time, infinite-horizon Markov decision process model in which the objective is to minimize the risks of maternal and neonatal adverse outcomes. We use clinical data in our computational results and provide delivery strategies under various scenarios.

■ SD34

34-Room 411, Marriott

Medical Decision Making

Sponsor: Health Applications

Sponsored Session

Chair: Michelle Alvarado, Visiting Assistant Professor, Texas A&M University, 3131 TAMU, College Station, TX, 77840, United States of America, alvarado.michelle.m@gmail.com

1 - Assessing Prevention Strategies for Mid-life Adults: An Agent-based Modeling Approach

Yan Li, Research Scientist, The New York Academy of Medicine, 99-52 66th Rd. Apt. 9M, Rego Park, NY, 11374, United States of America, yli@nyam.org

70 percent of mid-life adults in the US have been diagnosed with at least one chronic condition and nearly half of them have two or more. We developed an agent-based model to capture the development and consequences of several

prevalent cardio-metabolic conditions, including obesity, hypertension, hypercholesterolemia, and diabetes, in mid-life adults. We conducted simulated trials to assess the impact of different lifestyle interventions on the health outcomes of general mid-life adults.

2 - Developing a Clinical Decision Support System for Diabetic Retinopathy

Saeed Piri, Research Assistant, Oklahoma State University, IEM department, 322 Engineering North, Stillwater, Ok, 74078, United States of America, saeed.piri@okstate.edu, Tieming Liu

About 29.1 million American have diabetes and about 30% of the diabetic patients develop diabetic retinopathy. The purpose of this research is to develop a clinical decision support system that could be used by the physicians and clinicians to manage the condition and progression path of the diabetic retinopathy. We are analyzing two sets of data, first EHR data of about 3 million diabetic patients, and second, detailed data of about 2000 diabetic retinopathy patients.

3 - Readmission Reduction Strategies in Medicaid / Medicare – Hospital System

Michelle Alvarado, Visiting Assistant Professor, Texas A&M University, 3131 TAMU, College Station, TX, 77840, United States of America, alvarado.michelle.m@gmail.com, Yi Zhang, Mark Lawley

In 2012 the Centers for Medicare and Medicaid Services implemented a penalty-only system for hospitals with high readmission rates. We develop a penalty-incentive model for hospital readmissions in a basic game theoretic setting between Medicaid/Medicare and a Hospital. Medicaid/Medicare designs a penalty-incentive mechanism that can inspire the Hospital to adopt a proper level of care. We identify the win-win region for the penalty-incentive factor and present preliminary analysis results.

■ SD35

35-Room 412, Marriott

OR in Public Policy: From Healthcare to Food Banks

Sponsor: Public Sector OR

Sponsored Session

Chair: Ebru Bish, Associate Professor, Virginia Tech, Dept of Industrial and Systems Engg, 250 Durham Hall, Blacksburg, VA, 24061-0118, United States of America, ebru@vt.edu

1 - Value of Inventory Information in Allocating Flu Vaccine with Limited Supply

Zihao Li, PhD Student, Georgia Institute of Technology, 755 Ferst Drive NW, Atlanta, GA, 30332-0205, United States of America, zli66@gatech.edu, Pinar Keskinocak, Julie Swann

Timely vaccination can prevent influenza, but flu vaccine supply is often limited. We study the allocation of vaccines when the uptake rates vary geographically. We derive allocation strategies based on inventory information and compare them to strategies that are population based. We quantify how many cases of flu can be prevented, how much inventory is saved, and the unmet demand under both policies. The results emphasize the need for greater visibility in public health supply chains.

2 - Modeling for the Equitable and Effective Distribution of Food Donations under Stochastic Capacities

Irem Sengul Orgut, Lenovo, 1009 Think Place, Morrisville, NC, United States of America, isengul@ncsu.edu, Reha Uzsoy, Julie Ivy

In partnership with the Food Bank of Central and Eastern North Carolina, which distributes donated food to a 34-county service area, our objective is to achieve the equitable and effective food distribution among the population at risk for hunger. Counties' capacities are the main source of uncertainty in this system as they constrain the total food distribution due to the need to distribute food equitably. We develop stochastic models for optimal food distribution and prove structural results.

3 - Resource Deployment and Donation Allocation for Epidemic Outbreaks

Azrah Azhar, Graduate Student, George Washington University, 800, 22nd Street NW, Washington, DC, 20052, United States of America, azrah@gwu.edu, Miguel Lejeune

We propose an epidemic response model for developing countries that determines the number and location of treatment facilities and ambulances; deploys medical staff; and organizes the transportation of patients. We develop a framework to optimize the utilization of earmarked donations, and carry out a cost-benefit analysis for intervention strategies financed by a donation.

4 - Optimal Post-donation Blood Screening under Prevalence Rate Uncertainty

Hadi El-amine, PhD Student, Virginia Tech, 250 Durham Hall Perry St., Blacksburg, VA, 24061-0118, United States of America, hadi@vt.edu, Ebru Bish, Douglas Bish

Blood product safety, in terms of being free of transfusion-transmissible infections, is crucial. Under prevalence rate uncertainty, various objective functions, including minimization of a mean-variance objective and minimization of the maximum regret, were considered in order to determine a "robust" post-donation blood screening strategy that minimizes the risk of releasing an infected unit of blood into the blood supply. Efficient and exact algorithms are provided.

■ SD36

36-Room 413, Marriott

Public and Nonprofit Sector Applications

Sponsor: Public Sector OR

Sponsored Session

Chair: Ece Zeliha Demirci, PhD Candidate, Bilkent University, Department of Industrial Engineering, Bilkent University, Ankara, 06800, Turkey, edemirci@bilkent.edu.tr

1 - Designing Intervention for Public-interest Goods

Ece Zeliha Demirci, PhD Candidate, Bilkent University, Department of Industrial Engineering, Bilkent University, Ankara, 06800, Turkey, edemirci@bilkent.edu.tr, Nesim K. Erkip

We study intervention design problem for public-interest goods with two intervention tools: investment on demand increasing strategies and subsidies. We consider a setting composed of a retailer whose demand is exponentially distributed and a central authority with fixed budget. We characterize the optimal solution structure and enrich our findings with detailed analysis of results.

2 - A Two-stage Model for Dynamic Staff-job Assignments in the Non-for-profit Sector

Tina Rezvanian, PhD Student, Northeastern University, Huntington Ave, Boston, 02115, United States of America, rezvanian.t@husky.neu.edu, Ozlem Ergun

We design mechanisms for large-scale assignment problems that appear in public sector applications by identifying complete, stable, and fair staff-job matchings over time, even when preference lists are truncated. To address these issues we consider dynamic and multi-stage negotiation policies using stochastic optimization. Equilibrium concepts and heuristics are proposed to approximate the proposed problem to optimality.

3 - Modelling and Analysis of New Zealand (NZ) Legislation Network

Neda Sakhaee, PhD Candidate, University of Auckland, Room 576, 38 Princes Street, Auckland, 1010, New Zealand, nsak206@aucklanduni.ac.nz, Golbon Zakeri, Mark Wilson

Network representation of legal documents is a novel approach to study this complex system. The result is a huge citation network of legal documents (as nodes) and links between them (as edges). We present this network for NZ acts using a data set of more than 700 year old acts from NZ legislation website. We study the structure of the network, measures, clusters and time evolution. Then, we present correlation studies between the clusters and government policies considering longitudinal changes

4 - Optimizing Government Resource Allocation to Increase Community Resilience

Saba Pourreza, PhD Candidate, University of North Texas, 1307 West Highland Street, Denton, TX, 76201, United States of America, saba.pourrezajourshari@unt.edu, Brian Sauser

This study constructs an optimization model that considers two decision variables job creation, goods and service production. The aim of the model is to enhance the community impact of small medium size businesses (SMB) when a disruption hits.

■ SD37

37-Room 414, Marriott

Health Care Modeling and Optimization IV

Contributed Session

Chair: Xiang Zhong, University of Wisconsin, 5019 Old Middleton Rd, Madison, WI, 53706, United States of America, oliver040525@gmail.com

1 - A Predictive Readmissions Model for Coronary Bypass Artery Grafting Patients

Jingyun Li, California State University Stanislaus, 7740 McCallum Blvd., Dallas, TX, 75252, United States of America, jli9@csustan.edu, Steves Ring, Indranil Bardhan

Short-term hospital readmissions due to CABG surgery is a burgeoning problem. Drawing on archival data of CABG patients from 27 hospitals in North Texas, during a three-year period, our model predicts the 30-day readmission propensity of CABG patients, as well as their frequency, and time to readmission.

2 - Innovation in Healthcare Management using Data-driven Clinical Pathways

Yiye Zhang, Carnegie Mellon University, 4800 Forbes Ave, Pittsburgh, PA, 15213, United States of America, yiyez@andrew.cmu.edu, Rema Padman

This paper investigates how service innovations in the management of healthcare delivery can be facilitated through the development of data-driven clinical pathways. We propose a clinical pathway learning algorithm that models the association between treatments and patients health conditions as a hidden Markov model, and also makes predictions for patients' future states. We customize clinical pathways by patient and treatment types using hierarchical clustering and frequent sequence mining.

3 - Analysis of the Impact of Electronic Visits on Patient Care Delivery

Xiang Zhong, University of Wisconsin, 5019 Old Middleton Rd, Madison, WI, 53706, United States of America, oliver040525@gmail.com, Jingshan Li, Philip Bain, Albert Musa

To improve care access, many healthcare organizations have introduced electronic visits to provide patient-physician communication. In this study, we introduce an analytical model to study the care delivery with e-visits. Analytical formulas to evaluate the mean and variance of patient length of stay during access to care are derived. The impact of e-visits on patient access to other care delivery venues is investigated. Scheduling and control policies to improve care access are discussed.

■ SD38

38-Room 415, Marriott

Big Data III

Contributed Session

Chair: Munir Majdalawieh, Associate Professor, Zayed University, Academic City, Dubai, United Arab Emirates, munir.majdalawieh@zu.ac.ae

1 - A Simulation-Optimization Method for Quantitative Aggregation of Prior Statistical Findings

Mohammad Jalali, Massachusetts Institute of Technology, Cambridge, MA, 02141, United States of America, jalali@mit.edu

We introduce a simulation-optimization method for quantitative aggregation of prior statistical findings. The method uses only available statistical results from prior studies to estimate a meta-model that is consistent with those original findings. As an empirical demonstration, we aggregate prior studies of the determinants of basal metabolic rate. Our model proves more accurate than existing models in the literature and the models by World Health Organization and Institute of Medicine.

2 - Guaranteed Matrix Completion via Non-convex Factorization

Ruoyu Sun, Stanford University, Menlo Park, CA, 94025, United States of America, sundirac@gmail.com, Zhi-Quan Luo

Matrix factorization is very popular for large-scale matrix completion. However, due to the non-convexity, there is a limited theoretical understanding of this approach. We show that under similar conditions to those in previous works, many standard optimization algorithms converge to the global optima of the non-convex factorization based formulation, thus recovering the true low-rank matrix. Our result is the first one that provides exact recovery guarantee for many standard algorithms.

3 - Developing Adaptive Islamic Law BPS Models for Islamic Finance and Banking by Text Mining the Qurnian

Munir Majdalawieh, Associate Professor, Zayed University,
Academic City, Dubai, United Arab Emirates,
munir.majdalawieh@zu.ac.ae, Farhi Marir, Ahmed Al-dawoody

In this study we will attempt to develop a Quranic financial corpus and use computational and analytical approaches to mine the Quran (the Muslim holy book) and the Hadith (actions and words of the prophet Muhammad peace be upon him) to uncover hidden knowledge on Islamic financial business processes and controls. The knowledge acquired from this investigation will be translated into an IFBPs model to be adapted by financial institutions when moving to Islamic finance and banking.

4 - Randomized Matrix Algorithms in Parallel and Distributed Environments

Jiyan Yang, Stanford University, 44 Olmsted Road, Stanford, CA,
United States of America, jiyanyang12@gmail.com

We first review recent work on developing and implementing random projection and random sampling algorithms for very large very overdetermined least squares regression problems in parallel and distributed environments. We evaluate the their performance on up to terabyte-sized data in existing distributed systems using Spark. In the second part of the talk, we discuss how randomized linear algebra can be used in low-rank factorization of large-scale matrix with applications in bioimaging.

■ SD39

39-Room 100, CC

Pricing and Consumer Behavior in Retail and Service Operations

Cluster: Operations/Marketing Interface

Invited Session

Chair: Arvind Sainathan, Nanyang Business School, 50 Nanyang Avenue, Singapore, Singapore, asainathan@ntu.edu.sg

1 - Production Planning with Advance Demand Information using Real Options

Geoffrey Chua, Assistant Professor, Nanyang Technological University, 50 Nanyang Avenue, S3-B2A-04, Singapore, Si, 639798, Singapore, GBACHUA@ntu.edu.sg, Shaoxiang Chen, Zhiguang Han

We consider a newsvendor in a B2C setting who sells a real option in period 1 ahead of the spot market in period 2 and find the optimal production and option pricing decisions. We show that option selling is better than advance selling. We also find two benefits of option selling: revenue management and demand updating. For a market with two segments, we compare three policies: selling one option to the higher segment, selling one option to both segments, and selling one option to each segment.

2 - Optimal Promotion Strategy for a Service Firm with Delay Sensitive Customers

Guangwen Kong, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55414, United States of America, gkong@umn.edu

Online social advertising tools such as Groupon generate new business for service providers and at the same time generate new challenges. Discount-seeking customers may impose externalities on the system that could drive away regular customers. We analyze these trade-offs and devise recommendations as to when would Groupon promotions be beneficial.

3 - Stockout Recovery under Consignment: The Role of Inventory Ownership in Supply Chains

Rui Yin, Associate Professor, Arizona State University, Dept of Supply Chain Management, W.P.Carey School of Business, Tempe, AZ, 85287, United States of America, Rui.Yin@asu.edu, Yan Dong, Kefeng Xu

We examine how a supply chain firm may implement an incentive contract under inventory consignment to recover stockouts and to retain customers. We formulate principal-agent models to capture the strategic interactions in a supply chain and explore the impact of supply chain opportunisms on the value of inventory consignment.

4 - Prioritization and Price-plus-delay Competition with Self-selecting and Heterogeneous Customers

Arvind Sainathan, Nanyang Business School, 50 Nanyang Avenue, Singapore, Singapore, asainathan@ntu.edu.sg

In service operations, with the absence of severe capacity constraints, prioritization has been "taken for granted" and presumed to do better when customers are heterogeneous in their delay sensitivities. We show that it is not true when customers self-select. In particular, we identify two key novel aspects – sufficient customer heterogeneity and customer composition – that become crucial, due to self-selection and competition respectively, in determining the performance of prioritization.

■ SD40

40- Room 101, CC

Behavioral Operations II

Contributed Session

Chair: Bernard M Groen, Dr, Durham University, Durham Business School, Durham, DH1 5LB, United Kingdom, b.m.groen@durham.ac.uk

1 - Managerial Deviance in High-Volume Store Replenishment Decisions: Cognition vs. Computation Power

Shivom Aggarwal, IE Business School, Instituto de Empresa, S.L., CIF: B823343, C/ Maria de Molina, 12 Bajo, Madrid, 28006, Spain, dr.shivom@gmail.com, Antti Tenhiala

The behavior of deviating from recommendations of artificially intelligent systems is rife and often encouraged. Past research has found that the ordering behavior of managers is subjected to their incentives, but lacks investigation of its antecedents and consequences. Using longitudinal data from a multi-site implementation of an Automatic Store Replenishment (ASR) system in a retail chain, this study investigates the factors that explain the success of managerial decisions to deviate.

2 - Can Safe Drivers be Productive Too? Empirical Evidence from Long-Duration Truck Trips

Debjit Roy, Associate Professor, Indian Institute of Management Ahmedabad, Vastrapur, Ahmedabad, 380015, India, debjit@iimahd.ernet.in, Rene De Koster, Jelle De Vries

Road safety still remains a prime concern for public policy makers. Through empirical investigation, we attempt to understand the relationship between safety conscious drivers and their trip productivity for long route trips.

3 - A Behavioral Study of Service Recovery Process – Focusing on the Compensation

Hyejeong Gwon, PhD Candidate, Korea University, 408 LG-POSCO Business bldg., Anam-Dong, Seongbuk-Gu, Seoul, Korea, Republic of, 11ku11@korea.ac.kr, Daeki Kim

Even though a company provides best service, the company cannot satisfy all the customers and prevent all service failure. The proper service recovery, especially the proper compensation can determine the level of customer satisfaction. On this paper, we investigate the effect of compensation on customer satisfaction focusing on its several dimensions after service failure.

4 - Complex Organisational Integration – A Behavioural Approach

Bernard M Groen, Dr, Durham University, Durham Business School, Durham, DH1 5LB, United Kingdom, b.m.groen@durham.ac.uk

Understanding the psychological aspects which underpin any organisational change is considered to be increasingly vital in the 21st century. This paper focuses on the implicit and explicit behaviour and the possible 'dissonance' between what teams say, and the actual behaviour displayed. I will briefly evaluate the relative merits of explicit and implicit behavioural methods, before drawing out the main reasons and provide useful solutions to increase the likelihood of successful change.

■ SD41

41-Room 102A, CC

Healthcare Capacity and Patient Flow Analytics

Sponsor: Manufacturing & Service Oper
Mgmt/Healthcare Operations

Sponsored Session

Chair: Retsef Levi, J. Spencer Standish (1945) Professor of Operations Management, Sloan School of Management, MIT, 100 Main Street, BDG E62-562, Cambridge, MA, 02142, United States of America, retsef@mit.edu

- 1 - The Impact of Delays in Transfer out of the Intensive Care Unit**
David Scheinker, Postdoctoral Research Fellow, MIT Sloan School of Management, 50 Memorial Dr, E52-289, Cambridge, MA, 02142, United States of America, dscheink@mit.edu, Sara Dolcetti, Benjamin Christensen, Ulrich Schmidt, Retsef Levi, Peter Dunn

Few studies examine delays in transfer out of the ICU. We studied four years of patient flow through six ICUs at a large academic medical center. Over 36% of ICU patients transferring to a general care unit experienced a non-clinical delay of over 12 hours. Each day a patient was delayed added approximately a full day to their total hospital length of stay. These results have direct implications for hospital capacity design, bed assignments, and care processes across units within the hospital.

- 2 - Using Data Analytics and Systems Modeling to Inform Hospital Obstetrics Capacity Planning**

Nan Liu, Columbia University, 722 W. 168th. St., New York, NY, United States of America, nl2320@columbia.edu, Linda Green

Using a recent large data set that contains all hospital obstetrics units (n=40) in NYC, we demonstrate and validate the use of data analytics and systems modeling for planning hospital bed capacity. We estimate capacity needs based on the probability of delay experienced by patients in getting a bed. Our analysis reveals significant variation in obstetrics capacity utilization in NYC; and shows that the whole city can save \$26.5M a year with an appropriate reallocation of obstetrics capacity.

- 3 - Optimization-driven Framework to Understand Healthcare Networks Cost and Resource Allocation**

Fernanda Bravo, Assistant Professor, UCLA-Anderson, 110 Westwood Plaza, Los Angeles, CA, United States of America, fbravo@mit.edu, Retsef Levi, Marcus Braun, Vivek Farias

Consolidation in the HC industry has resulted in the creation of large delivery networks. Traditional practices in cost accounting, e.g., overhead and labor cost allocation to activities, are not suitable for addressing network challenges. We develop an optimization-driven framework inspired by network revenue management to better understand network costs and support strategic network design and capacity allocation decisions. We report the application of this approach on a real case study.

■ SD42

42-Room 102B, CC

Patient Scheduling under Resource Constraints

Sponsor: Manufacturing & Service Oper
Mgmt/Healthcare Operations

Sponsored Session

Chair: Hossein Abouee Mehrizi, University of Waterloo, 200 University Avenue West, Department of Management Sciences, Waterloo, ON, N2L 3G1, Canada, habouee@uwaterloo.ca

- 1 - Optimal Mix of Elective Surgical Procedures under Stochastic Patient Length of Stay**

Hessam Bavafa, Assistant Professor, Wisconsin School of Business, Madison, WI, United States of America, hbavafa@bus.wisc.edu

We consider the problem of allocating daily hospital service capacity among several types of elective surgical procedures. Our focus is on the interaction between two major constraining hospital resources: operating room and bed capacity. In our model, each type of surgical procedure has an associated revenue, deterministic procedure duration and stochastic hospital length of stay.

- 2 - Appointment Scheduling Problem when the Server Responds to Congestion**

Zheng Zhang, University of Michigan, 1205 Beal Ave, Ann Arbor, MI, 48105, United States of America, zzhang0409@gmail.com, Brian Denton, Xiaolan Xie

We describe a stochastic programming model for appointment scheduling that incorporates server response to congestion, i.e., the server increases the service rate as the workload grows. It materially differs from previous studies in the sense that the uncertainty in appointment systems is endogenous with respect to the decision variables. We describe properties of the model, methods to solve it efficiently, and results that illustrate the impact of congestion in practice.

- 3 - Multi-priority Online Scheduling with Cancellations**

Van-Anh Truong, Columbia University, 500 West 120th St, New York, NY, 10027, United States of America, vt2196@columbia.edu, Xinshang Wang

We study a fundamental model of resource allocation in which a finite amount of service capacity must be allocated to a stream of jobs of different priorities arriving randomly over time. Jobs incur costs and may also cancel while waiting for service. To increase the rate of service, overtime capacity can be used at a cost. This model has application in healthcare scheduling, server applications, make-to-order manufacturing systems, general service systems, and green computing.

- 4 - Multi-speciality Surgery Scheduling under Hospital Resource Constraints**

Shrutivandana Sharma, Singapore University of Technology and Design, 8 Somapah Road, Singapore, 487372, Singapore, shrutivandana@sutd.edu.sg, Hossein Abouee Mehrizi

We consider a surgery scheduling problem, where the decision is to schedule surgeries of two different types over a finite planning horizon. The number of surgeries of each type that can be performed in any period is bounded by the availability of operating resources and the availability of beds. We formulate the problem as a multi-period inventory problem, and characterize the optimal solution.

■ SD43

43-Room 103A, CC

Data-Driven Revenue Management

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Pelin Pekgun, Assistant Professor, University of South Carolina, 1014 Greene Street, Columbia, SC, 29208, United States of America, pelin.pekgun@moore.sc.edu

- 1 - Resource Pricing in Hospitality Industry**

Xiaodong Yao, SAS Institute Inc, SAS Campus Drive, Cary, NC, 27519, United States of America, xiaodong.yao@sas.com, Tugrul Sanli, Matt Maxwell, Jason Chen

Best Available Rate (BAR) pricing is probably the most important pricing decision for hotels. There are two forms: BAR by Day, and BAR by LOS (Length of stay). In BAR by Day, prices are set for each resource, i.e., a pair of (room type, stay night), and a LOS price is just the sum of prices on each resource. While in BAR by LOS, prices are set for each product, a triple of (room type, arrival date, LOS). In this talk, we discuss several methods for solving the resource pricing problem.

- 2 - Estimating Revenue Variance in the Pricing Models**

Darius Walczak, Principal Research Scientist, PROS Inc., 3100 Main Street, Suite 900, Houston, TX, 77002, United States of America, dwalczak@pros.com, David McCaffrey

Variance and other distributional moments are important in modeling risk in optimization problem. They are more challenging computationally than linear load metrics such as load factor. We adopt an approach found in the Markov Decision Process literature to calculate variance of revenue under dynamic policies in single-resource pricing problems. We discuss possible extensions to network problems.

- 3 - Advanced Behavioral Models in Integer Optimization**

Shadi Sharif Azadeh, EPFL, EPFL ENAC TRANSP-OR GC B3 444, (Batiment GC) Station 18, Lausanne, Switzerland, shadi.sharifazadeh@epfl.ch, Bilge Atasoy, Moshe Ben-akiva, Michel Bierlaire

We are interested in discrete optimization models where supply and demand closely interact (airlines). We propose a general methodology leading to an integrated supply and demand model, based on discrete choice that is linear in its decision variables. We illustrate it with an example where a supplier (such as an airline, or a chain of movie theaters) needs to decide to offer some services, and to decide about the price of each slot of the available capacity in order to maximize its revenues.

4 - Analysis of Competitive Pricing with Multiple Overlapping Competing Bids in Revenue Management

Goutam Dutta, Professor, Indian Institute of Management, Wing 3, PMQ Area, Room No 3H, Old Campus, Ahmedabad, 380015, goutam@iimahd.ernet.in, Sumeetha Natesan

We analyze the competitive pricing situation of one company with more than one competitor. Based on the past experience one can have some idea about what the competitors will bid which can be described by various distributions. The prices of company and its competitors follow independent, overlapping uniform distribution. First we derive expression for probability of win and then, we attempt to derive conditions for maximizing the expected contribution to profit.

5 - Data Science, Operations Research, Analytics and Revenue Management

Jon Higbie, Managing Partner & Chief Scientist, Revenue Analytics, 3100 Cumberland Blvd., Suite 1000, Atlanta, GA, 30339, United States of America, jhigbie@revenueanalytics.com

The term Data Science and the job title Data Scientist are much in vogue right now. How does Data Science relate to Operations Research? What lessons might we learn about the past boom in Operations Research that can be applied to the current boom in Analytics? How is the increased emphasis on Business Analytics impacting Revenue Management? These questions will be explored through a series of case studies, and discussion.

■ SD44

44-Room 103B, CC

Algorithmic Revenue Management with Strategic Customers

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Vivek Farias, Associate Professor, MIT, 100 Main Street, Cambridge, United States of America, vivekf@mit.edu

Co-Chair: Yiwei Chen, ywchen@ckgsb.edu.cn

1 - Analysis of Discrete Choice Models: A Welfare-Based Framework

Guiyun Feng, University of Minnesota, 1006 27th Avenue SE,, Minneapolis, MN, 55414, United States of America, fengx421@umn.edu, Zizhuo Wang, Xiaobo Li

We propose a framework for discrete choice models through a welfare function. The framework provides a new way of constructing choice models. It also provides great analysis convenience for establishing connections among existing choice models. We define a new property in choice models: substitutability/complementarity and study conditions for a choice model to be substitutable. We show that our framework is flexible in this property, which is desirable in capturing practical choice patterns.

2 - Robust Dynamic Pricing with Strategic Customers

Yiwei Chen, Assistant Professor, Renmin University of China, No. 59 Zhongguancun Street, Beijing, China, chenyiwei@rbs.org.cn, Vivek Farias

We consider the canonical revenue management problem that a seller sells finite number of a product over a finite horizon via dynamic pricing. We assume that customers are forward looking with heterogeneous strategic factors (time discount rates and monitoring costs). We propose a class of pricing policies that achieve at least 29% of revenue under an optimal dynamic mechanism. Our policies require no knowledge of customers' strategic factors and ensure customers to behave myopically.

3 - Managing Multi-period Production Systems with Limited Process Flexibility

Yehua Wei, Fuqua School of Business, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, yehua.wei@duke.edu, Cong Shi, Yuan Zhong

We develop a theory for the design of process flexibility in a multi-period production system. We propose and formalize a notion of "effective chaining" termed the Generalized Chaining Condition (GCC). We show that any partial flexibility structure that satisfies GCC is near-optimal under a class of policies called the Max-Weight policies. Furthermore, we show that GCC can be satisfied using just k arcs, where k is the equal to the number of products plus the number of plants.

4 - Optimal Dynamic Pricing with Patient Customers

Yan Liu, University of Minnesota, Room L123, ME Building, 111 Church ST, Minneapolis, MN, 55455, United States of America, liux0984@umn.edu, William Cooper

We consider a single-product pricing problem in which a fraction of customers is patient and the remaining fraction is myopic. A patient customer will wait up to some fixed number of time periods for the price to fall below his valuation, at which point the customer will make a purchase. If the price does not fall below a patient customer's valuation at any time during those periods, then the customer will leave without buying. We identify the structure of an optimal pricing policy.

■ SD45

45-Room 103C, CC

Pricing – Examples of Collaboration Between Academia and Industry

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Georgia Perakis, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, georgiap@mit.edu

1 - Balancing Profit Maximization and Inventory for Recommending Personalized Bundles

Anna Papush, MIT, 77 Massachusetts Avenue, Cambridge, MA, United States of America, apapush@mit.edu, Georgia Perakis, Pavithra Harsha

Market forecasts show that e-commerce stands to ultimately inherit a significant proportion of the retail market. Gaining a competitive edge in this sector is of utmost importance to any firm's success. The model presented in this work guarantees customer satisfaction by providing relevant recommendations at personalized prices in a way that balances profit maximization with business operations. We demonstrate its value on actual e-tailer data.

2 - Pricing for a Satellite Service Provider

Charles Thraves, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, thraves@mit.edu, Georgia Perakis

We present a pricing optimization formulation of the data plans of a satellite service provider. First, to estimate reservation prices for all customers (including unobserved customers) we deal with the missing data problem. We introduce a MIP formulation and develop properties and heuristics for the problem. We develop analytical bounds for our heuristics and conclude that they can help the company increase its profits by more than 10%.

3 - Scheduling Promotion Vehicles to Boost Profits

Lennart Baardman, MIT, Operations Research Center, Cambridge, MA, 02139, United States of America, baardman@mit.edu, Kiran Panchamgam, Danny Segev, Georgia Perakis, Maxime Cohen

Retailers use promotion vehicles (e.g. flyers, commercials) to increase profits. We model how to assign promotion vehicles to maximize profits as an NLP. The problem is NP-hard and even hard to approximate. However, we construct an epsilon-approximation in the form of an IP of polynomial size. Also, we propose a greedy algorithm with a provable guarantee and on average near-optimal performance. Finally, using supermarket data we show that our model can lead to a significant increase in profits.

4 - Dynamic Pricing through Combinatorial Methods

Jeremy Kalas, MIT, Cambridge, United States of America, jkalas@mit.edu, Swati Gupta, Kiran Panchamgam, Georgia Perakis, Maxime Cohen

We explore fast combinatorial methods for the multi-period, multi-item Promotion Optimization Problem under general demand functions that depend on past prices. As the problem is NP-hard for large memory, we consider an approximation via the reference price model, and give a PTAS. We extend this model to handle cross-item effects using a "virtual" reference price. We report a projected 4-6% increase in profits on real-world data sets, in collaboration with the Oracle Retail Science group.

■ SD46

46-Room 104A, CC

Empirical Operations Management: Services

Sponsor: Manufacturing & Service Oper Mgmt/Service Operations

Sponsored Session

Chair: Robert Bray, robertlbray@gmail.com

1 - Free Riding and Auto Recalls: An Asymmetric Dynamic Discrete Choice Game

Ahmet Colak, Northwestern University, 1116 W Loyola Ave Apt 3S, Chicago, IL, 60626, United States of America, a-colak@kellogg.northwestern.edu, Robert Bray

We structurally study auto recalls. Two agents can initiate a recall: the manufacturer and the federal regulator. Initiating recalls is an entry game with optimal stopping. We unexpectedly find that the regulator has no deterrence power over the manufacturer, and that the two agents free ride off each other's recall efforts. Free riding decreases the regulator's and manufacturer's median recall probabilities by 2.9% and 0.7% respectively, and increases society's exposure to defective parts.

2 - Consumer Behavior in Pay-as-you-go Business Models

Jose Guajardo, University of California Berkeley,
545 Student Services Bldg #1900, Berkeley, CA, 94720-1900,
United States of America, jguajardo@berkeley.edu

Pay-As-You-Go business models have become widely adopted for the diffusion of energy solutions in developing economies. In this research, we analyze consumer behavior in pay-as-you-go environments and discuss implications for firms operating in these novel markets.

3 - Price to Compete...with Many: How to Identify Price Competition in High Dimensional Space

Jun Li, Assistant Professor, Ross School of Business, University of Michigan, 701 Tappan St, Ann Arbor, 48103, United States of America, junwli@umich.edu, Serguei Netessine, Sergei Koulayev

We study price competition in markets with large (in magnitude of hundreds or thousands) number of potential competitors, using the hotel industry as a test bed. This research addresses two methodological challenges: simultaneity bias and high dimensionality.

4 - Measuring the Effectiveness of Self-service: An Empirical Investigation of Supermarket Self-checkout

Marcelo Olivares, Assistant Professor, Universidad de Chile, Republica 701, Santiago, Chile, molivares@u.uchile.cl

Using transactional data from a large supermarket chain, we study the impact of self-checkouts in customer purchases. We combine video analytics data with point-of-sale transactions to analyse how waiting time in checkouts affects consumer decisions on which lines to join, basket expenditures and visiting frequency.

■ SD47

47-Room 104B, CC

Topics in Remanufacturing and Consumer Product Returns

Sponsor: Manufacturing & Service Oper Mgmt/Sustainable Operations

Sponsored Session

Chair: V. Daniel R. Guide, Jr., Mary Jean And Frank P. Smeal Chaired Professor Of Operations And Supply Chain Management, Pennsylvania State University, 480 Business Bldg., University Park, PA, 16802, United States of America, drgl6@psu.edu

1 - Measuring the Value of Return Policies in Online Retailing

Guangzhi Shang, Assistant Professor, Florida State University, College of Business, RBB354, Tallahassee, FL, 32306, United States of America, gshang@business.fsu.edu, Michael Galbreth, Mark Ferguson, Pelin Pekgun

Lenient return policies are popular in the industry. However, how much consumers value such a policy is difficult to measure from firm's perspective. We tackle this challenge and measure the value of return policies to consumers in the online retail context.

2 - False Failure Returns: An Experimental Investigation of Supply Chain Coordination

Yue Cheng, Doctoral Student, The Pennsylvania State University, 460A Business Bldg, University Park, PA, 16802, United States of America, yuc190@smeal.psu.edu, Brent Moritz, V. Daniel R. Guide, Jr.

To reduce false failure returns, prior research has proposed a target rebate contract to coordinate the closed-loop supply chain. We modify the model to account for the best response to a proposed contract. We conduct two experiments, and observe sub-optimal coordination caused by mid-point bias and inequality aversion.

3 - Product Acquisition Management – A Third Party Remanufacturer Perspective

Akshay Mutha, Doctoral Student, The Pennsylvania State University, Business Bldg, University Park, PA, 16802, United States of America, axm536@smeal.psu.edu, Saurabh Bansal, V. Daniel R. Guide, Jr.

We examine various acquisition strategies for a third party remanufacturer (3PR). We develop a model for the 3PR's profit maximization problem and characterize the optimal solution. We derive the structural properties of the model. Using realistic data for a smartphone remanufacturer, we show that the hybrid acquisition strategy increases the profit by up to 12%.

4 - A Typology of Closed-loop Supply Chains with Remanufacturing

V. Daniel R. Guide, Jr., Mary Jean And Frank P. Smeal Chaired Professor Of Operations And Supply Chain Management, Pennsylvania State University, 480 Business Bldg., University Park, PA, 16802, United States of America, drgl6@psu.edu, James Abbey

We present a typology of closed-loop supply chains with remanufacturing.

■ SD48

48-Room 105A, CC

Empirical Topics on OM/Finance Interface

Sponsor: Manufacturing & Service Oper Mgmt/IFORM

Sponsored Session

Chair: S. Alex Yang, Assistant Professor, London Business School, Sussex Place, London, United Kingdom, sayang@london.edu

1 - Sourcing with Financing in an Unreliable Supply Chain: Should Buyers Offer Loans to Suppliers?

Jing Wu, jwu7@chicagobooth.edu, S. Alex Yang, Chris Tang

Two financing schemes related to sourcing from a financial constrained supplier are characterized and discussed. Choosing between purchase order financing or supply chain financing, the manufacturer balances its information advantage and the bank's financing advantage.

2 - An Empirical Study of Liquidation Value for Retail Inventories

Nathan Craig, Ohio State University, 2100 Neil Avenue, 630 Fisher Hall, Columbus, OH, 43210, United States of America, craig.186@osu.edu, Ananth Raman

The liquidation value of a firm's assets appears in models in operations management (e.g., the newsvendor) and finance (e.g., cost of debt). Yet relatively little is known about the liquidation process and its outcomes. To characterize liquidation values for retail inventories, we use proprietary data on liquidation outcomes for 70 retailers and \$8B of inventory. We complement this with data from multiple sources to identify economic factors that significantly affect liquidation value.

3 - Size Distribution of Manufacturing Firms in India : Empirical Evidence and Theoretical Models

Sridhar Seshadri, Professor, Indian School of Business, Faculty Housing, Gachibowli, Hyderabad, AP, 500032, India, sridhar_seshadri@isb.edu, Yangfang Zhou

The dualism of the manufacturing sector in India resulting in employment concentration in small and large firms has puzzled researchers. We provide a possible explanation for the missing middle phenomenon using supply chain models and models of competition. We discuss the policy implications of our findings.

4 - Dynamic Discounting

Nitish Jain, Assistant Professor, London Business School, Regents Park, London, United Kingdom, njain@london.edu, S. Alex Yang

Using a proprietary dataset, we empirically investigate how firms behave on a dynamic discounting platform.

■ SD49

49-Room 105B, CC

Service Process Design

Sponsor: Manufacturing & Service Oper Mgmt/Supply Chain

Sponsored Session

Chair: Mustafa Akan, Associate Professor, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, akan@andrew.cmu.edu

1 - Maintenance and Spare Part Optimization for Moving Assets

Ayşe Sena Eruguz, Eindhoven University of Technology, P.O. Box 513, Eindhoven, 5600 MB, Netherlands, a.s.eruguz@tue.nl, Tarkan Tan, Geert-Jan Van Houtum

We consider an integrated maintenance and spare part planning problem for a single critical component of a moving asset for which the degradation level is observable. Degradation level is a function of the system state, mostly dictated by where the moving asset physically is, e.g., in harbour, in transit, or in mission for a maritime application. Possible actions and their consequences are also dependent on the system state.

2 - Role of Alternative Payment Models in Incentivizing Information Sharing in Healthcare

Mehmet Ayvaci, Asst. Professor, University of Texas-Dallas, School of Management, Richardson, TX, 75080, United States of America, mehmet.ayvaci@utdallas.edu, Srinivasan Raghunathan, Huseyin Cavusoglu

We explore the incentive alignment problem for electronic sharing of health information (HIE) under episode and performance-based payments. In particular, we study what quality improvement provisions should be embedded into the payments and which of the specific performance incentives associated with alternative payment models; rewards, penalty, or a combination of the two better aligns the incentives for HIE adoption.

3 - Design of Multi-stage Services with Diagnostic Tasks

Mohammad Delasay, Post-doctoral Fellow, Tepper School of Business, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, United States of America, delasays@andrew.cmu.edu, Itai Gurvich, Mustafa Akan

Many services require diagnostic tasks, e.g., diagnostic testing in an emergency room. The time spent on these tasks and the sequence in which they are performed is usually discretionary. We explore how discretionary diagnostic tasks should be distributed among different stages of a multi-stage operations system to deliver high quality service with minimum wait cost. We are interested in situations where the extent of information gained from diagnostic tasks varies across different stages.

4 - Coordinating Product Support Supply Chains under Outcome-based Compensations

Dong Li, Singapore University of Technology and Design, 8 Somapah Road, Singapore, Singapore, dong_li@sutd.edu.sg, Nishant Mishra

We look at contracting between an OEM and a supplier, where the supplier manufactures the part, and the OEM assembles the final product and manages product availability for the customer under an outcome-based contract. We find that wholesale price contracts and repair cost sharing contracts cause under-investment in failure reduction effort and over-investment in service capacity. Penalty sharing contracts can achieve the first best solution and coordinate the supply chain.

■ SD50

50-Room 106A, CC

Retail Operations

Sponsor: Manufacturing & Service Operations Management
Sponsored Session

Chair: Vidya Mani, Assistant Professor, Pennsylvania State University, 461 Business Building, University Park, 16801, United States of America, vmani@psu.edu

1 - The Effect of Cyber Attack on Customers' Purchase and Channel Choice Behavior

Ramkumar Janakiraman, Darla Moore School Of Business, University of South Carolina, 1014 Greene Street, Columbia, SC, 29208, United States of America, ram@moore.sc.edu, Joon Ho Lim, Kumar Subodha, Rishika Rishika, Ram Bezawada

This paper examines the effect of data breach announcement on customer shopping behavior in terms of spending level, frequency of shopping trips and channel migration. By using actual customer transaction data from a multichannel retailer and exploiting a natural experiment, we find that the cyberattack announcement leads to a 22.5% decrease in sales and a 14.1% decrease in shopping trips made by customers. Also, we find that customers tend to migrate to channels that were not breached.

2 - Learning about Customer Preferences from Clickstream Data

Dorothee Honhon, Associate Professor, University of Texas at Dallas, 800 W. Campbell Road, Richardson, TX, 75080, United States of America, Dorothee.Honhon@utdallas.edu

We study the problem of an e-tailer who learns about consumer preferences from observing sales or clickstream data in a Bayesian fashion. The e-tailer decides which products to display on the search page and which products are available for purchase. We show that in some cases, it may be optimal to display products which are not purchasable so as to learn about consumer preferences.

3 - Optimal Replenishment in the Presence of Phantom Inventories using Point-of-sales Data

Ioannis Stamatopoulos, Doctoral Candidate, Northwestern University, Kellogg School of Management, 2001 Sheridan, Evanston, IL, 60208, United States of America, i-stamatopoulos@kellogg.northwestern.edu, Antonio Moreno-Garcia, Achal Bassamboo

We study how inventory managers can fully utilize point-of-sales (POS) data for the design of replenishment strategies that account for the existence of phantom inventories. We show that even though the optimal replenishment timing in the presence of phantom inventories is complex in nature, there is a simple policy that performs very close to optimally, and provides the same recommendation as the optimal policy for a vast majority of scenarios.

4 - Impact of Tabletop Technology on Restaurant Performance

Fangyun (Tom) Tan, Assistant Professor, Cox Business School, SMU, 6212 Bishop Blvd, Dallas, TX, 75275, United States of America, ttan@cox.smu.edu, Serguei Netessine

We analyze a large data set of transactions in a casual restaurant chain to understand the effect of implementing a tabletop technology on service performance (measured in sales and meal duration). We find the technology directly increases sales and significant reduces the meal duration. We provide insights on how to manage technology in restaurant operations.

■ SD51

51-Room 106B, CC

MSOM Student Paper Competition Finalists II

Sponsor: Manufacturing & Service Operations Management
Sponsored Session

Chair: Goker Aydin, Indiana University, 1309 East Tenth Street, Bloomington, IN, 47405, United States of America, ayding@indiana.edu

Co-Chair: Karan Girotra, Associate Professor, INSEAD, Boulevard de Constance, Fontainebleau, 77300, France, Karan.GIROTRA@insead.edu

Co-Chair: Sameer Hasija, Assistant Professor, INSEAD, 1 Ayer Rajah Avenue, Grange Heights, Singapore, Singapore, Sameer.Hasija@insead.edu

1 - MSOM Student Paper Competition Finalists Sessions INFORMS 2015

The MSOM Student Paper Competition is awarded annually by the Manufacturing & Service Operations Management Society at the INFORMS Annual Meeting for papers judged to be the best in the field of operations management.

■ SD52

52-Room 107A, CC

Designing Services: Marketing and Operations Inter-related Issues I

Sponsor: Service Science
Sponsored Session

Chair: Rohit Verma, Professor, Cornell University, School of Hotel Administration, 338 Statler Hall, Ithaca, NY, 14853-6902, United States of America, rohit.verma@cornell.edu

1 - A Data-driven Approach to Designing Service Concepts for Vehicle Operations Management

Min-Jun Kim, PhD Student, POSTECH, Engineering Building #4-316, Pohang, 790-784, Korea, Republic of, minjun@postech.ac.kr, Kwang-jae Kim, Chie-Hyeon Lim

This talk proposes a data-driven approach to designing service concepts for vehicle operations management (VOM). The proposed approach first collects VOM-related data through various sensors installed on vehicles, analyzes the data to extract insights regarding vehicle operations, and then designs service concepts to support the operation of vehicles. This talk also presents case studies on passenger and commercial vehicles.

2 - Characteristics of Consulting Firms and Their Challenges**Co-producing with their Clients**

Matthew Walsman, Student, Cornell University, 455 Statler Hall,
Ithaca, United States of America, mcw237@cornell.edu,
Rohit Verma, Michael Lewis, Alistair Brandon-jones

Using mixed methods (best-worst survey-based study supported by qualitative interviews) we uncover characteristics of consulting firms and their managerial challenges that are often different than those suggested by traditional frameworks of Professional Service Firms. We extend this with an experiment designed to test some of our initial findings regarding consultant's primary function as advisers or those tasked with making decisions for (or giving recommendations to) others.

3 - A Comparative Analysis of Technology Usage and Utility Between Experts and Customers in Hospitality

Min Kyung Lee, Clemson University, 100 Sirrine Hall,
Box 341305, Clemson, SC, 29634, United States of America,
minl@g.clemson.edu, Aleda Roth, Rohit Verma

With great development in social media and peer-to-peer markets, sharing economy has emerged as alternative suppliers of services. Sharing economy has taken a power away from experts and focused more on peer-to-peer feedback. This empirical study analyzes the usage and utility of technology innovations between experts and customers.

SD53

53-Room 107B, CC

2015 INFORMS BOM Section Best Working Paper Awards

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Karen Zheng, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, yanchong@mit.edu

1 - 2015 INFORMS Behavioral Operations Management Section Best Working Paper Awards

Karen Zheng, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, yanchong@mit.edu

This session is reserved for the finalists of the 2015 INFORMS Behavioral Operations Management Section Best Working Paper Awards. The finalists will present their papers. The committee will announce and honor the first place, the second place, and the honorable mention(s) at the end of the session.

SD54

54-Room 108A, CC

Robust Optimization, Risk Ambiguity

Cluster: Tutorials

Invited Session

Chair: Dan Iancu, Assistant Professor, Stanford University, 655 Knight Way, Stanford, CA, 94305, United States of America, daniancu@stanford.edu

1 - Tutorial: Robust Multi-Stage Decision Making

Erick Delage, HEC Montreal, Canada, erick.delage@hec.ca,
Dan Iancu

Testifying to more than ten years of academic and practical developments, this tutorial attempts to provide a succinct yet unified view of the robust multi-stage decision making framework. In particular, the reader should better understand: (1) the distinction between static versus fully or partially adjustable decisions, (2) the root of tractability issues, (3) the connection to robust dynamic programming, (4) some motivation for using simple decision rules, especially in terms of optimality, (5) how time consistency issues can arise and (6) some relevant applications.

SD55

55-Room 108B, CC

Analysis of Infrastructure using DEA

Cluster: Data Envelopment Analysis

Invited Session

Chair: Hyojung Kang, Postdoctoral Associate, Pennsylvania State University, 310 Leonhard Building, University Park, PA, 16801, United States of America, hqk5116@psu.edu

1 - Highway Safety Performance Evaluation of Commercial Transportation using Data Envelopment Analysis

Yaote Tsai, Auburn University, 3332 Shelby Center, Auburn University, Auburn, AL, 36832, United States of America, yzt0007@auburn.edu, Stephen Startz, Fadel Megahed

Transportation safety has been one of the most important issues discussed in recent years. An effective method to measure and improve the current safety performance is needed to decrease the total number of incidents and costs of job-related injuries. The proposed methodology uses Data Envelopment Analysis (DEA) for benchmarking the safety performance. The results of this research are to provide an objective safety performance and improvement recommendations for commercial transportation.

2 - Airport Site Selection using Analytical Hierarchy Process and Data Envelopment Analysis

Gulsah Hancerliogullari, Istanbul Bilgi University, Eski Silahtaraga Elektrik Santrali Kazim, Karabekir Cad. No: 2/13 34060 Eyüp, Istanbul, 34060, Turkey, gulsah.hancerli@bilgi.edu.tr, Emrah Koksalmis

The aim of a site-selection problem is to find the optimum location that satisfies a number of predetermined selection factors. The identification of alternative sites, assessment criteria and priorities for the construction of a new airport is a complex task that requires the cooperation of multiple stakeholders. This study deals with the problem of finding the optimum location for an airport to serve in Turkey, using the methods of analytical hierarchy process and data envelopment analysis.

3 - Assessing Efficiency and Quality of Emergency Departments using Data Envelopment Analysis

Hyojung Kang, Postdoctoral Associate, Pennsylvania State University, 310 Leonhard Building, University Park, PA, 16801, United States of America, hqk5116@psu.edu, Nathaniel Bastian, Harriet Nembhard

Emergency departments (EDs) seek ways to improve quality while achieving operational efficiency. However, it is not clear if EDs have mutually satisfied these objectives. Using data envelopment analysis, this study investigates the relationship between efficiency and quality of EDs in the U.S. The results provide insights into resource management in the EDs.

SD56

56-Room 109A, CC

Location Models

Sponsor: Location Analysis

Sponsored Session

Chair: Oded Berman, University of Toronto, 105 St. George Street, Toronto, M5S 3E6, Canada, Berman@rotman.utoronto.ca

1 - New Product Network Design: Facility Location and Capacity Decisions under Uncertainty

Mozart Menezes, Associate Professor, Kedge Business School-Bordeaux, 680 Cours de la Libération, Bordeaux, 33405, France, mozart.menezes@me.com, Kai Luo, Oihab Allal-Cherif

We attempt to shed light on the effect of stochastic demand on the location and capacity of production facilities. The framework is that of a traditional Newsvendor problem where decisions will generate expected under- and over-capacity costs, which are function of both unitary cost of acquiring capacity and transportation cost (function of facility location). In this work the 'critical fractile' is not uniform across facilities.

2 - Comprehensive Framework for Hazmat Network Design, Response Team Location, and Equity of Risk

Rajan Batta, Suny Distinguished Professor, University at Buffalo (SUNY), 410 Bell Hall, Buffalo, United States of America, batta@buffalo.edu, Masoumeh Taslimi, Changhyun Kwon

Control variables are locations of hazmat response teams and which additional links to include. Regulatory authorities (upper level) aim to minimize the maximum transport risk incurred by a transportation zone. Our measure of risk incorporates average response time. Hazmat carriers (lower level) seek to minimize travel cost. Using optimality conditions, we reformulate the non-linear bi-level model into a single-level mixed integer linear program, and propose a greedy heuristic approach.

3 - Primal and Dual Algorithms for Min-max Location with Euclidean Distance Plus Fixed Distance in R^n

Lin Dearing, Professor Emeritus, Clemson University, 520 Bentbrook Lane, Clemson, SC, 29631, United States of America, pmdrn@g.clemson.edu, Akshay Gupta

Primal and dual algorithms are given for one center min-max location using Euclidean distance plus fixed distance in R^n , based on a directional search method along paths that are a ray or a two-dimensional hyperbola in R^n . Search paths are derived from the intersection of bisectors of points, which may be hyperplanes or hyperboloids in R^n , and the step size is determined explicitly. The problem is equivalent to finding the minimum covering Euclidean ball of a given set of balls in R^n .

4 - Stochastic Location Models with Congestion

Oded Berman, University of Toronto, 105 St. George Street, Toronto, Canada, Oded Berman, Dmitry Krass

We review facility location models where consumers generate stochastic demands, and service times are stochastic. We focus on the customer-facility interaction, developing a classification of models based on the how customer demand is allocated to facilities and whether the demand is elastic or not. We use this classification to organize the variety of models considered in the literature into four thematic groups that share common assumptions and structural properties.

SD57

57-Room 109B, CC

Joint Session with all ENRE Clusters: The Energy, Natural Resources, and Environment Awards Session

Sponsor: ENRE – Energy II – Other (e.g., Policy, Natural Gas, Climate Change)

Sponsored Session

Chair: Erin Baker, University of Massachusetts, MIE Department, 220 ELAB, Amherst, MA, United States of America, edbaker@ecs.umass.edu

1 - Best Young Researcher Award

Enzo Sauma, Pontificia Universidad Catolica de Chile, Santiago, Chile, esauma@ing.puc.cl

The winner of the award will present a brief synopsis of the research

2 - ENRE Best Publication Award 2015 in Energy

Benjamin Hobbs, Professor, The Johns Hopkins University, 3400 North Charles Street, Baltimore, MD, United States of America, bhobbs@jhu.edu

This award is given annually to the best refereed journal article in the area of Energy published within the three calendar years prior to the year in which the award is given.

3 - ENRE Best Publication Award in Natural Resources 2015

Sandor Toth, U. of Washington, Box 352100, Seattle, WA, United States of America, toths@uw.edu

This award is given annually to the best refereed journal article in the area of Natural Resources published within three calendar years prior to the year in which the award is given.

4 - Brief Presentation by the Award Winner

Victoria Chen, The University of Texas at Arlington, Dept. of Ind., Manuf., & Sys. Engr., Campus Box 19017, Arlington, TX, 76019, United States of America, vchen@uta.edu

The winner of the Energy, Natural Resources, and Environment Award will present a brief synopsis of the research.

5 - Enre Student Travel Award Competition

Sauleh Siddiqui, Assistant Professor, Johns Hopkins University, 3400 N. Charles St. Latrobe 205, Baltimore, MD, 21218, United States of America, siddiqui@jhu.edu

The winner of the ENRE Student Travel Award Competition will present a brief synopsis of their research.

SD58

58-Room 110A, CC

Funding Opportunities within CMMI

Cluster: Funding Opportunities at NSF

Invited Session

Chair: Diwakar Gupta, National Science Foundation, Arlington, VA, United States of America, guptad@umn.edu

1 - Service, Manufacturing and Operations Research Program

Diwakar Gupta, National Science Foundation, Arlington, VA, United States of America, guptad@umn.edu

This talk will describe a new program for funding research in the area of service, manufacturing and operations research.

2 - NSF Research Opportunities in Engineering and Systems Design

Chris Paredis, Program Director, National Science Foundation, 4201 Wilson Blvd, Arlington, VA, United States of America, cparedis@nsf.gov

The National Science Foundation supports research in Engineering and Systems Design through a core program in the CMMI division (Civil, Mechanical and Manufacturing Innovation). This presentation provides an overview of the ESD program, specifically highlighting opportunities for contributions by the Operations Research community.

3 - Funding Opportunities for Research in Smart Service Systems

Alexandra Medina-borja, Program Director, National Science Foundation/ UPRM, 2507 Fowler St, Falls Church, VA, 22046, United States of America, amedinab@nsf.gov

An overview of interdisciplinary funding opportunities for researchers modeling the interaction between humans and engineered systems that could enable the smart service systems of the future. Requirements and opportunities will be discussed by one of the NSF cognizant program officers fostering these initiatives, including opportunities for translational interdisciplinary research.

SD59

59-Room 110B, CC

Small Firms, Mobility, and Entrepreneurial Spawning

Cluster: Strategy Science

Invited Session

Chair: Todd Zenger, todd.zenger@eccles.utah.edu

1 - A New Small Firm Effect? Ability Sorting by Firm Size among Ph.D.s in Science and Engineering

Daniel Elfenbein, Associate Professor of Strategy, Washington University at St. Louis, Olin School of Business, St. Louis, MO, United States of America, elfenbein@wustl.edu

2 - Forged in the Heat of Battle: New Organizations and Small Firms as Business Incubators

Tiantian Yang, Assistant Professor, Duke University, Durham, NC, United States of America, ty41@duke.edu, Howard Aldrich, Frederic Delmar

Organizational scholars have long been interested in the question of where do organizations come from. In this study, we revisit this central question within organization theory by establishing links between macro approaches that emphasize institutional conditions and micro approaches that stress organizational conditions. Using a unique data set that has comprehensive coverage of individual employees and employing organizations in Sweden from 1990 to 2002, we demonstrate that institutional conditions encouraging monopoly but discouraging individual entrepreneurial efforts amplify entrepreneurial spawning in small and autonomous organizations. Conditions in small and new organizations amplify peer influence on nascent entrepreneurs, whereas intra-firm job mobility in large corporations suppresses it. Results from a novel method – Ridge Regression – address unobserved heterogeneity, and provide compelling evidence for the argument that nascent entrepreneurs are forged in the heat of battle, as small and new organizations struggle to survive in an economy dominated by monopolistic corporations. We call for greater attention to the genesis of organizations through research on the interplay between organizations and their environments.

3 - Educational Mismatch, Work Outcomes, and Entry into Entrepreneurship

Briana Sell, Georgia Institute of Technology, Atlanta, GA,
United States of America, brian.sell@scheller.gatech.edu,
Henry Sauermann

A growing body of research explores how employees' organizational context shapes entrepreneurial activity. We contribute to this line of work by examining how "educational mismatch" – when a job does not utilize the skills an employee has acquired during formal education – relates to subsequent transitions into entrepreneurship. While prior research has focused on mismatch due to labor market frictions, workers may also enter mismatches for a variety of other reasons such as a change in career interests or family obligations. Different reasons, in turn, may relate in distinct ways to wages and job satisfaction and thus to the opportunity costs of entering entrepreneurship. Moreover, mismatch may also affect human capital development, including the formation of a broader range of skills that is beneficial in entrepreneurship. Using longitudinal data from over 22,000 scientists and engineers, we document a broad range of reasons for educational mismatch and show that the relationships between educational mismatch and wages, job satisfaction and skill variety differ significantly depending upon the reason for a mismatch. Mismatched individuals are more likely to enter into entrepreneurship in a subsequent period, an effect that goes beyond higher labor mobility per se. In addition to lower opportunity costs, greater skill variety appears to be an important factor linking educational mismatch to subsequent entrepreneurship. We discuss implications for research, managers, and policy makers.

SD60

60-Room 111A, CC

Publications in Education

Sponsor: INFORM-ED

Sponsored Session

Chair: Susan Palocsay, Professor, James Madison University, CIS & BSAN Department, Harrisonburg, VA, 22807, United States of America, palocsw@jmu.edu

1 - Education Issues in the Wiley Encyclopedia of OR/MS

Susan Palocsay, Professor, James Madison University, CIS & BSAN Department, Harrisonburg, VA, 22807,
United States of America, palocsw@jmu.edu

This presentation will give a synopsis of articles on Education Issues in the Wiley Encyclopedia of OR/MS. This topic area is aimed at providing a reference on pedagogical methods and instructional materials for teaching OR/MS. The process for developing a new article will be described with discussion of possible subjects.

2 - Panel Discussion: Publishing in Inform Transactions on Education

Armarn Ingolfsson, University of Alberta, University of Alberta,
Edmonton, Canada, aingolfs@ualberta.ca, Moderator: Jill Wilson,
Panelists: Anita Tucker, Jeroen Belijn

The panelists include ITE editors and authors who have published recently in ITE. The authors will discuss their experiences with submitting articles to ITE. The editors will provide suggestions to authors who wish to submit their work to ITE—in particular, articles about case studies and about educational games.

SD61

61-Room 111B, CC

Decision Analysis IV

Contributed Session

Chair: David Rogers, University of Cincinnati, Carl H. Lindner College of Business, Operations, Business Analytics, and IS, Cincinnati, OH, 45221-0130, United States of America, David.Rogers@UC.edu

1 - Comparative Techno-economic Analysis of Biofuel Production Considering Logistic Settings

Qi Li, Iowa State University, 0076 Black Engineering, Ames, IA, 50011, United States of America, qili@iastate.edu, Guiping Hu

A new comparative techno-economic analysis methodology is introduced of commercial biorefinery by considering the practical logistic settings and constraints. This new method would give benefit for pathway selection and parameters estimation. A case study of Iowa is conducted to illustrate and validate the proposed methodology.

2 - Optimization of Maintenance Policy in the Presence of Competing Risks

Nilofar Varzani, PhD Student, Rutgers Business School, 1 Washington Park, Newark, NJ, 07102, United States of America, nilofarv@scarletmail.rutgers.com, Michael Katehakis, Suresh Govindaraj

We study the optimal replacement and maintenance policy for a single unit system which undergoes periodic inspection in order to decide if the system should be replaced or not. The system is subject to competing risks of deterioration; regular depreciation due to usage and random shocks. We model it as a discrete time semi-markovian process and use competing risk models to search for the existence of an optimal replacement and maintenance policy.

3 - Decision-Making for Portfolio Optimization using Information Entropy

David Rogers, University of Cincinnati, Carl H. Lindner College of Business, Operations, Business Analytics, and IS, Cincinnati, OH, 45221-0130, United States of America, David.Rogers@UC.edu, George Polak

Information entropy, a measure of the uncertainty based upon the probabilities encountered, is appropriate for decision makers wanting to proactively deal with risk. An optimization model for a risk-return trade-off will be examined with entropy as either the objective to minimize subject to a constraint on expected returns or expressed as an upper-bounded constraint for the objective of maximizing return. A comparison to other objectives will be assessed with a portfolio optimization setting.

4 - Why Classical Hybrids are so Risky for Entrepreneurs, and What to do About It

Gaston De Los Reyes, Assistant Professor, George Washington University School of Business, 2201 G St. NW, Fungler 615, Washington, DC, 20052, United States of America, gdlr@gwu.edu

Williamson (1991) insufficiently characterized the institutions of hybrid governance, emphasizing forms that feature neoclassical devices to co-govern past contract close. Entrepreneurs, however, frequently resort to hybrids of classical form, lacking terms to protect from 'lawful' opportunism in case of disruption. I explicate the implications, drawing upon my dissertation study of contract law. I discuss a novel institutional solution and managerial strategies for the status quo.

SD62

62-Room 112A, CC

Transportation

Contributed Session

Chair: Mohammed Obeidat, Kansas State University, Manhattan, KS, 66502, United States of America, moh2001ie@yahoo.com

1 - Forecasting Bike Sharing Demand in New York City: A Study of Environmental Factors

Stanislav Mamonov, Assistant Professor, Montclair State University, 1 Normal Ave, Montclair, NJ, 07043, United States of America, stanislav.mamonov@montclair.edu, Andrada Ivanescu

Bike-sharing programs are universally praised for their potential to provide a sustainable and eco-friendly public transportation option. In a year since its launch, NYC Citi Bike program became the largest bike-sharing program in North America with over 100,000 annual members. In this study, we perform functional regression modeling of environmental factor (temperature, humidity, wind, rain, etc.) impact on the demand for Citi bikes in NYC to assist in system rebalancing efforts.

2 - Reliability-based Bridge Maintenance and Rehabilitation Budget Planning and Allocation

Haotian Liu, Rutgers, The State University of New Jersey, 100 Brett Road, Piscataway, NJ, 08854-8018, United States of America, yunbai.cait@rutgers.edu, Ali Maher, Yun Bai

This research develops a reliability-based model to mitigate infrastructure deterioration uncertainty for optimal planning and allocation of annual budgets for bridge maintenance and rehabilitation, a process that minimizes total social costs, the sum of agency- and user- costs, for a network of bridges. The risk of budget overruns can be reduced by explicitly considering budget variances quantified through our proposed model.

3 - A Hybrid Algorithm for Bicycle Network Design

Chin Sum Shui, The University of Hong Kong, Seat 16, Room LG208, Composite Building, Pokfulam Road, Hong Kong, Hong Kong - PRC, samshui2004@hotmail.com, Wy Szeto

This study introduces a bicycle network design problem that maximizes coverage and demand satisfaction within a limited budget. Two metaheuristics, Genetic Algorithm and Artificial Bee Colony Algorithm, are combined to solve this network design problem. Computational experiments are conducted and showed that this hybrid algorithm outperforms both GA and ABC in solving large-scale bicycle network design. The tradeoff between two objectives is investigated through varying the weighting factor.

4 - Morning Commute Management Considering Commuters' Aversion to Credit Loss

Mohammad Miralinaghi, Purdue University, West Lafayette, IN, 47906, United States of America, mohammad.miralinaghi@gmail.com, Srinivas Peeta

Under the tradable credit scheme, this study analyzes commuters' departure time choices considering their aversion to credit loss. The analysis helps in determining credit price to manage morning commute congestion. The existence and uniqueness of the equilibrium credit price are investigated and a linear model is developed to obtain system optimum credit allocation and charging schemes.

5 - Effect of Glare on Shoulder-mounted Guide Sign Visibility

Mohammed Obeidat, Kansas State University, Manhattan, KS, 66502, United States of America, moh2001ie@yahoo.com, Malgorzata Rys

Glare is a serious concern in roadway safety during nighttime driving. Shoulder-mounted guide sign visibility will be evaluated under presence of glare in a field experiment using different retroreflective sheeting. Several variables will be considered. Data will be analyzed statistically to determine the significant variables that contribute to sign's visibility.

SD63

63-Room 112B, CC

Nicholson Student Paper Competition II

Cluster: Nicholson Student Paper Competition
Invited Session

Chair: Mark Squillante, IBM Research, Thomas J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, United States of America, mss@us.ibm.com

1 - Nicholson Student Paper Competition

Illya Hicks, Rice University, 6100 Main MS-134, Houston, TX, 77005, United States of America, ivhicks@rice.edu

This session highlights the finalists for the 2015 George Nicholson Student Paper Competition.

SD64

64-Room 113A, CC

Value of Information

Sponsor: Decision Analysis
Sponsored Session

Chair: Debarun Bhattacharjya, IBM T. J. Watson Research Center, 1101 Kitchawan Road, Rt. 134, Yorktown Heights, NY, 10598, United States of America, debarunb@us.ibm.com

1 - Balancing Research and Funding Needs: Value of Information and Portfolio Tools for Nano Risk Decisions

Matthew Bates, Research Engineer, US Army Corps of Engineers, Engineer R&D Center, 696 Virginia Rd, Concord, MA, 01742, United States of America, Matthew.E.Bates@usace.army.mil, Jeffrey Keisler, Niels Zussblatt, Kenton Plourde, Ben Wender, Igor Linkov

Nanotechnologies are economically and technically promising yet pose risks. Research may identify risks and paths to make technologies less hazardous or more acceptable. Given limited resources, funders need to prioritize research efforts. Current prioritization is done primarily thorough committee or executive decision. We apply value of information and portfolio analysis techniques to develop an efficient frontier of hazard research sets across three prominent nanomaterials (Ag, TiO₂, MWCNTs).

2 - Scoring Rules, Value of Information, and Sensitivity Analysis

Victor Richmond Jose, Georgetown University, 544 Hariri Bldg, 37th & O Sts NW, Washington, DC, United States of America, vrj2@georgetown.edu, Emanuele Borgonovo, Gordon Hazen, Elmar Plischke

Scoring rules & value of information (VOI) are useful tools in decision analysis that measure the information content of data. In this talk we bridge these two seemingly separate areas of research. We obtain analytic expressions for VOI associated with some scoring rules and show that the resulting VOI sensitivity measures are global sensitivity measures that fall in a common rationale. We study this common rationale & obtain conditions that characterize properties of these sensitivity measures.

3 - Valuing Data: A Closed Form Solution for the Expected Value of Sample Information

Adam Fleischhacker, Assistant Professor Of Operations Management, University of Delaware, 222 Lerner Hall, Newark, DE, 19716, United States of America, ajf@udel.edu, Pak-wing Fok, Mokshay Madiman

We present a method for valuing sample data prior to its collection. This valuation is given in closed-form and is flexible enough to mimic multiple decision making contexts. Compared to existing techniques, it provides tighter estimates of information value, insight as to the conditions under which data is valuable, and insight into the amount of data required to achieve certain levels of value.

4 - Preference Elicitation Schemes, Random Utility Models and the Value of Information

Debarun Bhattacharjya, IBM T. J. Watson Research Center, 1101 Kitchawan Road, Rt. 134, Yorktown Heights, NY, 10598, United States of America, debarunb@us.ibm.com, Stephane Deparis

Behavioral research indicates that when posed with preference elicitation queries, people provide inconsistent responses that depend on contextual factors. Random utility models have been proposed as a potential way to represent such inconsistencies. In this talk, we introduce a hierarchical Bayesian approach where the system is uncertain about the noise in a decision maker's responses to queries, and present a methodology to compute the value of information from various elicitation schemes.

SD65

65-Room 113B, CC

Decision Analysis in Procurements and Procurement Auctions

Sponsor: Decision Analysis
Sponsored Session

Chair: Janne Kettunen, Assistant Professor, The George Washington University, 2201 G Street, NW, Washington, DC, 20052, United States of America, jkettune@email.gwu.edu

1 - Evaluating Technology Readiness for Adoption and Integration at Navy Installations

Eva Regnier, Associate Professor, Naval Postgraduate School, 699 Dyer Road, Monterey, CA, 93943, United States of America, eregnier@nps.edu, Robert Barron, Daniel Nussbaum

While the DOD has adopted and adapted NASA's technology readiness level (TRL) definitions in many contexts to measure its technologies' progress, the achievement of high TRL levels has not necessarily led to adoption operationally. We propose a measure of the progress in removing specific barriers to technology adoption and integration in Navy installations that includes criteria for technical readiness, as well as stakeholder acceptance and removal of barriers to procurement.

2 - Scheduling Procurement Auctions

Janne Kettunen, Assistant Professor, The George Washington University, 2201 G Street, NW, Washington, DC, 20052, United States of America, jkettune@email.gwu.edu, Young Kwak

We derive conditions when scheduling procurement auctions impacts significantly on their expected costs. To help the procurement auction owner in scheduling the auctions, we develop a non-linear integer programming model, which we reformulate as a mixed integer programming problem to make it computationally amenable. We apply the model for the Florida Department of Transportation procurement auction data. Our results indicate that the optimal schedule can provide substantial cost savings.

3 - Decision Analysis Concepts in Public Procurement

Jay Simon, American University, jaysimon@american.edu

Decision analysis can play a significant role in helping carry out public procurement effectively. Public procurement decisions often require assessing preferences over multiple attributes. There may also be uncertainty regarding one or more elements of the process. Recent work has examined some of the unique challenges in public procurement, and how decision analysis techniques can be used to improve outcomes.

4 - On the Inefficiency of Multiattribute Auctions for Post-Auction Produced Goods

Gregory Kersten, Prof, Concordia University, 1455 De Maisonneuve Blvd. W, 1450 Guy Street, Montreal, Qu, H3H 0A1, Canada, gregory.kersten@concordia.ca

Multiattribute auctions are used to procure heterogeneous products. If they are produced post-auction, then the price and other attributes are interrelated and the assumption of the buyers' and the sellers' quasi-linearity utility does not hold. The implication is that while winning bids may be efficient solutions the auctions are inefficient mechanisms. The inefficiency and the possibility of improving the winning efficient bids via the side payment is illustrated with Cobb-Douglas economy.

■ SD66

66-Room 113C, CC

Aviation Applications Section: Award Finalists

Sponsor: Aviation Applications

Sponsored Session

Chair: Senay Solak, University of Massachusetts Amherst, Isenberg School of Management, Amherst, MA, 01003, United States of America, solak@isenberg.umass.edu

1 - Robust Aircraft Routing

Chiwei Yan, Massachusetts Institute of Technology, 77 Massachusetts Avenue, E40-130, Cambridge, MA, United States of America, chiwei@mit.edu

We propose a robust optimization approach to minimize total propagated delay in the aircraft routing problem, a setting first developed by Lan et al. (2006) and then extended by Dunbar et al. (2012). The major contribution of our model is that it allows us to model correlated flight leg delays that existing approaches cannot efficiently incorporate. Using both historical delay data and simulated data, we show our model outperforms the state-of-the-research stochastic approach.

2 - Optimization and Analytics for Air Traffic Management

Michael Bloem, NASA, Ames Research Center, Moffett Field, CA, United States of America, michael.bloem@nasa.gov

We discuss three types of decisions in the air traffic management system: (1) how to configure available airspace and other resources to ensure safe and efficient operations in a region of airspace, (2) how to assign a set of flights to a set of slots in an Airspace Flow Program, and (3) when to implement a Ground Delay Program.

■ SD67

67-Room 201A, CC

Container-based Logistics

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Mahir Yildirim, Turkey, mahiryldrm@sabanciuniv.edu

1 - Service Design for Liner Shipping with Service Levels

Jan Fabian Ehmke, Assistant Professor, Freie Universität Berlin, Garystr. 21, Berlin, 14195, Germany, JanFabian.Ehmke@fu-berlin.de, Ann Campbell, Kevin Tierney

We consider the liner shipping route design problem, where each port has a time window, and travel times between ports are assumed to be stochastic. We ensure that each time window is satisfied with a given service level while minimizing the costs of a single route. We investigate how different service levels affect the costs of a route. We also allow the model to increase the speed of a vessel to ensure the service level, and we analyze the trade-off between vessel costs and costs of speeding.

2 - Decision Support for Flexible Liner Shipping

Johan Oppen, Norway, Johan.Oppen@hiMolde.no

We present a transportation problem representing a combination of liner and tramp shipping, where using other modes of transportation is also an option. As an example, we consider transportation of palletized frozen fish from Russia and Norway to terminals in Norway, the Netherlands and the UK. We present a mathematical model for the planning problem associated with each tour and show that problem instances of realistic size can be solved to optimality using standard software.

3 - A Biased Random-Key Genetic Algorithm for the Container Pre-Marshalling Problem

Kevin Tierney, Assistant Professor, University of Paderborn, Warburger StraÙe 100, Paderborn, 33098, Germany, kevin.tierney@upb.de, Andre Hottung

Container terminals re-order containers they are storing through a pre-marshalling process in order to streamline their operations. Even small pre-marshalling problems are difficult for state-of-the-art techniques to solve. We introduce a biased random-key genetic algorithm with several novel heuristics for solving the container pre-marshalling problem. Our approach can be easily integrated into a decision support system for terminal operators to help them increase port efficiency.

4 - Scheduled Service Network Design Problems with Balance and Synchronization Constraints

Mahir Yildirim, Turkey, mahiryldrm@sabanciuniv.edu, Tom Van Woensel, Theo Crainic

In this study, we address the problem of scheduled service network design (SND) for container freight distribution along rivers, canals, and coastlines. We propose a new concise continuous-time mixed-integer linear programming model where the objective is to build a minimum cost SND and container distribution plan defining services, their departure and arrival times, as well as vehicle and container routing. The model is solved with an ALNS-based heuristic with specific neighborhood structures.

■ SD68

68-Room 201B, CC

Electric Vehicles I

Sponsor: Transportation, Science and Logistics

Sponsored Session

Chair: Hong Zheng, Purdue University, United States of America, zheng255@purdue.edu

1 - Charging Efficiency Analysis of the Dynamic Charging Electric Vehicle

Young Jae Jang, Assistant Professor, KAIST, 291 Daehak ro, Industrial and Systems Eng, KAIST, Daejeon, 305701, Korea, Republic of, yjang@kaist.ac.kr

The Dynamic Wireless Charging Electric Vehicle (DWC-EV) charges the battery in the vehicle from a power transmitter embedded in the road. The advantage of the system is that the charge can be done while the vehicle is in motion. The KAIST On-Line Electric Vehicle (OLEV) is a commercially available DWC-EVs. We present the charging efficiency analysis of DWC-EVs with data collected from the OLEV. We discuss how the power transmitters are effectively allocated with the finding from the analysis.

2 - Adaptive Routing and Recharging Policies for Electric Vehicles

Irina Dolinskaya, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, dolira@northwestern.edu, Timothy M. Sweda, Diego Klabjan

Recharging costs for an electric vehicle (EV), which increase as the battery's charge level increases, are fundamentally different than for conventional vehicles. Furthermore, the availability of charging stations along the way must be considered. We study the problem of finding an optimal routing and recharging policy for an EV in a grid network. We develop and analyze a variety of models depending on the amount and timing of information available to the EV driver while traveling.

3 - Electric Vehicle Routing and Network Design of Charging Station Locations

Hong Zheng, Purdue University, United States of America, zheng255@purdue.edu, Xiaozheng He, Srinivas Peeta

An electric vehicle (EV) cannot travel beyond its range without stopping to recharge its battery. This study addresses two problems for EVs. We show that the EV routing subject to range feasibility and maximum number of stops can be reduced to a dynamic program solving the shortest path problem on an auxiliary network. We then present a mixed-integer linear programming formulation and a solution algorithm for the network design problem of determining the charging station locations.

■ SD69

69-Room 201C, CC

Facility Logistics II

Sponsor: TSL/Facility Logistics

Sponsored Session

Chair: Clara Novoa, Associate Professor, Texas State University, 601 University Dr., San Marcos, TX, 78666, United States of America, cn17@txstate.edu

1 - New Aisle Designs for Order Picking Warehouses

Sabahattin Ozden, Auburn University, Shelby Center, Auburn, United States of America, sgo0002@auburn.edu, Alice Smith, Kevin R. Gue

We reveal results of a three year effort to find new aisle designs for order picking warehouses. We describe a computational system that searches all possible designs within a design class using an evolutionary strategy. To assess the fitness of a design, the system allocates SKUs to locations and then builds optimal routes from real orders. The results, we believe, are surprising and significant.

2 - Optimizing Storage-class Formation in Unit-load Warehouses

Yun Fong Lim, Associate Professor, Singapore Management University, 50 Stamford Road, #04-01, Singapore, 178899, Singapore, yflim@smu.edu.sg, Marcus Ang

We propose a new approach to optimize storage classes for a unit-load warehouse with a general layout. Under this approach, the “attractiveness” of each storage location is determined by its frequency of visits, which is estimated by a linear program that considers the warehouse’s layout and the products’ arrivals and demands. We group the locations with similar visit frequencies in the same class. Our approach gives a lower average travel cost than a cost-based method and a grid-based method.

3 - Two Single Instruction Multiple Data Implementations for Solving the Quadratic Assignment Problem

Clara Novoa, Associate Professor, Texas State University, 601 University Dr., San Marcos, TX, 78666, United States of America, cn17@txstate.edu, Apan Qasem, Abhilash Chaparala

We solve the Quadratic Assignment Problem by implementing 2-opt and tabu search in the Graphical Processing Unit (GPU). For the 2-opt we fine tune the thread block configuration and exploit inter-thread data locality through shared memory allocation. In the tabu search we exploit dynamic parallelism. We experiment with QAPLIB data sets. Tabu search accuracy is very satisfactory while 2-opt performance is impressive. Results are contrasted to a Tabu search GPU implementation from other authors.

4 - Optimizing Vehicle Travel Speed in Green Vehicle Routing Problems

Xiaoren Duan, Teaching Assistant, University of Louisville, Department of Industrial Engineering, University of Louisville, Louisville, KY, 40292, United States of America, duanxiaoren@gmail.com, Sunderesh Heragu

A Green Vehicle Routing problem with various travel speed is formulated to minimize total carbon emission. Heuristic algorithm based on Savings Algorithm and Tabu Search is developed to solve this problem. Numerical experiments show that the heuristic performs better compared with GAMS and can achieve 15.69% and 32.27% carbon emission reduction compared with basic G-VRP with and without time window limitation respectively. Impact of congestion on carbon emission is also investigated.

We develop a probabilistic flow-based location model to optimally deploy electric vehicle (EV) charging stations on traffic network, taking into account the probability of a demand node becoming an EV adopter. We demonstrate the model with the Sioux Falls network and solve the model using a Lagrangian relaxation based algorithm.

2 - Optimization-based Planning of Capacitated Infrastructure for Intercity Trips of Electric Vehicles

Yu Nie, Northwestern University, y-nie@northwestern.edu, Ali Zockaie, Mehrnaz Ghamami

The main purpose of this study is to facilitate the long-distance trips of electric vehicles. The objective is to minimize the construction cost of charging stations, battery cost, and refueling delay, while maintaining a certain level of service. To this end, a nonlinear optimization model is developed. To overcome computational difficulties of the commercial solvers, a metaheuristic algorithm is proposed to solve the nonlinear model, as the size of problem grows in real world case studies.

3 - Multi-period Capacitated Flow Refueling Location Problem

Anpeng Zhang, University at Buffalo, SUNY, 339 Bell Hall, Buffalo, NY, 14228, United States of America, anpengzh@buffalo.edu, Jee Eun Kang, Changhyun Kwon

We formulate a new flow refueling location problem for electric vehicles, considering the capacity of rechargers and the time span of construction. The model will help us determine the optimal locations of recharging stations as well as the number of recharging modules at each station over multiple time periods. We develop heuristic methods and present computational experiments based on the freeway network that spans between Washington DC and Boston.

4 - Infrastructure Planning for Fast Charging Stations in a Competitive Market

Zhaomiao Guo, University of California, Davis, 614 Sycamore Lane, Apt. 232, Davis, CA, United States of America, zmguo@ucdavis.edu, Yueyue Fan, Julio Deride

We study the fast charging infrastructure planning under competition using Multi-agents Optimization Problem with Equilibrium Constraints modeling framework. We find that the investment pattern could be affected by consumers’ weights on charging price and charging availability: if consumers care more about charging availability, the investment may cluster to a few locations; on the contrary, the investment may diffuse through out the network.

SD70

70-Room 202A, CC

RAS Roundtable: Part II Railroad Operations Efficiency and Recovery

Sponsor: Railway Applications

Sponsored Session

Chair: Erick Wikum, Principal Scientist, Tata Consultancy Services, 1000 Summit Drive, Milford, OH, 45150, United States of America, erick.wikum@tcs.com

1 - Railroad Operations Efficiency and Recovery

Erick Wikum, Principal Scientist, Tata Consultancy Services, 1000 Summit Drive, Milford, OH, 45150, United States of America, erick.wikum@tcs.com, Siddhartha Sengupta, Tao Tang, Lonny Hurwitz

In the railroad industry, achieving efficient operations and developing the capability to recover from inevitable disruptions are key to both customer service and financial performance. In this session, the second of two, panelists from the railroad industry worldwide explore how to define and measure efficiency and recovery and share case studies and a vision for the role OR/MS and analytics has played and can play in operational efficiency and recovery.

SD71

71-Room 202B, CC

Alternative Fuel Vehicles and Sustainable Transportation I

Sponsor: TSL/Urban Transportation

Sponsored Session

Chair: Changhyun Kwon, Associate Professor, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, chkwon@usf.edu

1 - A Probabilistic Location Model for Deployment of Electric Vehicle Charging Stations

Eric Huang, Assistant Professor, Clemson University, 314 Lowry hall, Clemson, SC, 29634, United States of America, yxhuang@clemson.edu, Shengyin Li

SD72

72-Room 203A, CC

IIE Transactions

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Jianjun Shi, Georgia Institute of Technology, 765 Ferst Dr, Atlanta, United States of America, jianjun.shi@isye.gatech.edu

1 - Progressive Measurement and Monitoring for Multi-resolution Data in Surface Manufacturing Considering Cross Correlations

Hui Wang, Assistant Professor, Florida State University, 2525 Pottsdamer St, Tallahassee, FL, 32310, United States of America, hwang10@fsu.edu

This paper develops a new approach to modeling and monitoring surface variations by fusing in-plant multi-resolution measurements and process information. The fusion is achieved by considering cross correlations among measured data and manufacturing process variables based on cutting dynamics. The model can make Bayesian inference on surface shapes progressively. A new monitoring scheme is then proposed for jointly detecting and locating defects without significantly increasing false alarms.

2 - Prediction of the Failure Interval with Maximum Power Based on the Remaining Useful Life Distribution

Junbo Son, PhD Candidate, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, json5@wisc.edu, Qiang Zhou, Shiyu Zhou, Mutasim Salman

Prognosis of remaining useful life (RUL) of a unit or a system plays an important role in system reliability. One key aspect of the RUL prognosis is constructing the best prediction interval. In this paper, we propose a new method, namely maximum prediction power interval (MPI). The MPI guarantees the best prediction performance under the given acceptable error range. A numerical simulation study and case study with real data confirm the better features of MPI over existing prediction intervals.

3 - Time Series Forecasting for Nonlinear and Non-stationary Processes: A Review and Comparative Study

Changqing Cheng, USF, 4202 E. Fowler Avenue, Tampa, FL, United States of America, cheng.changqing@gmail.com, Hui Yang, Zhenyu Kong, Satish Bukkapatnam

Forecasting of time series data is critical for the monitoring of complex systems. This article presents a review of nonlinear and non-stationary time series forecasting models and a comparison of their performances in certain real-world applications. Conventional approaches do not adequately capture the system evolution, from the standpoint of forecasting accuracy, computational effort, and sensitivity to quantity and quality of a priori information in these applications.

■ SD73

73-Room 203B, CC

Multicriteria and Multiobjective Models in Risk, Reliability and Maintenance

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Adiel De Almeida Filho, Assistant Professor, Universidade Federal de Pernambuco, Caixa Postal 7471, Recife, PE, 50630-971, Brazil, adieltaf@googlemail.com

Co-Chair: Adiel T De Almeida, Professor, Universidade Federal de Pernambuco, Caixa Postal 7462, Recife, PE, 50630-971, Brazil, almeidaatd@gmail.com

1 - Multicriteria and Multiobjective Models for Risk, Reliability and Maintenance Decision Analysis

Adiel T De Almeida, Professor, Universidade Federal de Pernambuco, Caixa Postal 7462, Recife, PE, 50630-971, Brazil, almeidaatd@gmail.com, Adiel De Almeida Filho, Marcelo H Alencar, Rodrigo J P Ferreira

Many decisions on Risk, Reliability and Maintenance (RRM) problems involve multiple objectives and multicriteria methods (MCDM). RRM decision problems may affect strategic results of organizations, human life (e.g. safety) and the environment, in order to comply with modern society demands. A framework for structuring MCDM in the RRM context is presented, based on the reference Multicriteria and Multiobjective Models for Risk, Reliability and Maintenance Decision Analysis.

2 - Multicriteria and Multiobjective Models on Maintenance Outsourcing

Adiel De Almeida Filho, Assistant Professor, Universidade Federal de Pernambuco, Caixa Postal 7471, Recife, PE, 50630-971, Brazil, adieltaf@googlemail.com, Thalles V Garcez, Adiel T De Almeida

This work presents key aspects of MCDM approaches for decisions on maintenance outsourcing, which including contract selection and supplier selection. Given the MCDM nature of maintenance outsourcing, models to address this problem include maintainability, dependability, quality of repair besides cost, which are detailed in the reference Multicriteria and Multiobjective Models for Risk, Reliability and Maintenance Decision Analysis.

3 - Multidimensional Risk Evaluation Based on Multicriteria and Multiobjective Models

Marcelo H Alencar, Universidade Federal de Pernambuco, Av. Professor Moraes Rego, 1235., Recife, PE, 50670-901, Brazil, marcelohazin@gmail.com, Adiel T De Almeida, Rodrigo J P Ferreira, Adiel De Almeida Filho, Thalles V Garcez

When considering a multidimensional risk evaluation model a broader view is enabled by considering financial, environmental and safety aspects simultaneously. This work presents MCDM approaches in two different contexts: natural gas pipelines and underground electricity distribution system. These models are part of the reference Multicriteria and Multiobjective Models for Risk, Reliability and Maintenance Decision Analysis.

4 - Multicriteria and Multiobjective Models on Preventive and Condition-based Maintenance

Rodrigo J P Ferreira, Assistant Professor, Universidade Federal de Pernambuco, Av. Professor Moraes Rego, 1235., Recife, PE, 50670-901, Brazil, rodjpf@gmail.com, Cristiano A.V. Cavalcante, Adiel T De Almeida, Adiel De Almeida Filho

Classical optimization models consider only the cost optimization for defining the best time interval for preventive maintenance. This work presents a framework to support the selection of time interval for equipment preventive maintenance involving reliability and availability aspects besides cost. A complete framework for such decisions is presented in the reference Multicriteria and Multiobjective Models for Risk, Reliability and Maintenance Decision Analysis.

■ SD74

74-Room 204A, CC

Panel Discussion: Funding Opportunities

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Abhishek Shrivastava, Assistant Professor, FAMU-FSU College of Engineering, Dept of Industrial & Manufacturing Eng, Tallahassee, FL, 32310, United States of America, ashrivastava@fsu.edu

1 - Panel Discussion: Funding Opportunities

Moderator: Abhishek Shrivastava, Assistant Professor, FAMU-FSU College of Engineering, Dept of Industrial & Manufacturing Eng, Tallahassee, FL, 32310, United States of America, ashrivastava@fsu.edu, Panelists: Fariba Fahroo, Sylvia Spengler, Diwakar Gupta

In this panel, program officers from NSF and DARPA will discuss funding opportunities in their programs. The panelists are Dr. Fariba Fahroo, Dr. Sylvia Spengler and Dr. Diwakar Gupta.

■ SD75

75-Room 204B, CC

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - IBM -Optimization Group - IBM Decision Optimization for Python IBM Optimization Group

In this tutorial, you will learn how to use the new CPLEX Modeling API for Python with standard development tools. You will learn how to install this open source library, configure your environment to use it and write optimization models in few minutes. At the end of the session, you will be able to write your own optimization model and solve them with the free IBM Decision Optimization offers (either with the DOcloud trial or with the Community Edition of CPLEX Optimization Studio). The hands-on part of the tutorial requires a 64-bit machine (Windows, Linux, or Max) and access to wifi, but all participants will be able to follow along. Follow us on twitter @IBMoptimization.

■ SD76

76-Room 204C, CC

Emerging Development in Simulation and Optimization

Sponsor: Simulation

Sponsored Session

Chair: Chun-hung Chen, George Mason University, 4400 University Drive, MS 4A6, SEOR Dept, GMU, Fairfax, VA, 22030, United States of America, cchen9@gmu.edu

1 - Slice Sampling Approaches to Stochastic Optimization

John Birge, Professor, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu

Crude Monte Carlo approaches are often used to approximate stochastic optimization problems, but such approaches suffer from both high variance and bias. This presentation will describe the slice sampling approach, which can significantly reduce variance, and mode identification, which can eliminated bias.

2 - Simulation Analytics

Barry Nelson, Walter P. Murphy Professor, Northwestern University, Dept. of IEMS, 2145 Sheridan Road, C210, Evanston, IL, 60208, United States of America, nelsonb@northwestern.edu, Yujing Lin

The influence of queueing theory on stochastic simulation is substantial, including simulation's emphasis on long-run averages of predetermined performance measures. As a result, the analysis of simulation data and real-world "big data" are entirely different. In this talk we explore how a data analytics perspective could significantly change the use of simulation.

3 - Conditional Probability of Correct Selection for Ranking and Selection Procedures

Dave Goldsman, Professor, Georgia Tech, School of ISyE,
Georgia Tech, Atlanta, GA, 30332, United States of America,
sman@gatech.edu, Joshua McDonald

Ranking and selection (R&S) procedures seek to select the best of a number of competing populations, subject to a guarantee on the achieved probability of correct selection (PCS). In the usual formulations of R&S problems, the guaranteed PCS is specified a priori. We instead study the conditional PCS after sampling has concluded - which may be substantially different than the a priori version. In particular, we show how to compute or estimate the conditional PCS given the observed scenario.

4 - Efficient Optimization via Multi-fidelity Simulation

Jie Xu, George Mason University, 4400 University Dr., MS 4A6,
Engr Bldg, Rm 2100, Fairfax, VA, 22030, United States of
America, jxu13@gmu.edu, Si Zhang, Edward Huang, Loo Hay
Lee, Nurcin Celik, Chun-hung Chen

To efficiently solve optimization problems involving time-consuming high-fidelity simulations, we propose a new multi-fidelity optimization framework known as MOTOS. MOTOS uses low-fidelity simulations to broadly explore the solution space and focuses high-fidelity simulations on promising solutions. MOTOS integrates low- and high-fidelity simulations in an efficient and rigorous manner and has been shown to lead to significant computational savings.

■ SD77

77-Room 300, CC

Supply Chain Management IV

Contributed Session

Chair: Chun Hung Chiu, Associate Professor, Associate Professor,
Sun Yat-sen University, Business School, Sun Yat-sen University,
No 135, Xingang West Rd., Guangzhou GD 510275, China,
zhaojx5@mail.sysu.edu.cn

1 - Public Versus Private Quality Disclosure of Counterfeit Goods

Laura Wagner, Zaragoza Logistics Center, Calle Bari, Zaragoza,
Spain, laurawa@mit.edu, Mustafa Cagri Görböz, Mahmut Parlar

Some manufacturers have been accused for withholding information on counterfeit incidences, while others have proactively warned. We analyse this situation in a supply chain setting. In particular we are interested in manufacturer's willingness to disclose the quality of the potentially counterfeit good, intermediary's purchasing decision in response to the disclosure strategy and consumers' responses to such warnings.

2 - Mean Variance Analysis for Supply Chain Contract

Jinfeng Yue, Professor, Middle Tennessee State University and
Shanghai University of Finance and Economics, Department of
Management and Marketing, Murfreesboro, TN, 37132,
United States of America, jinfeng.yue@mtsu.edu

This research studies the supply chain coordination by mean-variance analysis. When only the mean and variance information is available, the coordination conditions are obtained for wholesale price contract. The maximum number of retailers can also be determined. For general cases, the conditions to select the retailers are also obtained. Finally, an optimal designed wholesale price contract can coordinate the supply chain and split the total profit by any designed level.

3 - Economic Contracts Improving the Efficiency of Cotton Supply Chains

Jian Li, Associate Professor, Northeastern Illinois University, 5500
N. St. Louis Ave, Chicago, IL, 60625, United States of America,
jli@neiu.edu, Panos Kouvelis

We study the use of economic contracts to improve the efficiency of a stylized cotton supply chain structure of a ginner and a farmer. The benchmark is a standard transfer price contract that reflects the current practice on which a minimum price is imposed from the government. We show that the minimum transfer price is not necessarily effective. An incentive contract is proposed. Numerical studies show that the incentive contract achieves a win-win improvement.

4 - Supply Chain Performance Assessment and Supplier and Component Importance Identification

Dong Michelle Li, Assistant Professor of Supply Chain
Management, Department of Management & Marketing,
Kansas State University, Jonesboro, AR, 72467,
United States of America, dli@astate.edu, Anna Nagurney

We develop a multitiered competitive supply chain network game theory model with firms and associated potential suppliers. All decision-makers seek to maximize their profits. The supply chain network performance measures, which assess efficiency, are constructed for the full supply chain and the individual firm levels. The identification and ranking of the importance of suppliers as well as the components of suppliers with respect to the full supply chain or individual firm are also proposed.

5 - Channel Coordination under Information Asymmetry by Target Sales Rebate Quantity Discount Contracts

Chun Hung Chiu, Associate Professor, Sun Yat-sen University,
Business School, Sun Yat-sen University, No 135, Xingang West
Rd., Guangzhou, GD, 510275, China, zhaojx5@mail.sysu.edu.cn,
Jian Li, T.c.e. Cheng, Tsan Ming Choi

We study a target sales rebate quantity discount (TSR-QD) contract in a single-manufacturer and multi-retailer supply chain. The manufacturer is risk-neutral. Retailers are mean-variance seekers with different target profits which are unknown to the manufacturer. We explore how a Menu of TSR-QD Contracts (MTQ) can be applied to enhance the benefit of the manufacturer and the supply chain's efficiency.

■ SD78

78-Room 301, CC

Supply Chain Risk Management II

Contributed Session

Chair: Saravanan Kuppasamy, Assistant Professor, Quinnipiac
University, 275 Mt Carmel Ave, Hamden, CT, 06518, United States of
America, saravanan.kuppasamy@quinnipiac.edu

1 - A Fair Optimization of Expected Cost and Expected Service under Disruption Risks

Tadeusz Sawik, Professor And Chair, AGH University of Science &
Technology, Al. Mickiewicza 30, Krakow, 30059, Poland,
ghsawik@cyf-kr.edu.pl

A new decision-making problem of equitably efficient optimization of cost and service level in a supply chain under local and regional disruption risks is presented. The problem is formulated as a mixed integer program with the ordered weighted averaging aggregation of the two conflicting objective functions. Computational examples and some managerial insights are reported.

2 - Risk Assessment in a Large Retail Supply Chain

Burak Kazaz, Associate Professor, Syracuse University,
721 University Avenue, Syracuse, NY, 13244, United States of
America, bkazaz@syr.edu, Mert Hakan Hekimoglu, John Park

This study develops a new risk exposure index for various infrastructures in a large retail supply chain. It identifies detrimental disruptions, considers operational and financial metrics with excess capacity at distribution centers and fulfillment centers that can serve as backup facilities. It provides risk levels at all facilities.

3 - Risk Modeling in Food Supply Chain, Insights

Saravanan Kuppasamy, Assistant Professor, Quinnipiac
University, 275 Mt Carmel Ave, Hamden, CT, 06518, United
States of America, saravanan.kuppasamy@quinnipiac.edu,
Mario Norbis, Iddrisu Awudu

Issues related to food supply chain are becoming increasingly critical for the business and policy makers alike. We propose a food supply chain research framework that consider issues related to location, legislation, corporate responsibility, collaboration, risk measures, food safety and security measures. In addition to managerial insights and implications, we discuss the challenges and opportunities in food supply chains.

4 - Decision Model for Prioritization of Reverse Supply Chain Risks

Dr Jitender Madaan, Professor, Indian Institute of Technology
Delhi, Room No 606 DMS, VK Bhawan, Hauz Khas, New Delhi,
110016, India, jmadaan@dms.iitd.ac.in

This paper presents a flexible, generalized decision model that integrates and prioritize high-level and detailed RSC design decisions that incorporates risks.

5 - Design of a Responsive Vaccine Supply Chain under Supply and Demand Uncertainty

Stef Lemmens, KU Leuven, Naamsestraat 69 Box 3555, Leuven, 3000, Belgium, stef.lemmens@kuleuven.be, Nico Vandaele, Catherine Decouttere

Both literature and industrial evidence emphasize the challenge and the importance of the design of a responsive vaccine supply chain. We model the interrelationships between multi-echelon inventory, production capacity and lead time and take supply and demand uncertainty into account by the use of a methodology which combines the guaranteed service approach and queueing theory. Furthermore, we show the results of applying our methodology to a real-life industrial rotavirus vaccine supply chain.

■ SD79

79-Room 302, CC

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - Artelys - See the Artelys KNITRO 10.0 Optimization Solver in Action

Richard Waltz, Senior Scientist, Artelys Corp

KNITRO is the premier solver for nonlinear optimization and recent winner of the GECCO 2015 black-box optimization competition, finishing first among 28 solvers. This software demonstration will highlight the latest KNITRO features, including a new object-oriented interface and new SQP algorithm for derivative-free optimization (DFO). The demo will also provide an overview of how to effectively use KNITRO in a variety of environments and applications, and present recent benchmarking results for DFO and nonlinear optimization.

2 - GAMS Development Corp - GAMS – An Introduction

Steve Dirkse, Director of Optimization, GAMS Development Corp

This workshop will show you how to use the General Algebraic Modeling System (GAMS) in an efficient and productive way. There will be an introduction to the system and a presentation of the key concepts in GAMS. The largest part of the workshop consists of hands-on exercises. Amongst others, it will be demonstrated how GAMS interacts with other applications and you will see how to analyze and debug problems using the tools available within GAMS.

Monday, 8:00am - 9:30am**■ MA01**

01-Room 301, Marriott

Military O.R. and Applications III

Sponsor: Military Applications

Sponsored Session

Chair: Michael Hirsch, ISEA TEK, 620 N. Wymore Rd., Ste. 260, Maitland, FL, 32751, United States of America, mhirsch@iseatek.com

1 - Electronic Attack Decision Framework using Pomdp

Brandon Ha, Sr. Systems Engr II, Raytheon Company, 2000 E. El Segundo Blvd, E1/B2208D, El Segundo, CA, 90245, United States of America, Brandon.C.Ha@raytheon.com

The objective of this research is to develop a suite of machine learning algorithms to address the need for engaging with future advanced unknown agile RF threats and co-evolve with the adversary's response. Our approach uses POMDP to represent the unobservable elements in the environment and actions that can provide partial information about these elements – to learn (characterize) the unknown emitters and then to predict the intent and deploy optimal EA technique(s).

2 - Pursuit on a Graph using Partial Information: Max-delay

David Casbeer, Dr., Air Force Research Laboratory, 2210 8th Street, B20146 R300, Wright Patterson AFB, OH, 45433, United States of America, david.casbeer@us.af.mil, Krishna Kalyanam, Meir Pachter

The optimal control of a “blind” pursuer searching for an evader on a graph is presented. At specific locations on the graph (road network), unattended ground sensors (UGS) have been placed which detect the intruder. The pursuer (UAV) visits the sensors and decides where to travel in order to capture the evader. An algorithm is presented to compute the maximum initial delay for which capture is guaranteed. The algorithm also returns the corresponding optimal pursuit policy.

3 - Improved Sensor Placement in Multistatic Sonar Networks

W. Matthew Carlyle, Naval Postgraduate School, mcarlyle@nps.edu, Emily Czaparo, Mumtaz Karatas, Christoph Hof

Multistatic sonar networks containing non-collocated sources and receivers represent an important generalization of traditional sonar systems. Although they convey many tactical and operational advantages, multistatic sensor networks are difficult to model and to employ optimally. We discuss the multistatic sensing problem and describe algorithms for placing sources and receivers.

4 - Optimal Deployment of Network Defenses

David Myers, Research Engineer, United States Air Force, 26 Bedford Drive, Whitesboro, NY, 13492, United States of America, david.djm.myers@gmail.com

Optimally deploying an ever-growing slate of network defense capabilities, while maintaining the ability to perform the mission, is a critical component of future USAF operations. Utilizing a system's attack graph, this defense configuration problem (DCP) is a network interdiction problem where the network defender is the interdictor and the attacker is the evader. The purpose of this presentation is to formulate and describe the DCP and discuss extensions into a dynamic posture problem.

■ MA02

02-Room 302, Marriott

Game Theory in Practice for Homeland Security

Cluster: Homeland Security

Invited Session

Chair: Milind Tambe, USC, 941 Bloom Walk, Los Angeles, CA, United States of America, tambe@usc.edu

1 - Game Theoretic Applications in Coast Guard Operations

Erich Stein, USCG, 1 Chelsea St., New London, CT, 06339, United States of America, Erich.V.Stein@uscg.mil, Craig Baldwin, Sam Cheung

The Coast Guard has tested and operationalized game theory applications in several mission areas including port security and fisheries. A model was created to mitigate effects of illegal fishing and generate schedules for USCG assets. The Port Resilience Operational Tactical Enforcement to Counter Terrorism (PROTECT) game model optimizes limited security resource allocations. Finally, development of innovative patrol strategies for drug and migrant interdiction efforts is ongoing.

2 - New Trends in Perence Modeling of Adversary Decisions

Ali Abbas, Professor of Industrial and Systems Engineering and Public Policy and Director of Create, University of Southern California, 3710 McClintock Avenue, RTH 314, Los Angeles, CA, United States of America, aliabbas@price.usc.edu

This talk will discuss the need for new models of preferences in both competitive and cooperative games. Simulation results and videos of cooperative autonomous vehicles will also be presented using new models of preferences.

MA03

03-Room 303, Marriott

Teaching Modern Project Management

Cluster: Scheduling and Project Management

Invited Session

Chair: Nicholas G. Hall, The Ohio State University, Fisher College of Business, Columbus, OH, United States of America, hall.33@osu.edu

1 - Modern Project Management Curriculum

Ted Klastorin, Professor, University of Washington, Foster School of Business, Box 353226, Seattle, WA, 98195-3226, United States of America, tedk@u.washington.edu

Empirical evidence has documented the failure to adequately manage many complex projects, including IT and new product development projects. At the same time, the need to successfully manage large and risky projects has never been greater. As a result, the need for effectively educating students in the project management (PM) area is critical. In this talk, I will explore the main directions and concepts that should be included in a PM curriculum and how this differs from current courses.

2 - Designing a Project Management Game

Enno Siemsen, Associate Professor, University of Minnesota, 321 19th Ave S, Minneapolis, MN, 55455, United States of America, siems017@umn.edu

As a capstone event in my project management class, I have designed a game to capture organizational dynamics in the context of a project management organization. Teams in the game form a hierarchy, with players taking the role of Vice Presidents, Project Managers or Resources. Having different incentives, these three types of roles need to learn to cooperate to see their projects to completion.

3 - Everything is a Project

Nicholas G. Hall, The Ohio State University, Fisher College of Business, Columbus, OH, United States of America, hall.33@osu.edu

This talk describes the development of an MBA course on project management that is the most popular elective at Fisher College of Business. The course uses various teaching methods - games and group activities, graded in-class problem solving exercises, guest speaker presentations with hands-on activities, HBS simulations, case reports with student presentations, along with traditional lecture and class discussion. The course currently enrolls students from seven graduate programs across campus.

4 - Teaching a Quantitative Approach to Project Management

Rainer Kolisch, Technische Universität München, TUM School of Management, Arcisstraße 21, Munich, Germany, rainer.kolisch@wi.tum.de

I will report on my course "Project Management – A quantitative approach". The course is an elective in the third (and final) year of the undergraduate program in Management and Technology at TUM School of Management, Germany. The course covers a number of quantitative topics ranging from operational to strategic project management. I will report on the content of the course, pedagogical concepts used and feedback received from the students.

MA05

05-Room 305, Marriott

Applying Advanced Analytics to Social Media data

Cluster: Social Media Analytics

Invited Session

Chair: Mohsen Parsafard, University of South Florida, 4202 E. Fowler Avenue ENG 214, Tampa, FL, 33620, United States of America, parsafard@mail.usf.edu

1 - Estimating Social Media's Financial Contribution to the Hospitality Sector

Mark Gerner, Sr. Lead Economic Scientist, Booz Allen Hamilton,

22 Battery March St., Boston, MA, United States of America, gerner_mark@bah.com

In this paper we present a methodology leveraging natural language processing and machine learning techniques to estimate the reputational and financial contribution from customer social media conversation, customer ratings, and associated comments from multiple online travel sites.

2 - Efficient Community Partition Algorithm in Networks

Jiaofei Zhong, CSUEB, Dept. of Comp Sci., 25800 Carlos Bee Blvd, Hayward, CA, United States of America, fayzhong08@gmail.com, David Haley, Ehsan Kamalinejad

One fundamental problem in analyzing complex big data sets is the task of classification of the data. Community partitioning plays a crucial role in data analysis of scientific, social, and technological networks. As the study of isoperimetric inequalities is a well-explored field, it is possible to extend specific mathematical theory to its equivalent form in data clustering. We propose an efficient community partition algorithm to analyze the relationships among data via the network topology.

3 - Topic Dependent Edge Importance Measures in Social Media Platforms

George Michailidis, University of Florida, 1 University Ave, Gainesville, FL, United States of America, gmichail@umich.edu

Social media platforms produce large amounts of both structured and unstructured data. A key question for such platforms is to identify important interactions between nodes in the corresponding user network. We address this problem by using a stochastic model of interacting counting processes on a graph, so that topic dependent interactions can also be identified. We illustrate the results of our model on a US Senators Twitter data set.

4 - Role of Social Media in Healthcare via Analytics

Sinjini Mitra, Assistant Professor, California State University, Fullerton, ISDS Department, 800 N State College Blvd, Fullerton, CA, 92831, United States of America, smitra@exchange.fullerton.edu

The advance of computing resources and increased availability of large amounts of data in the recent decade has made it possible to use extensive analytics for effective decision-making in the healthcare industry. Based on a member survey of a large health plan, we identify factors (demographic, clinical and technological) that are significantly associated with member interest in adopting social and mobile media for obtaining health information via predictive and descriptive analytics.

5 - Time Geography Based Mobility Measures for Geo-tagged Twitter Data

Mohsen Parsafard, University of South Florida, 4202 E. Fowler Avenue ENG 214, Tampa, FL, 33620, United States of America, parsafard@mail.usf.edu, Guangqing Chi, Xiaopeng Li

Social media data present tremendous opportunities for studying individuals' travel behaviors. In this study, we propose a set of fundamental measures to quantify the bounds of an individual's spatial and temporal activity range. We further develop an interpolation approximation method to improve the computation efficiency of these measures. Our results reveal an interesting pattern of people's traveling and tweeting behavior where the proposed measures follow a power-law distribution.

MA06

06-Room 306, Marriott

Financial Engineering

Sponsor: Financial Services

Sponsored Session

Chair: Xuefeng Gao, Assistant Professor, The Chinese University of Hong Kong, xfgao@se.cuhk.edu.hk

1 - Mean Field Game with Singular Controls

Joon Seok Lee, UC Berkeley, 2033 Haste St. #313, Berkeley, CA, 94704, United States of America, ljshope@berkeley.edu, Xin Guo

We introduce a mean field game framework with singular controls. To solve this singular control problem with multiple agents, we derive the Fokker-Planck equation for the singular control, which is a generalization of the mean field game with regular controls. Both single controls of a bounded velocity and of a finite variation will be discussed. Finally, we will present some applications to optimal execution and systemic risk.

2 - Algorithmic Trading under the Effects of Volume Order Imbalance

Ryan Donnelly, EPFL, Quartier UNIL - Dorigny, Extrane 214, 1015, Lausanne, Switzerland, ryan.donnelly@epfl.ch

Shortcomings of some order book models are noted with motivation provided by data from the NASDAQ. The influence of volume order imbalance on order book dynamics is incorporated into a model which allows the agent to adjust their strategy based on an easily observable quantity. The imbalance allows the agent to

decide when they should trade more aggressively to take advantage of price movements, and when they should trade more conservatively to protect against adverse selection effects.

3 - Bettering Investment Performance using Market Implied Information

Duan Li, Professor, The Chinese University of Hong Kong,
Dept of Systems Eng. & Eng. Manag., Shatin, Hong Kong - PRC,
dli@se.cuhk.edu.hk

Financial markets are heavily driven by people's expectations of the future. Thus portfolio decisions should take into consideration the market implied forward-looking information, in addition to the backward-looking information from historical data. This talk discusses a formal framework in identifying hidden utilities of different representative investor groups by analyzing market implied information using inverse optimization solution schemes.

4 - Optimal Spread Crossing in a Limit Order Book

Xuefeng Gao, Assistant Professor, The Chinese University of Hong Kong, xfgao@se.cuhk.edu.hk, Nan Chen, Xiang Ma

We study when a precommitted trader converts a limit order to a market order in algorithmic executions of orders. We formulate the problem as an optimal stopping problem. We present structural properties of the optimal strategy and show how it depends on market conditions. We also study the optimal spread crossing problem under a Bayesian learning model for the fundamental value of an asset. Our numerical experiments illustrate how the price-learning affects the optimal spread crossing time.

■ MA07

07-Room 307, Marriott

Systemic Risk Measurement: Data and Algorithmic Aspects

Cluster: Risk Management

Invited Session

Chair: Andreea Minca, Cornell University, Ithaca, NY, United States of America, acm299@cornell.edu

1 - Systemic Impact in Fund Networks – Part I

Somya Singhvi, Cornell University, Ithaca, NY, United States of America, ss989@cornell.edu, Divya Singhvi, Andreea Minca

We analyze portfolios of equity funds to understand their impact on other portfolios. Further, we develop an algorithm that calculates the systemic impact of a fund on a network of funds. The algorithm captures the premature liquidation in response to investor outflows for different funds. Finally, we also show that our algorithm converges.

2 - Systemic Impact in Fund Networks Part II

Divya Singhvi, Cornell University, 516 University Ave, Apt. B8, Ithaca, NY, 14850, United States of America, ds576@cornell.edu, Andreea Minca, Somya Singhvi

Using the holdings data for US equity funds, we implement the systemic risk measure algorithm. We analyze the second order impact of a fund on the other funds. Our analysis suggest that the network structure leads to a significant additional impact on other funds. Further, we show that the funds begin to cluster themselves into groups of high and low impact based on their network properties.

3 - Inhomogeneous Financial Networks and Contagious Links

Andreea Minca, Cornell University, Ithaca, NY, United States of America, acm299@cornell.edu

We propose a framework for testing the possibility of large cascades in financial networks. This framework accommodates a variety of specifications for the probabilities of emergence of 'contagious links', where a contagious link leads to the default of a bank following the default of its counterparty. We give bounds on the size of the first order contagion and testable conditions for it to be small.

■ MA08

08-Room 308, Marriott

Topics in Innovative and Entrepreneurial Operations

Cluster: Business Model Innovation

Invited Session

Chair: Onesun Steve Yoo, University College London, Gower Street, London, WC1E 6BT, United Kingdom, o.yoo@ucl.ac.uk

1 - The Time-money Trade-off for Entrepreneurs: When to Hire the First Employee?

Onesun Steve Yoo, University College London, Gower Street, London, WC1E 6BT, United Kingdom, o.yoo@ucl.ac.uk, Charles Corbett, Guillaume Roels

Hiring the first employee is a major step in a firm's life cycle, marking the transition from an entrepreneur-dominated firm to a phase of rapid growth. It is also a significant operational problem because how an entrepreneur operates with an employee is fundamentally different than without. We present hiring as a time money tradeoff for entrepreneurs and examine when the entrepreneur should make the hiring decision depending on whether time or money is the chief bottleneck constraint.

2 - Collective Choice in Dynamic Public Good Provision: Real Versus Formal Authority

George Georgiadis, Assistant Professor, Northwestern University, 2001 Sheridan Rd, Evanston, IL, 60208, United States of America, g-georgiadis@kellogg.northwestern.edu, Renee Bowen, Nicolas Lambert

We study a game in which two heterogeneous agents exert effort over time to bring a project to completion, and the project scope can be determined at any point via collective choice. A larger project scope requires greater cumulative effort and delivers higher benefits on completion. We show that the efficient agent prefers a smaller project scope than the inefficient agent, but their preferences are time-inconsistent. We study the optimal allocation of property rights to minimize disagreement.

3 - Third Party Legal Funding under Asymmetric Information

Noam Shamir, Assistant Professor, Tel-Aviv University, Haim Levanon, Tel-Aviv, Israel, nshamir@post.tau.ac.il, Julia Shamir

Third party legal funding describes the phenomenon in which a company that has no direct stake in a legal claim, covers the legal costs of this claim in exchange for future share of the monetary outcome of the claim. We study the implications of this phenomenon in terms of its effect on the litigation strategy and court congestion.

4 - Entrepreneurship Company Formation from University Technology Commercialization

Vish Krishnan, UCSD, La Jolla, CA, 92037, United States of America, vkrishnan@ucsd.edu, Kanetaka Maki

We study how the commercialization of university technologies leads to company formation and collaboration with industrial partners. Specifically, using a mathematical model and empirical testing, we detail the way in which the technology transfer offices both moderate and mediate collaboration.

■ MA09

09-Room 309, Marriott

Understanding Knowledge Sources and Politics in Technology Management

Sponsor: Technology, Innovation Management & Entrepreneurship

Sponsored Session

Chair: Zhijian Cui, Assistant Professor of Operations and Technology Management, IE Business School, Calle de Maria de Molina 12, Madrid, 28006, Spain, Zhijian.Cui@ie.edu

1 - The Differential Effect of Knowledge Sources on Innovation Strategy: A Contingency Approach

Beatriz Rodriguez-Prado, University of Valladolid, Avda. Valle del Esgueva, Valladolid, 47011, Spain, bprado@eco.uva.es, Elena Revilla, Zhijian Cui

We examine how innovation strategy determines the sources of knowledge (own-generated, bought-in and co-developed) and their impact on innovation performance. Data of 9054 firms belonging to fourteen European Countries constitute the empirical base of the study. Results derived from Cluster analysis, ANOVAs and Generalized Linear Models strongly indicate investments in innovation activities may generate differential value depending on key contextual factors.

2 - The Effects of Outsourcing Knowledge on the Dynamics of Outsourcing Modes

Qiong Chen, University of Science and Technology of China, School of Management, USTC, 96 Jin Zhai Road, Bao He District, Hefei, 230026, China, qiongc@g.clemson.edu, Shouqiang Wang, Gulru Ozkan-Seely, Alveda Roth

We evaluate buyer's dynamic choice of outsourcing channels: directly through in-house procurement department or indirectly through an intermediary. Using a two-period game theoretic model, we demonstrate the critical yet interesting role of outsourcing knowledge and highlight effects of direct and indirect learning on the change of buyer's strategies over time.

3 - Politics as an Impediment to Technology Strategy Implementation

Marc Finkelstein, IE Business School, 52 Lawrence Ave West,
Toronto, ON, M5M1A4, Canada, marc.finkelstein@gmail.com

Organizations expend significant resources to develop a technology strategy, yet too often fail to accomplish it. They commonly perceive the failure to stem from a lack of resources and capabilities, yet exploratory research suggests that organizational politics are significantly more impactful. Research will outline the types of political maneuvering exhibited and how it is impactful to the achievement of the technology strategy.

■ MA10

10-Room 310, Marriott

Economics of Digital Channels

Sponsor: E-Business

Sponsored Session

Chair: Yi-Chun (Chad) Ho, Assistant Professor, George Washington University, 2201 G Street NW, Washington, DC, 20052, United States of America, chadho@gwu.edu

1 - Loyalty Program: The Dilemma of Shipping Fee

Xue Tan, University of Washington, 4747 30th Ave NE J171,
Seattle, WA, 98105, United States of America, xuetan@uw.edu,
Yi-chun (chad) Ho, Yong Tan

Loyalty programs that offer one year of free shipping after consumers prepay a membership fee has become prevalent in recent years. This paper studies the mechanism of membership free shipping and compare it with contingent free shipping which waives the shipping fee when the order size reaches a threshold in a game theoretical setting. By changing the speed consumers receive their products, membership free shipping changes the product value.

2 - Help Doesn't Help: A Partially Ordinal Discrete Choice Model on Review with Review in Review

Jinyang Zheng, PhD Student, University of Washington,
Mackenzie Hall (MKZ), Room 342, University of Washington,
Seattle, WA, 98105, United States of America, zhengjy@uw.edu,
Yong Tan, Guopeng Yin

We investigate the objectivity of content on review platform with review in review function. By applying a partially ordinal discrete choice model, our research identifies the social capital maximization behavior when user gives rating. We find that rating giving distribution is generated by a mixed distribution of quality driven incentives and expected RIR performance driven incentives, which indicates a consequence of less objectivity of reviewers and less variety of the system.

3 - Corporate Information Disclosure: Social Media Vs. Investor Website

Behnaz Bojd, University of Washington, Seattle WA,
United States of America, behnaz@uw.edu, Yong Tan, Qixing Qu

Traditionally, investors' had access to key information only through the company's websites. Nowadays, companies can also use social media platforms such as Twitter and Facebook, to release information and communicate with the market and shareholders. In this study we compare the nature of information disseminated on each channel and estimate their effectiveness on market behavior.

4 - Incentive Pricing and Quality Screening in Two-sided Markets: The Case of Zocdoc.com

Yuan Jin, University of Connecticut, School of Business, OPIM,
2100 Hillside Road Unit 1041, Storrs, CT, 06269,
United States of America, yuan.jin@business.uconn.edu

Patients and doctors can schedule appointments on an online two-sided market platform, ZocDoc.com. ZocDoc's profits depend on its doctors' market quantity, and this quantity is associated with patients' market quantity, which is in turn determined by doctors' market quantity and quality. In this paper, I study the effect of pricing in ZocDoc's case, and conclude that the addition of monetary incentives for high-quality doctors can improve both profits and overall doctor quality.

■ MA11

11-Franklin 1, Marriott

Convexification Techniques in Mixed-Integer Programming

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Sercan Yildiz, PhD Student, Carnegie Mellon University,
5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America,
syildiz@andrew.cmu.edu

1 - Sparse Cuts for Sparse Integer Programs

Qianyi Wang, Georgia Institute of Technology, 755 Ferst Drive,
NW, Atlanta, GA, 30332, United States of America,
crown200x@gmail.com, Marco Molinaro, Santanu Dey

In this talk, we present an analysis of the quality of sparse cuts for IPs with sparse formulations. In order to accomplish this analysis, we define a notion of an induced graph based on the constraint matrix. Then, we are able to relate the strength of sparse cutting-planes to graph-theoretic parameters of the induced graph.

2 - Envelopes of Bilinear Functions over Polytopes with Application to Network Interdiction

Danial Davarnia, University of Florida, 303 Weil Hall,
Gainesville, FL, United States of America, d.davarnia@ufl.edu,
Mohit Tawarmalani, Jean-philippe P Richard

We present a convexification technique to obtain, in the space of their defining variables, a linear description of the convex hull of graphs of bilinear functions over the Cartesian product of a general polytope and a simplex. We apply this procedure to study envelopes of various bilinear functions over certain polytopes. For network interdiction, our procedure yields an improved set of linearization constraints for bilinear objective terms that is cognizant of paths and cycles in the network.

3 - Convexification Techniques for Disjunctive Conic Sets

Sercan Yildiz, PhD Student, Carnegie Mellon University, 5000
Forbes Ave, Pittsburgh, PA, 15213, United States of America,
syildiz@andrew.cmu.edu, Fatma Kilinc Karzan

We study the convex hull of disjunctions applied to a set defined as the intersection of a cone with an affine subspace. The resulting nonconvex sets are of fundamental importance in mixed-integer conic programming where they are used to derive valid inequalities. We identify and study the cases where a single convex inequality is sufficient to describe the convex hull and where this inequality can equivalently be expressed in an appropriate conic form.

4 - How to Convexify the Intersection of a Second Order Cone and a Nonconvex Quadratic

Samuel Burer, Professor, University of Iowa, S346 Pappajohn
Business Building, Iowa City, IA, 52242-1994, United States of
America, samuel-burer@uiowa.edu, Fatma Kilinc Karzan

We study how to convexify the intersection of a second-order cone and a nonconvex quadratic. Under several easy-to-verify conditions, we derive a simple, computable convex relaxation. Under further conditions, we prove that this relaxation captures precisely the corresponding convex hull. Our approach unifies and extends previous results, and we illustrate its applicability and generality with many examples.

■ MA13

13-Franklin 3, Marriott

Distributionally Robust Optimization

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Karthik Natarajan, Singapore University of Technology and Design, Singapore, Singapore, 487372, Singapore, karthik_natarajan@sutd.edu.sg

1 - Robust Optimization using Inconsistent Overlapping Marginals

Anulekha Dhara, Postdoctoral Fellow, Singapore University of
Technology and Design, 8 Somapah Road, Singapore, 487372,
Singapore, anulekha@sutd.edu.sg, Karthik Natarajan

In this paper, we consider a robust linear optimisation problem with random objective coefficients belonging to a Frechet class of distributions with inconsistent overlapping marginal. For this class of problem the goal is to find the tightest possible bound on the expected optimal value. To solve this problem we apply the notion of closest consistent marginal to obtain an approximate upper bound.

2 - Sparse but Efficient Operation: A Conic Programming Approach

Gao Yini, National University of Singapore, 1 Business Link,
Singapore, Singapore, yini.gao@u.nus.edu, Chung Piau Teo,
Zhenzhen Yan

Standardization and flexibility are two competing paradigms in designing efficient operations. We ask whether there is a sparse but flexible operation mode to reap the benefits of both. Using copositive conic programming, we develop a new mechanism which gives sparse but efficient network structures. It recovers a chain in the context of process flexibility. We further apply it to Singapore Changi Airport "roving team" deployment problem and obtain a sparse yet efficient deployment network.

3 - SDP Reformulation of CP Programs: Best-worst Choice and Range Estimation Applications

Karthik Natarajan, Singapore University of Technology and
Design, Singapore, 487372, Singapore,
karthik_natarajan@sutd.edu.sg, Chung Piau Teo

We show that the worst case moment bound on the expected optimal value of a mixed integer linear program with a random objective c is obtained from a SDP reformulation of a completely positive program. We illustrate the usefulness of the distributionally robust bounds in estimating the expected range of random variables with two applications arising in random walks and best-worst choice models.

4 - Robust Inventory Models with Demand Partitioning Information

Joline Uichanco, Asst. Professor, University of Michigan, Ross
School of Business, 701 Tappan Ave, Ann Arbor, MI, 48109,
United States of America, jolineu@umich.edu, Karthik Natarajan,
Melvyn Sim

We present the distributionally robust newsvendor with demand asymmetry information through partition statistics. We derive a closed-form for the robust order quantity under the special case of semivariance, implying a simple rule-of-thumb for setting order quantities under limited information. The distribution can be calibrated from primitive demand data. We demonstrate the performance of the method in computational experiments on data from an automotive spare parts company.

MA14

14-Franklin 4, Marriott

Stochastic Optimization Applications to Renewable Energy Integration

Sponsor: Optimization/Optimization Under Uncertainty
Sponsored Session

Chair: Lindsay Anderson, Assistant Professor, Cornell University, 316
Riley Robb Hall, Ithaca, NY, 14853, United States of America,
landerson@cornell.edu

1 - Multi-Objective Optimal Sensor Deployment under Uncertainty for Advanced Power Systems

Urmila Diwekar, President, Vishwamitra Research Institute, 2714
Crystal Way, Crystal Lake, IL, 60012, United States of America,
urmila@vri-custom.org, Pallabi Sen, Kinnar Sen

Advanced power plants using an integrated gasification combined cycle (IGCC) offer a competitive and economical means to produce electricity with reduced emission levels. An efficient, safe, and reliable operation of an IGCC plant requires effective strategies for monitoring and control. The results of this multi-objective framework for optimizing observability, efficiency, and cost for an IGCC system are presented in this work.

2 - Optimal Microgrid Design under Load and Photovoltaic Power Uncertainty

Alex Zolan, University of Texas at Austin, 204 E. Dean Keeton
Street, Stop C2200, Austin, TX, 78712, United States of America,
alex.zolan@utexas.edu, Alexandra Newman, David Morton

We present a model for establishing the design and energy dispatch for a microgrid that minimizes cost and fuel requirements given the set of technologies (diesel generators, solar arrays and batteries), photovoltaic power (PV) availability on location, and probability model that governs the load and PV availability of a forward operating base. We introduce a policy-based restriction of the problem that allows for the solution of a multiple scenario problem while preserving solution quality.

3 - Tracking a Stochastic Generate-pump Schedule for a Pumped-storage Hydroelectric Unit

Bismark Singh, The University of Texas at Austin, 204 E. Dean
Keeton Street, Stop C2200 ET, Austin, TX, 78705, United States
of America, bismark.singh@utexas.edu, Surya Santoso

Using a stochastic dynamic program, we first optimize the generate-pump schedule for a pumped-storage hydroelectric unit to maximize profit. Since energy prices are stochastic, we find an adaptive policy for the schedule. And,

since we must submit bids to an ISO, we seek a bidding strategy that will allow us to track the desired generate-pump schedule. Thus, we solve a model that yields an optimal block-bidding policy in the sense of tracking the desired stochastic generate-pump policy.

4 - A Stochastic Model to Determine Probabilistic Reserves Requirements for Unit Commitment Problems

Gabriela Martínez, Cornell University, Ithaca, NY, United States of
America, gabriela.martinez@cornell.edu, Lindsay Anderson

In this work, we propose a stochastic unit commitment model to decide appropriate spinning and non-spinning reserve requirements for a power system with high penetration of renewable energy. The day-ahead scheduling of the systems is formulated as a chance-constrained model in which the network power balance of the systems is ensured with a high-probability level and the system reserves are allocated in a risk-averse fashion by selection of quantiles of the uncertain generation.

MA15

15-Franklin 5, Marriott

Radiation Therapy Optimization

Sponsor: Optimization in Healthcare
Sponsored Session

Chair: Arka Roy, Bowling Green State University, 440 W. Barry Ave.,
Chicago, IL, United States of America, arkaroy1@gmail.com

1 - A Robust Optimization Method for Homogeneous Magnet Design in MR-guided Radiation Therapy

Iman Dayarian, University of Toronto, 5 King's College Road,
Toronto, ON, M4Y 2P9, Canada, iman@mie.utoronto.ca,
Timothy Chan, Teodor Stanescu

Magnetic resonance imaging uses a magnetic field generated by a configuration of coils to image patients. An optimization-generated coil configuration can be sensitive to small perturbations that affect the homogeneity of the magnetic field. This sensitivity is especially important when the coils are mounted on a treatment device that rotates during treatment, which is the case in MR-guided radiation therapy (MRgRT). This talk presents a robust optimization approach to magnet design for MRgRT.

2 - Incorporating Lung Ventilation Function in Intensity-modulated Radiation Treatment Planning

Fujun Lan, Postdoctoral Fellow, University of Maryland,
Baltimore, 22 S. Greene St., GGJ02, Baltimore, MD, 21201,
United States of America, flan@email.arizona.edu,
Warren D'Souza, Hao Zhang

4DCT-derived ventilation images were used for pencil-beam intensity modulation to achieve functional sparing of lung on a voxel-by-voxel basis. This functional approach was compared to the conventional anatomical planning on 10 patients retrospectively. Significant reductions (p -values < 0.001) of V20 (lung volume receiving ≥ 20 Gy) (11%), functional V20 (18%), mean lung dose (MLD) (7%) and functional MLD (11%) were achieved without significantly increasing doses to the other organs-at-risk.

3 - Optimizing Global Liver Function in Stereotactic Body Radiotherapy Treatment Planning

Victor Wu, PhD Student, University of Michigan, 1205 Beal
Avenue, Ann Arbor, MI, 48109, United States of America,
vwu@umich.edu, H. Edwin Romeijn, Marina Epelman,
Martha Matuszak, Yue Cao, Mary Feng, Hesheng Wang,
Randall Ten Haken

We propose a radiotherapy treatment planning optimization model for liver cancer cases. In this work, we plan treatment using voxel-based liver dose-response model: post-treatment liver function depends on its pre-treatment function and the dose received. We maximize predicted post-treatment global liver function. We approximately solve the resulting non-linear non-convex problem with a customized mixed-integer linear programming-based algorithm. 2D synthetic and 3D clinical cases were studied.

4 - Robust Adaptive Optimization in Radiation Therapy

Arka Roy, Bowling Green State University, 440 W. Barry Ave.,
Chicago, IL, United States of America, arkaroy1@gmail.com,
Omid Nohadani

Radiotherapy treatments degrade over time in the presence of uncertainties. Robust models leap beyond such limitations. However, traditional robust models solve for the worst-case realization of the uncertainty prior to the start of the treatment, which may be too conservative at later fractions. We propose a robust two-stage approach that adapts to the first-stage decisions during treatment. The results are demonstrated through a clinical prostate case.

■ MA16

16-Franklin 6, Marriott

**Conic Convex Optimization:
New Algorithms and Results**

Sponsor: Optimization/Linear and Conic Optimization

Sponsored Session

Chair: Robert Freund, Professor, MIT Sloan School of Management, Building E62-567, 77 Massachusetts Ave., Cambridge, MA, 02139, United States of America, rfrend@mit.edu

1 - Approximation Schemes for Linear Programming in Inner Product Spaces

Sergei Chubanov, University of Siegen, Kohlbeistr. 15, Siegen, Germany, sergei.chubanov@uni-siegen.de

The size of an LP is the sum of binary sizes of the coefficients describing this LP. Such LPs are known to be polynomially solvable. The situation changes if each element of the data can be accessed only via an oracle and the size is defined as the size of the data used by the oracle. This class includes dynamic flows and DP formulations of some other NP-hard problems. A further generalization leads to LPs in inner product spaces. In this talk, we discuss a new algorithm for such problems.

2 - Solving General Convex Conic Problems with First-order Methods
James Renegar, Professor, Cornell University, 224 Rhodes Hall, Ithaca, NY, 14853, United States of America, renegar@cornell.edu

We present recent results in ongoing research pertaining to a framework that is novel in allowing any convex, conic optimization problem to be recast as an equivalent convex optimization problem whose only constraints are linear equations and whose objective function has Lipschitz constant no greater than one, to which a broad class of first-order methods can be applied.

3 - New Computational Guarantees for First-order Methods for Convex Optimization, via a Function Growth Constant

Robert Freund, Professor, MIT Sloan School of Management, Building E62-567, 77 Massachusetts Ave., Cambridge, MA, 02139, United States of America, rfrend@mit.edu, Haihao Lu

We present new algorithms and complexity bounds for solving convex optimization problems using first-order methods. We presume we are given a strict lower bound on f^* . We introduce a new functional measure called the growth constant G for $f(x)$ that measures how quickly the function level sets grow and that plays a fundamental role in the complexity analysis. We present new computational guarantees for non-smooth and smooth optimization that improves on existing complexity bounds in many ways.

■ MA17

17-Franklin 7, Marriott

Network Optimization under Uncertainties

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Neng Fan, University of Arizona, 1127 E. James E. Rogers Way Room 111, Tucson, AZ, 85721, United States of America, nfan@email.arizona.edu

1 - Identifying Critical Nodes of Interdependent Networks by Integer Programming

Shanshan Hou, University of Arizona, Tucson, AZ, 85721, United States of America, shanshanh@email.arizona.edu, Neng Fan, Andres Garrido

In this talk, we analyze the vulnerability of interdependent networks by identify a set of nodes in power grid, whose removal results high impacts by the cascading failures in the interdependent communication network and itself. We propose an approach by integer programming to identify such set of nodes. Knowing the behavior of these networks can help to be more prepared before attacks and failures that may affect the power network supply and functionality.

2 - Improving the Global Pre-positioning Network for Natural Disaster Recovery

Adam Prokop, Graduate Msc Student In Supply Chain Management, Wilfrid Laurier University, 75 University Avenue West, Waterloo, ON, N2L3C5, Canada, prok3910@mylaurier.ca

Pre-positioning critical supplies in strategic locations can increase the effectiveness of humanitarian relief aid for natural disasters. An optimization model, utilizing recent global disaster risk indexes, was developed to evaluate the current United Nations Humanitarian Response Depot network. Alterations of the current network were shown to significantly minimize the average distance between pre-positioning facilities and demand regions.

3 - Network Optimization under Non-linear Utility

Chin Hon Tan, National University of Singapore, 1 Engineering Drive, Singapore, 117576, Singapore, isetch@nus.edu.sg

Decision makers are rarely risk neutral in practice. Hence, solutions that maximize expected rewards or minimize expected costs, which assumes that the decision maker is risk neutral, may not be appropriate. In this presentation, we study the sensitivity of solutions with respect to the risk neutral assumption and discuss how solutions that are robust to the decision maker's utility can be improved upon.

4 - An Integer Programming Approach for Mixed Fault Diameters

Elham Sadeghi, Graduate Research Assistant, University of Arizona, Tucson, AZ, United States of America, sadeghi@email.arizona.edu, Neng Fan

We consider the minimum (k,l) -connected d -dominating set problem which is a fault-tolerance dominating set. This problem is a generalization of minimum connected dominating set problem. The integer programming formulations based on vertex-cut and edge-cut is introduced and a cutting plane algorithm is proposed to solve it.

■ MA18

18-Franklin 8, Marriott

The Reborn of Traditional OR Methods in the Era of Big Data

Cluster: Modeling and Methodologies in Big Data

Invited Session

Chair: Shouyi Wang, Assistant Professor, University of Texas at Arlington, 3105 Birch Ave, Grapevine, TX, 76051, United States of America, shouyiw@uta.edu

Chair: Danica Xiao, PhD Candidate, University of Washington, Seattle, 3900 Northeast Stevens Way, Seattle, WA, 98195, United States of America, xiaoc@uw.edu

1 - A Dynamic Active-Set Method for Linear Programming

Alireza Noroziroshan, University of Texas at Arlington, 600 Grand Ave, Apt#103, Arlington, TX, 76010, United States of America, alireza.norozir.en@gmail.com, Bill Corley, Jay Rosenberger

An active-set method obtains solution for linear programming problems by adding one or more constraints at a time to solve smaller problems iteratively. We present an efficient constraint selection rule for adding varying numbers of constraints at each iteration. This approach is significantly faster than the standard linear programming algorithms.

2 - Big Data Analytics for RFID-Enabled Logistics Data from Ubiquitous Manufacturing Shopfloors

Ray Y. Zhong, Post-doctoral Fellow, The University of Hong Kong, 8-16 Haking Wong Building, IMSE, Pokfulam Road, HKU, Hong Kong, Hong Kong - PRC, zhongzry@gmail.com, George Q. Huang

RFID has been widely used in logistics and supply chain management. This paper discusses the manufacturing shopfloor where typical logistics resources are converted into smart manufacturing objects (SMOs) by using RFID and wireless technologies to create a RFID-enabled intelligent shopfloor environment. In such environment, enormous RFID data has been captured and collected. This paper introduces a Big Data Analytics for the RFID logistics data by defining different behaviors of the SMOs.

3 - On the Mixed Set Covering, Packing and Partitioning Polytope

Yong-Hong Kuo, Research Assistant Professor, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong - PRC, yhkuo@cuhk.edu.hk, Janny Leung

We study the polyhedral structure of the mixed set covering, packing and partitioning problem, derive the mixed odd hole inequality, and identify sufficient condition for it to be facet-defining. In the special case when the induced graph is a (mixed) odd hole, the inclusion of this new facet-defining inequality provides a complete polyhedral characterization. Computational experiments show that these new valid inequalities achieve a significant time reduction in solving the mixed problems.

4 - Using Big-Data Analytics for Identifying Hot Spots of Border Security

Haibo Wang, Killam Distinguished Asso Prof, Texas A&M International University, 5201 University Blvd, Laredo, TX, United States of America, hwang@tamiu.edu, Yaquan Xu, Jun Huang, Wei Wang

This project develops a comprehensive data aggregation and analysis system to provide the decision support for identifying hot spots of border security using a complex network model for transportation infrastructure in the border region. All these research related data will be aggregated on both space and time dimensions and analyzed by using "big data" models and tools developed in this study

■ MA19

19-Franklin 9, Marriott

Distributed and Parallel Optimization

Sponsor: Computing Society

Sponsored Session

Chair: Mohammad Javad Feizollahi, Assistant Professor of Business Analytics, Robinson College of Business, 35 Broad St. NW, Room 1109, Georgia State University, Atlanta, GA, 30303, United States of America, mfeizollahi@gsu.edu

1 - Object-parallel Solution of Large-scale Lasso Problems

Gyorgy Matyasfalvi, Doctoral Candidate, Rutgers University, 100 Rockefeller Road, Piscataway, NJ, 08854, United States of America, matyasfalvi@gmail.com, Jonathan Eckstein

We describe an “object-parallel” C++ approach to implementing first-order optimization methods. Using a “symbolic temporaries” technique to improve operator overloading efficiency, high-performance parallel algorithms may be expressed with MATLAB-like simplicity. As an example application, we solve large-scale Lasso problems on a distributed-memory supercomputer with the spectral projected gradient (SPG) method. We can efficiently accommodate highly unbalanced sparsity patterns.

2 - Decentralized Mixed Integer Programming

Mohammad Javad Feizollahi, Assistant Professor of Business Analytics, Robinson College of Business, 35 Broad St. NW, Room 1109, Georgia State University, Atlanta, GA, 30303, United States of America, mfeizollahi@gsu.edu, Shabbir Ahmed

We propose a decentralized mixed integer programming (MIP) approach based on adding primal cuts and restricting the Lagrangian relaxation of the original MIP problem. A key challenge is that, because of the non-convex nature of MIPs, classical distributed and decentralized optimization approaches cannot be applied directly to find their optimal solutions. We test the proposed method on the unit commitment problem and discuss its pros and cons comparing to the central MIP approach.

3 - Dealing with Asynchrony and Information Delays in Parallel Optimization

Hamid Reza Feyzmahdavian, PhD Student, Royal Institute of Technology (KTH), Osquldas Väg 10, Floor 6, Stockholm, 10044, Sweden, hamidrez@kth.se, Arda Aytekin, Mikael Johansson

This talk presents an asynchronous and parallel mini-batch algorithm for regularized stochastic optimization problems that allows multiple workers to work at different rates and perform computations independently of each other. Several examples are worked out to demonstrate that the impact of asynchrony on the convergence rate of the algorithm is asymptotically negligible, and a near-linear speedup in the number of workers can be expected.

4 - Deep Learning with Auxiliary Coordinates, with an Application to Fast Image Search

Miguel Carreira-Perpinan, Associate Professor, University of California, Merced, 5200 N. Lake Road, Merced, CA, 95343, United States of America, mcarreira-perpinan@ucmerced.edu, Ramin Raziperchikolaei

Many nonconvex problems in machine learning arise from nested functions consisting of nonlinear processing layers, such as deep neural nets. We describe a generic technique to train such models, the method of auxiliary coordinates. This introduces significant parallelism in the optimization, is easy to implement by reusing existing algorithms, and can handle nonsmooth layers. We illustrate it with a binary hashing application involving an intermediate layer of binary variables.

5 - Decentralized Approximation Methods for Potential Games under Exogenous Uncertainty

Harikrishnan Sreekumaran, PhD Candidate, Purdue University, 315 N Grant St., West Lafayette, IN, 47906, United States of America, harikrishnan.sreekumaran@gmail.com, Andrew Liu

We consider computing Nash equilibria of certain classes of games under exogenous uncertainty and analyze distributed algorithms for solving such problems. We establish convergence of parallel Gauss-Jacobi and sequential Gauss-Seidel type methods, when combined with approximation schemes such as Monte Carlo sampling. Implementation schemes and numerical results for the proposed approach are presented for applications such as traffic routing and network design games.

■ MA20

20-Franklin 10, Marriott

Resource Allocation in Cloud Computing

Cluster: Cloud Computing

Invited Session

Chair: Yuan Zhong, Columbia University, 500 W. 120th Street, New York, NY, 10027, United States of America, yz2561@columbia.edu

1 - Massively Parallel Queueing Networks

Mariana Olvera-Cravioto, Associate Professor, Columbia University, New York, NY, 10027, United States of America, mo2291@columbia.edu

We study a network with many parallel servers where jobs are split into a number of pieces to be processed in parallel on a random subset of servers, with the constraint that all pieces of a job must be processed in a synchronized fashion. We discuss an analytically tractable model where all fragments of a job must initiate their service at the same time and compare it to the one where the synchronization occurs at the end, as in MapReduce. We also compare it against the optimal routing model.

2 - Heavy-traffic Behavior of the Maxweight Algorithm in a Switch with Uniform Traffic

Siva Theja Maguluri, Postdoctoral Researcher, IBM TJ Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, smagulu@us.ibm.com, R. Srikant

We consider a switch with uniform traffic operating under the MaxWeight scheduling algorithm. This traffic pattern is interesting to study in the heavy-traffic regime since the queue lengths exhibit a multi-dimensional state-space collapse. We characterize the heavy-traffic behavior of the expectation of the sum queue lengths in steady-state and show that MaxWeight algorithm has optimal queue-length scaling behavior with respect to the size of a switch. This settles an open conjecture.

3 - Flexible Queueing Architectures

Kuang Xu, Stanford University, Stanford, CA, United States of America, kuangxu@stanford.edu, John Tsitsiklis

We consider a service system with n independent job streams and n servers, where each server can only serve a relatively small number, d , of job streams. We wish to design a service architecture so that the system has as large a capacity region as possible, and a scheduling policy under which queueing delays become vanishingly small as the system size, n , increases. We show that our objective can be accomplished by combining an expander graph architecture and a batching policy.

■ MA21

21-Franklin 11, Marriott

Public Health and Health System Modeling

Sponsor: Health Applications

Sponsored Session

Chair: Stan Finkelstein, MIT, 1 Amherst Street, Cambridge, MA, 01773, United States of America, snfinkel@mit.edu

1 - Engineering Effective Responses to Influenza Outbreaks

Stan Finkelstein, MIT, 1 Amherst Street, Cambridge, MA, 01773, United States of America, snfinkel@mit.edu, Richard Larson, Karima Nigmatulina, Anna Teytelman

The year 2009 witnessed a worldwide flu pandemic. Our questions: In the absence of vaccines, what steps can be taken to reduce the chance of becoming infected? When vaccines arrive late, what allocation policy will minimize the number who become infected? We discuss how to reduce the exponential growth factor by hygiene and social distancing behaviors, and recommend a data-driven adaptive vaccine allocation policy that, if used in 2009, might have reduced infections in the U.S. by five million.

2 - A Stochastic Programming Approach to Reduce Patient Wait Times and Overtime in an Outpatient Infusion Center

Jeremy Castaing, University of Michigan, IOE 1205 Beal Ave., Ann Arbor, MI, United States of America, jctg@umich.edu, Amy Cohn, Brian Denton

Chemotherapy infusion treatments for cancer have significant and unpredictable variability in duration. We present an algorithm for designing patient appointment schedules under uncertainty in treatment times. The objective is to minimize a trade-off between expected patient wait times and expected total time required to treat patients. Computational experiments based on real-world data are presented and used to draw managerial insights.

3 - Optimal Screening Policies for Women at High Risk of Breast Cancer

Caglar Caglayan, Georgia Institute of Technology, Atlanta, GA,
United States of America, ccaglayan6@gatech.edu, Turgay Ayer,
George Rust

Women with breast density, family history of breast or ovarian cancer, or BRCA1 and BRCA2-mutation-carriers are at higher risk of breast cancer. For such women, non-mammographic modalities such as ultrasound or MRI, adjunct to or instead of mammogram, can be beneficial but they lead to an increased screening cost. Considering both potential health benefits and financial aspects, we study this multi-modality breast cancer screening problem and identify cost-effective optimal screening policies.

4 - Modeling Supply Chain System Structure to Trace Sources of Food Contamination

Abigail Horn, PhD Candidate, Engineering Systems Division,
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
E40-240, Cambridge, MA, 02139, United States of America,
abbyhorn@mit.edu, Richard Larson, Stan Finkelstein

We are developing a methodology to identify high probability sources of contamination in the event of large-scale outbreaks of foodborne disease based on a graph-theoretic Bayesian inference algorithm. We present results from 2 modeling frameworks used to develop the inference algorithm: analytical models of stylized versions of the problem leading to new, general insights, and a Bayesian Network model used to support decision making and targeted information gathering during investigations.

■ MA22

22-Franklin 12, Marriott

New Advances in Stochastic Networks

Sponsor: Applied Probability

Sponsored Session

Chair: Guodong Pang

Assistant Professor, Penn State University, 363 Leonhard Bldg,
University Park, PA, 16802, United States of America,
gup3@engr.psu.edu

1 - Networks with Several Types of Interacting Tasks

Yuri Suhov, Professor, University of Cambridge/Penn State
University, yms@maths.cam.ac.uk

I am going to present and discuss new analytic results on a class of reversible networks with several types of interactive customers. The main result is product-type formulas for the equilibrium distributions.

2 - Staffing Large-scale Service Systems with Stochastic Arrival Rates

Ying Chen, PhD Candidate, University of Texas at Austin,
1 University Station, ETC 5.112, Austin, TX, 78712,
United States of America, lesley@utexas.edu, John Hasenbein

We minimize the staffing level for large-scale queueing systems with random arrival rates, where a QoS constraint is enforced on the probability a customer is queued. For single-station systems, we consider an Erlang-C model with only partial information provided for the discrete arrival-rate distribution, and we present a numerically stable procedure to obtain asymptotically optimal results. In the multi-station case, we introduce a joint QoS constraint and explore the corresponding solutions.

3 - Ergodic Control of Multiclass Multi-pool Networks in the Halfin-Whitt Regime

Ari Arapostathis, Professor, University of Texas at Austin,
Electrical and Computer Engineering, Austin,
United States of America, ari@ece.utexas.edu, Guodong Pang

We study the scheduling and routing control of Markovian multiclass multi-pool networks under the long-run average (ergodic) cost criteria in the Halfin-Whitt regime. We develop a new framework to study the associated ergodic diffusion controls and characterize the optimal solutions via the HJB equations. The asymptotic optimality results are established via a spatial truncation technique to approximate the solutions to the HJB.

4 - Pricing Server Information in Distributed Systems

Mauro Escobar, Columbia University, 500 W 120th Street,
3rd Floor, New York, NY, 10027, United States of America,
me2533@columbia.edu, Mariana Olvera-Cravioto

We consider a queueing network where each job consists of a random number of pieces to be served in parallel, and such that all the pieces of a same job must begin their processing simultaneously. We analyze the performance of two models, one where the different pieces are routed to a random subset of servers and another one where they are optimally assigned to the servers with the shortest workloads. We illustrate how to use these two models to evaluate intermediate routing policies.

■ MA23

23-Franklin 13, Marriott

Queues: Approximations and Control

Sponsor: Applied Probability

Sponsored Session

Chair: Amy Ward, Professor, University of Southern California,
Marshall School of Business, Los Angeles, CA, 90089,
United States of America, amyward@marshall.usc.edu

Co-Chair: Mor Armony, NYU Stern, 44 West 4th Street, New York, NY,
10012, United States of America, marmony@stern.nyu.edu

1 - Stein's Method for Diffusion Approximations of Many-Server Queues

Anton Braverman, Cornell University, Ithaca, NY, 14850,
United States of America, ab2329@cornell.edu, J. G. Dai

Diffusion approximations for many-server queues have been studied extensively since the pioneering work of Halfin and Whitt (1981). We focus on many-server queues that have phase-type service time distributions and exponential customer patience distributions. We establish rate of convergence of the steady-state distribution of a many-server queue in the Halfin-Whitt regime. Our proof technique connects naturally with Stein's method for establishing normal approximations.

2 - Optimal Traffic Schedules

Harsha Honnappa, Purdue University, West Lafayette, IN,
United States of America, honnappa@purdue.edu, Rami Atar,
Mor Armony

We consider the problem of optimally scheduling a finite, but large, number of customers over a finite time horizon at a single server FIFO queue, in the presence of 'no-shows'. We study the problem in a large population limiting regime as the number of customers scales to infinity and the appointment duration scales to zero. We show that in the fluid scaling heavy-traffic is obtained as a result of asymptotic optimization. We also characterize the diffusion-scale optimal schedule.

3 - Collaboration and Multitasking in Networks: Capacity Versus Queue Control

Jan Van Mieghem, Professor, Kellogg School of Management,
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States of America, vanmieghem@kellogg.northwestern.edu,
Itai Gurvich

We study networks where some activities require the simultaneous processing by multiple types of multitasking human or indivisible resources. The capacity of such networks is generally smaller than the bottleneck capacity. This paper shows how this capacity is achieved through, and affected by, dynamic queue control. Prioritizing specific queues comes at a significant loss of capacity. We present policies that balance capacity and queue control while guaranteeing stability and optimal scaling.

4 - Dynamic Scheduling in a Many-Server Multiclass System with General Abandonment Distributions

Amy Ward, Professor, University of Southern California,
Marshall School of Business, Los Angeles, CA, 90089,
United States of America, amyward@marshall.usc.edu

Our purpose is to understand how the assumed customer abandonment distribution affects scheduling decisions in a multiclass M/M/N+GI queue. To do this, we set up and solve an approximating diffusion control problem. We find that threshold control is in general sub-optimal. For two classes, we establish conditions for the optimal policy to have a "U-shape", instead of the step function that characterizes a threshold policy.

■ MA24

24-Room 401, Marriott

Social Media Analytics and Big Network Data

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Bin Zhang, Assistant Professor, University of Arizona,
Department of MIS, Tucson, AZ, 85721, United States of America,
binzhang@arizona.edu

1 - Predicting Hacker IRC Participation using Discrete-time Duration Modeling with Repeated Events

Victor Benjamin, University of Arizona, 1130 E Helen St,
Room 430, Tucson, AZ, 85719, United States of America,
vabenji@email.arizona.edu, Bin Zhang, Hsinchun Chen

Literature documents the existence of many active online hacker communities containing thousands of users. Some participants are expert cybercriminals, but

many have fleeting interests and only generate noise that skew analyses. Thus we propose an automated and scalable approach to identify top hacker participants in big online communities. Specifically, we utilize discrete-time duration modeling with recurrent events for extracting top participating hackers among large hacker IRC communities.

2 - Semi-supervised Learning for Structured Regression on Partially Observed Attributed Graphs

Zoran Obradovic, Laura H. Carnell Professor Of Data Analytics; Director, Center For Data Analytics And Biomedical Informatics; Professor, Computer And Information Sciences Department; Professor, Statistics Department, Temple University, 1925 N. 12th St., 386 SERC, Philadelphia, PA, 19122, United States of America, zoran.obradovic@temple.edu, Jelena Stojanovic, Djordje Gligorijevic, Milos Jovanovic

We propose a structured regression model for temporal applications where a large fraction of observations is missing. The benefits are demonstrated on precipitation prediction and on hundreds of evolving graphs with up to 80% labels missing under various mechanisms. The proposed method and result were published at SDM 2015 conference proceedings.

3 - From Spot Market to Customized Contract: Role of Reputation on Market Choice of Crowdsourcing Vendors

Xiao Han, Shanghai Jiaotong University, 1954 Huashan Rd, Shanghai, China, hanxiao@sjtu.edu.cn, Pei-yu Chen, Bin Gu, Pengzhu Zhang

Based on a unique dataset obtained from a large online crowdsourcing platform with different markets in China, we examine the effect of reputation on vendors' winning chance and revenues as well as their market choices over time. Our results show that as vendors become more experienced and establish more successful relationships with buyers, they will move from spot market to customized contract market, at the same time, they will win more and earn more.

4 - The Heterogeneity of Online Searching and Its Impact on Stock Returns

Qiang Ye, Harbin Institute of Technology, School of Management, Harbin, China, yeqiang@hit.edu.cn, Xianwei Liu

Internet search frequency on stocks has been widely used to measure investor attention in recent studies. Researchers found that weekly searching frequency strongly associated with weekly returns for certain stocks. But we have limited knowledge about the heterogeneity of Internet searches under different circumstances and its varying impact on stock market. In this study, we seek to explore whether searches done on different circumstances guarantee equal attention.

■ MA25

25-Room 402, Marriott

Examining the Social Crowd

Sponsor: Information Systems

Sponsored Session

Chair: Gordon Burtch, Assistant Professor, University of Minnesota, 321 19th Ave. S., Minneapolis, MN, 55455, United States of America, gburtch@umn.edu

1 - Motivating Group Donation: Evidence from a Large Field Experiment

Tianshu Sun, University of Maryland Smith School of Business, 3330 Van Munching Hall, College Park, MD, 20740-2840, United States of America, tianshusun@rhsmith.umd.edu, Gordon Gao, Ginger Zhe Jin

Using a randomized field experiment involving 80,000 participants, we study how mobile messaging can leverage recipients' social connections to increase blood donation. We find 1) blood banks can motivate group formation to increase donation, but only with group reward; 2) group reward works through a sorting mechanism; 3) participants donate more blood when donating in a group. Our study provides insights on the optimal design of mobile messaging for charities to leverage donors' social network

2 - Field Experiment on the Impact of Recommender Systems on Sales Volume and Diversity

Dokyun Lee, Carnegie Mellon University, Pittsburgh, PA, United States of America, leedokyun@gmail.com, Kartik Hosanagar

We investigate the impact of collaborative filtering recommender algorithms, commonly used in e-commerce, on sales volume and diversity. We do this by running a randomized field experiment with a top retailer in North America. We show results for sales volume and diversity. We further investigate the genre cross-purchase behavior to shed insight into mechanism behind diversity shift.

3 - Randomized Experiment(s) Evaluating the Drivers of User Content Generation

Gordon Burtch, Assistant Professor, University of Minnesota, 321 19th Ave. S., Minneapolis, MN, 55455, United States of America, gburtch@umn.edu, Kevin Hong, Ravi Bapna, Vidas Griskevicius

UGC under-provision is a persistent problem in many online communities. We undertake a set of randomized experiments aimed at understanding the drivers of increased UGC production, in terms of both quantity and quality. We consider i) the role of peer feedback on past content (stated approval vs. download), and ii) incentives to contribution (social vs. monetary).

■ MA26

26-Room 403, Marriott

2015 INFORMS Special Session for JIPE and IJOR

Cluster: Globalization and International Activities

Invited Session

Chair: Kuo-Hao Chang, National Tsing Hua University, Hsinchu, Taiwan, China, chang@mx.nthu.edu.tw

1 - An Activity-Driven Optimization Model for Smart Space

Kuo-Hao Chang, National Tsing Hua University, Hsinchu, Taiwan, China, chang@mx.nthu.edu.tw

In this paper, we propose an activity-driven optimization model, followed by the development of a solution method, to enable the optimal and automatic control of environmental conditions, including humidity and temperature, so as to provide people with the most comfortable environment but with the least energy consumption. A computational study based on instances of realistic size is conducted at the end to show the viability of the research.

2 - Optimal Arc Restoration Schedules with Resource Constraints for Recovering Nodes in a Network of Damaged Arcs

I-Lin Wang, Professor, Department of Industrial and Information Management, National Cheng Kung University, Tainan, Taiwan, China, ilinwang@mail.ncku.edu.tw

Consider a network containing some damaged arcs with estimated restoration time and resource. In order to access all nodes in minimum time, we aim to find optimal arc restoration schedules that determine the timing and resources required for restoring some damaged arcs. We will show that special cases of this problem can be converted to minimum spanning tree, shortest path, and NP-hard parallel machine scheduling problems. Finally, proposed IP formulations and solution methods will be discussed.

3 - The Coopetition Game in International Liner Shipping

Dung-Ying Lin, Associate Professor, Department of Transportation and Communication Management Science, National Cheng Kung University, Tainan 70101, Taiwan, China, dylin@mail.ncku.edu.tw

In maritime freight transportation, carriers build a collaborative relationship with other carriers while competing with each other to optimize their own profits. In this scenario, a game of competition is formed. We formulate a nonlinear mixed-integer problem to determine the optimal levels of coopetition for a single company and embed the resulting problem into a general game theoretic framework. A diagonalization algorithm that incorporates an ascent direction search technique is developed to effectively evaluate the game. The numerical results show that carriers choose similar coopetition levels to maximize their profits, and the coopetition game can reach equilibrium under general conditions.

■ MA27

27-Room 404, Marriott

Theory and Applications of the Analytic Network Process

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Orrin Cooper, University of Memphis, 332 Fogelman, Memphis, TN, United States of America, olcooper@memphis.edu

1 - Coherence within the ANP Supermatrix

Orrin Cooper, University of Memphis, 332 Fogelman, Memphis, TN, United States of America, olcooper@memphis.edu, Idil Yavuz

In an ANP network there is both the ability and the need to check for additional levels of consistency and coherence. A Supermatrix with priority vectors that were obtained from either perfect or nearly perfect consistent pairwise comparison can generate suboptimal decisions. Simulations demonstrate the frequency of these events in general ANP networks. A form of cross validation within the Supermatrix called linking validation and a Linking Coherency Index (LCI) is developed and demonstrated.

2 - Using an AHP Approach for Eyewitness Identification

Enrique Mu, Carlow University, Pittsburgh, PA,
United States of America, emu@carlow.edu,
Tingting Rachel Chung, Lawrence Reed

Eyewitnesses of a crime are usually asked to identify a potential criminal out of a lineup of suspects. An online experiment using Amazon MT was conducted. Results show that an AHP approach may offer better eyewitness identification success and more importantly less false positive identification ratios than currently sequential lineup approach.

3 - Modeling the Sensitivity and Stability of Preferences Among Colorectal Cancer Screening Alternatives

Magda Gabriela Sava, PhD Candidate, Joseph M. Katz Graduate School of Business, University of Pittsburgh, 241 Mervis Hall, Pittsburgh, PA, 15260, United States of America, mgsava@katz.pitt.edu, Luis Vargas, James G. Dolan, Jerrold H. May

Patients are faced with multiple alternatives when selecting the preferred method for colorectal cancer screening, and there are multiple criteria to be considered in the decision process. We model the patient's choice using an Analytic Network Model and propose a new approach for characterizing the idiosyncratic preference regions for each patient. We show how to use that characterization to derive insights as to the sensitivity and stability of a patient's individual choice of alternative.

4 - A Stakeholder-theory Based Employer Health Plan Selection Model

Mehdi Amini, Professor, The University of Memphis, Department of Marketing & SCM, Fogelman College of Business & Economics, Memphis, TN, 38152, United States of America, mamini@memphis.edu, Orrin Cooper, Mike Racer

Organizations are called to re-evaluate current plan offerings and potentially, for the first time, select new healthcare providers and policies to ensure that a minimum level of coverage required by law. A new stakeholder-theory based Analytic Network Process (ANP) model is developed to capture a health plan selection decision with the consideration of multiple stakeholders' interests. What-if analysis is used to explore the robustness of the selected plan.

MA28

28-Room 405, Marriott

Matching Markets and Their Applications

Cluster: Auctions

Invited Session

Chair: Thayer Morrill, NC State University, Raleigh, NC, United States of America, thayer_morrill@ncsu.edu

1 - Incentives in the Course Allocation Problem

Hoda Atef Yekta, University of Connecticut School of Business, Storrs, CT, United States of America, Hoda.AtefYekta@business.uconn.edu

Kominers et al. (2011) introduced a heuristic for comparing incentives among the course allocation problem (CAP) algorithms. We investigate their method and adapt it to a more realistic setting with course overlap and a limited number of courses for each student. We compare algorithms including the bidding-point mechanism, the draft mechanism, and recently proposed algorithms like the proxy-agent second-price algorithm in their vulnerability to non-truthful bidding.

2 - Near-optimal Stochastic Matching with Few Queries

John Dickerson, CMU, 9219 Gates-Hillman Center, Pittsburgh, PA, 15213, United States of America, dickerson@cs.cmu.edu, Avrim Blum, Nika Haghtalab, Ariel Procaccia, Tuomas Sandholm, Ankit Sharma

In kidney exchange, patients with kidney failure swap donors. Proposed swaps often fail before transplantation. We explore this phenomenon through the lens of stochastic matching, which deals with finding a maximum matching in a graph with unknown edges that are accessed via queries, and its generalization to k-set packing. We provide adaptive and non-adaptive algorithms that perform very few queries, and show that they perform well in theory and on data from the UNOS nationwide kidney exchange.

3 - The Secure Boston Mechanism

Thayer Morrill, NC State University, Raleigh, NC, United States of America, thayer_morrill@ncsu.edu, Unut Dur, Robert Hammond

We introduce the first mechanism that Pareto dominates the Deferred Acceptance algorithm (DA) in equilibrium. Our algorithm, the Secure Boston Mechanism (sBM), is a hybrid between the Boston Mechanism and DA. It protects students that are initially guaranteed a school but otherwise adjusts priorities based on student rankings. We demonstrate that sBM always has an equilibrium that weakly dominates the DA assignment, and that in equilibrium no student receives worse than a fair assignment.

4 - Mechanism Design for Team Formation

Yevgeniy Vorobeychik, Vanderbilt University, 401 Bowling Ave, Nashville, TN, United States of America, eug.vorobey@gmail.com, Mason Wright

We present the first formal mechanism design framework for team formation, building on recent combinatorial matching market design literature. We exhibit four mechanisms for this problem, two novel, two simple extensions of known mechanisms from other domains. We use extensive experiments to show our second novel mechanism, despite having no theoretical guarantees, empirically achieves good incentive compatibility, welfare, and fairness.

MA29

29-Room 406, Marriott

Applied Analytics Across Industries

Sponsor: Analytics

Sponsored Session

Chair: Polly Mitchell-Guthrie, Sr. Mgr., Advanced Analytics Customer Liaison Group, SAS Institute, SAS Campus Dr., Cary, NC, 27513, United States of America, Polly.Mitchell-Guthrie@sas.com

1 - Tracking the Regional Economy in Real Time (through Rain and Snow)

Michael Boldin, Federal Reserve Bank of Philadelphia, 10 Independence Mall, Philadelphia, PA, 19106-1574, United States of America, Michael.Boldin@phil.frb.org

The project involves enhancing real-time econometric tracking models for a regional economy to use weather station measurements. Most econometric models use pre-filtered data that excludes seasonal patterns that can distort the effects of important weather events. This project makes use of data that is not pre-filtered and simultaneously derives normal seasonal patterns, the effects of specific weather events, and a measure of the adjusted 'health' of the regional economy.

2 - Threadlab: An Analytics Driven Online Clothing Service for Men

John Toczec, ThreadLab, Philadelphia, PA, United States of America, toczek@gmail.com

ThreadLab is a startup company that provides a convenient and customer-friendly online clothing service to men. It elegantly solves a common challenge for a majority of men: Men simply do not like to shop for clothes. ThreadLab takes the work out of clothes shopping by moving the entire decision process onto an analytics platform. All decisions at ThreadLab (from what to stock, what to ship, etc.) are driven by analytical techniques such as mathematical modeling and optimization.

3 - Geospatial Analysis of Bike Share Data

Matthew Windham, Director, Analytics, NTELX, Inc., 1945 Old Gallows Rd, Vienna, VA, 22182, United States of America, mwindham@ntelx.com

We will explore an end-to-end example of processing Washington DC Bike Share data with BASE SAS. We will walk through the data ingest, cleaning, analysis, and visualization. The results will be visualized in Google Earth. All of the SAS code will be made available to attendees, including the code to write Google Earth KML files that underpin the visualization and exploration capabilities.

MA30

30-Room 407, Marriott

2015 Edelman Finalists Reprise

Sponsor: CPMS

Sponsored Session

Chair: Pooja Dewan, BNSF Railway, Fort Worth, TX, 76092, United States of America, Pooja.Dewan@bnsf.com

1 - Maximizing U.S. Army's Future Contribution to Global Security using Capability Portfolio Analysis

Matthew Hoffman, Sandia National Laboratories, P.O. Box 5800 MS 1188, Albuquerque, NM, 87185-1188, United States of America, mjhoffm@sandia.gov, Scott Davis, Shatell Edwards, David Bassett, Gerald Teper, Brian Alford, Craig Lawton, Liliana Shelton, Stephen Henry, Darryl Melander, Frank Muldoon, Roy Rice, Michael McCarthy, Scott Johnson

The Army and supporting team developed and applied the Capability Portfolio Analysis Tool (CPAT), which employs a novel multi-phase mixed integer linear program to optimize fleet modernization problems under complex cost, production, and schedule constraints. Army leadership can now base investment decisions on rigorous portfolio analytics, allowing billions of taxpayer dollars to be optimally prioritized and providing maximum capability and protection to U.S. troops in the decades to come.

■ MA31

31-Room 408, Marriott

Retail Analytics

Sponsor: Data Mining

Sponsored Session

Chair: Matthew Lanham, Doctoral Candidate, Virginia Tech, Dept of Business Information Technology, Blacksburg, VA, 24061, United States of America, malanham@gmail.com

1 - Assortment Planning for Consumers Learning their Tastes

Canan Ulu, Assistant Professor, Georgetown University, McDonough School of Business, Washington, DC, 20057, United States of America, Canan.Ulu@georgetown.edu, Dorothee Honhon

We study a firm that offers novel products to consumers who do not have set preferences. Consumers try different products to learn which product suits their tastes better.

2 - Optimal Stocking Decisions in a Multi-channel Retail Environment

Nevin Mutlu, PhD Candidate, Virginia Tech, Department of Industrial and Systems Eng, Blacksburg, VA, 24061, United States of America, nmutlu@vt.edu, Ebru Bish, Erick Wikum

As traditional brick-and-mortar retailers are expanding their sales channels to online and mobile channels, consumer adoption rates of these emerging channels is increasing over time. We develop a novel, dynamic demand model, and integrate it within an optimization model to understand the implications of this dynamic environment on the retailers' optimal stocking decisions considering different products and different market settings.

3 - Inventory Mirroring in a Heterogeneous Network

Zhiwei (Tony) Qin, Staff Data Scientist, Walmart Labs, 850 Cherry Ave, San Bruno, CA, 94066, United States of America, TQin@walmartlabs.com

Inventory mirroring determines how many fulfillment centers (FC) and where each stock-keeping unit (SKU) should be stocked. Optimizing inventory mirroring is necessary when the FCs have SKU count limits. We propose an approximate inventory mirroring algorithm for a heterogeneous network, where the fulfillment centers (FC) have different capacities and SKU type eligibilities. We present analysis results of the output to validate the effectiveness of algorithm.

4 - Parameter Estimation Procedures for a Hierarchical Assortment Planning Decision

Matthew Lanham, Doctoral Candidate, Virginia Tech, Dept of Business Information Technology, Blacksburg, VA, 24061, United States of America, malanham@gmail.com, Ralph Badinelli

Estimating a consumer's propensity to purchase a product as well as their substitution behavior are critical parameters to a retailer's assortment decision. We investigate the methodologies used to understand consumer demand, substitution behavior, and formulate a novel approach that could be used strategically in a hierarchical assortment planning decision model.

■ MA32

32-Room 409, Marriott

George B. Dantzig Dissertation

Cluster: George B. Dantzig Dissertation

Invited Session

Chair: Nils Rudi, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, nils.rudi@insead.edu

1 - Robust Optimal Control for Medical Treatment Decisions

Yuanhui Zhang, NC State, Raleigh, NC, United States of America, yuanhui.zhang@gmail.com

In this dissertation, we develop a new data-driven robust stochastic optimization model for optimizing medical treatment decisions. We present computationally efficient methods for solving this model and theoretical analysis of the optimal policies. We illustrate the application of this model for optimizing treatment decisions for patients with type 2 diabetes and show that robust optimal policies could potentially provide guidance for clinicians and policy makers to make treatment decisions.

2 - Integrated Allocation and Utilization of Airport Capacity to Mitigate Air Traffic Congestion

Alexandre Jacquillat, PhD Candidate, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Building E40-240, Cambridge, MA, 02116, United States of America, alexandre.jacquillat@gmail.com

This thesis jointly optimizes airport operating procedures at the tactical level and flight scheduling interventions at the strategic level for congestion mitigation. It

relies on an original modeling architecture that integrates an Integer Programming scheduling model, a Dynamic Programming operational model and a Stochastic Queuing Model of congestion. Results suggest that operating enhancements and limited, targeted scheduling adjustments can significantly reduce delays at busy airports.

3 - Design and Analysis of Matching and Auction Markets

Daniela Saban, Stanford University, 655 Knight Way, Stanford, CA, United States of America, dsaban@stanford.edu

Auctions and matching mechanisms have become an increasingly important tool for planners to allocate scarce resources among competing individuals or firms. This thesis addresses several questions that arise when designing and analyzing such markets. For example, we design auctions to construct catalogs of goods for government use, and matching mechanisms that can potentially be used to handle appeals in the public school assignments of thousands of incoming high school students.

■ MA33

33-Room 410, Marriott

Policymaking in Public Health

Sponsor: Health Applications

Sponsored Session

Chair: Ben Johnson, Georgia Institute of Technology North Av, Atlanta, GA, 30332, United States of America, benjohnson@gatech.edu

1 - HIV and STIS Among Young MSM and the Operational Issues of Expanding Testing

Benjamin Armbruster, Northwestern University, 2514 Sheridan Rd, Evanston, IL, United States of America, armbrusterb@gmail.com

We discuss the health policy conclusions one can draw from a detailed and validated agent-based network simulation model of HIV, gonorrhea, and chlamydia spread among young men who have sex with men (YMSM) in Chicago. We focus on racial disparities and the operational issues of expanding HIV and STI testing such as combined testing, cost-effectiveness, roll-out speed, and uptake behavior.

2 - Data Driven Approach to Bundled Payments

Margret Bjarnadottir, Assistant Professor of Management Science and Statistics, Robert H. Smith School of Business, University of Maryland, 4324 Van Munching Hall, College Park, MD, 20742, United States of America, margret@rhsmith.umd.edu, Wenchang Zhang, Ruben Proano, David Anderson, Renata Konrad

Healthcare reimbursement is at the forefront of healthcare reform debates. Bundled payments reimburse a single amount for an episode of care and have been proposed as a practical and promising reimbursement alternative to the current fee-for-service system. In this talk we investigate data driven methods to automatically define sets of services constituting episode of care.

3 - Improving the Equity of Access to Primary Care

Mike Carter, University of Toronto, Mechanical & Industrial Engineering, 5 King's College Rd., Toronto, ON, M5S 3G8, Canada, mike.carter@utoronto.ca, Anna Graber, Vedat Verter

Many countries experience disparities in the distribution of health professionals. There is evidence that trainees from a rural background are more likely to choose to practice in rural areas. Our proposed optimization model incorporates interests of two main stakeholders in the system, namely the regulator and the health professionals, and provides the optimal training locations and required background of trainees in each location.

4 - Evaluating Policy and Network Interventions to Improve Dental Accessibility and Availability for Children

Ben Johnson, Georgia Institute of Technology, Georgia Institute of Technology North Av, Atlanta, GA, 30332, United States of America, benjohnson@gatech.edu, Nicoleta Serban, Paul Griffin, Susan Griffin

We develop an intervention optimization model to match supply and need for pediatric dental care in Georgia under different dental care policies and provider networks. The model is used to assess the trade-off between efficiency (expenditure) and equity (systematic variations in accessibility and availability) under different policies for managing decision making and outcomes. Network and policy interventions are then determined to provide optimal improvements in dental access.

■ MA34

34-Room 411, Marriott

Managing Healthcare Services

Sponsor: Health Applications

Sponsored Session

Chair: Vishal Ahuja, Southern Methodist University, P.O. Box 750333, Dallas, TX, United States of America, vahuja@smu.edu

1 - Coordination between Service Professionals in Health Care**Delivery: A Multiple-case Study**

Claire Senot, Tulane University, 7 McAlister Dr., New Orleans, LA, United States of America, csenot@tulane.edu,
Aravind Chandrasekaran, Peter T. Ward

We investigate the specific coordination challenges faced by hospital's caregivers (physicians and nurses) and the organizational mechanisms that allow them to combine their expertise. We employ a case study methodology that involves 49 semi-structured interviews from the heart-failure units of five U.S. acute care hospitals.

2 - Patient Portals in Primary Care: Impacts on Patient Health and Physician Productivity

Hessam Bavafa, Assistant Professor, Wisconsin School of Business, Madison, WI, United States of America, hbavafa@bus.wisc.edu

Interest in innovative healthcare delivery models has increased due to measures such as the Affordable Care Act, which is designed to expand insurance coverage and contain healthcare costs. One innovation that has been forwarded as a low-cost alternative to physician office visits is "e-visits," or secure messaging between patients and physicians. We evaluate the effect of e-visit adoption on patient health and physician productivity using a panel dataset from a primary care provider in the US.

3 - Quantifying the Impact on Care Coordination on Health Outcomes

Vishal Ahuja, Southern Methodist University, P.O. Box 750333, Dallas, TX, United States of America, vahuja@smu.edu,
Hari Balasubramanian, Ian McCarthy

This paper quantifies the impact of care coordination on patient health outcomes, using data on outpatient health encounters for diabetes patients. Considering that a PCP's task is to consciously facilitate the patient's navigation of the health system, we use the number of PCP visits as a proxy for care coordination. We define new measures to capture the fragmentation of care.

4 - Does Medical Litigation Against Physicians Increase Inpatient Hospital Costs?

Zeynal Karaca, Senior Economist, Agency for Healthcare Research and Quality, 540 Gaither Road, Rockville, MD, United States of America, zeynal.karaca@ahrq.hhs.gov, Mehmet Ayvaci, Turgay Ayer, Herbert Wong

We empirically assess the impact of medical litigations against physicians on hospital inpatient costs using Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases. We separately assess the cost impact on individual physicians facing the lawsuit and other physician colleagues (spillover effects). We find increased inpatient costs due to medical litigation and substantial variation in the degree of impact across board certified medical specialties.

■ MA35

35-Room 412, Marriott

Health Policy

Sponsor: Public Sector OR

Sponsored Session

Chair: Diana Prieto, Assistant Professor, Western Michigan University, 1903 W. Michigan Ave., Kalamazoo, MI, United States of America, diana.prieto@wmich.edu

1 - A Bilevel Optimization Model for Health Information Exchange Policy Design

Diego A. Martinez, Postdoctoral Fellow, Johns Hopkins School of Medicine, 733 N Broadway, Baltimore, MD, 21205, United States of America, dmart101@jhmi.edu, Tapas K. Das, Jose L. Zayas-Castro, Felipe Feijoo

Health information exchange (HIE) requires collaboration among competitors. While exceptions exist, reluctance to engage in information sharing is abundant from small medical practices to large hospital systems. To study the potential impact of federal policy stimulating HIE participation, we present a strategic gaming model formulated as a bilevel optimization program. Numerical examples from a hospital network in Florida are presented.

2 - Mapping Chikungunya Disease Transmission and Implications for Surveillance

Elaine Nsoesie, Assistant Professor, IHME, University of Washington, 2301 5th Avenue Suite 600, Seattle, WA, United States of America, en22@uw.edu

A Chikungunya virus epidemic, which started in December 2013 in the Caribbean island of St. Martin has spread to several countries and islands in the Americas, affecting an estimated one million people within a year. We applied a comprehensive approach involving the integration of data from multiple sources to assess and map the global occurrence of Chikungunya. A thorough knowledge of Chikungunya transmission globally has significant implications for surveillance and burden estimation.

3 - Value of Perfect Information and Perfect Implementation: Anyi-VEGF Therapy for Ophthalmologic Use

David Hutton, Assistant Professor, Department of Health Management and Policy, University of Michigan, 1420 Washington Heights, Ann Arbor, MI, 48109, United States of America, dwhutton@umich.edu, Eric Ross, Joshua Stein

We discuss differences between the value of information and value of implementation in the case of high-cost anti-VEGF therapy for ophthalmologic use. We review uncertainty in clinical trial data and discuss how it is used to create prior distributions necessary to ascertain value of information. We review Markov modeling and Monte Carlo methods for calculation, provide examples of these results for anti-VEGF therapy (billions of dollars), discuss next steps, and insights for other diseases.

4 - Data-driven Monitoring of Medical Recommendations for Breast Cancer Treatment

Milton Soto, PhD Candidate, Western Michigan University, 4601 Campus Drive, Kalamazoo, MI, 49008, United States of America, miltonrene.sotoferrari@wmich.edu, Diana Prieto

Medical recommendations for Breast Cancer healthcare may create overtreatment or undertreatment. Overtreatment may occur when aggressive courses are prescribed to patients with low risk of cancer spreading, while undertreatment may be generated by patients' behaviors, as well as by social, economical or racial disparities. We describe techniques for the monitoring of over or undertreatment using data mining methods to identify possible mistreatment candidates.

5 - Performance of Machine Learning Models in Predicting Presence of BRCA Mutations

Mehrnaz Abdollahian, University of South Florida, 4202 East Fowler Avenue, Tampa, FL, 33620, United States of America, mehnaz@mail.usf.edu, Tapas K. Das

BRCA1/2 gene mutations drastically increase chances of developing breast and ovarian cancers. These mutations are present in most hereditary breast and ovarian cancer patients. It is common practice for the physicians to require genetic BRCA testing for those that fit the rules of national cancer comprehensive network. However, historically 70% of tested are found negative. We have examined the power of predicting BRCA mutations using machine learning models on a nation-wide survey data.

■ MA36

36-Room 413, Marriott

Resilient Public Health Supply Chains

Sponsor: Public Sector OR

Sponsored Session

Chair: Jacqueline Griffin, Assistant Professor, Northeastern University, 334 Snell Engineering Center, 360 Huntington Ave, Boston, MA, 02125, United States of America, ja.griffin@neu.edu

1 - Minor Disruptions Lead to a Major Problem for the U.S. Saline Supply Chain

Rana Azghandi, Northeastern University, 334 Snell Engineering Center, 360 Huntington Ave, Boston, MA, 02125, United States of America, rana.azghandi@gmail.com, Ozlem Ergun, Jacqueline Griffin

In January 2014, FDA announced an ongoing national shortage of saline which has resulted in increased health risks for patients across the country. The underlying cause of this shortage has been the simultaneous occurrence of many small disruptions such as recalls and increased demand. A system dynamics model is used to analyze the saline supply chain network and to characterize how such a phenomenon results from minor supply disruptions due to feedback processes.

2 - New Strategies for Quantifying the Resilience of Supply Chains to Temporally Distinct Disruptions

Jacqueline Griffin, Assistant Professor, Northeastern University,
334 Snell Engineering Center, 360 Huntington Ave, Boston, MA,
02125, United States of America, ja.griffin@neu.edu,
Ozlem Ergun, Shiqing Liu

The saline supply chain network flow formulation applied for a multi-level supply chain with lead time between each level and concerning about how factors would influence each other in different time periods. We present closed form expressions to characterize the resilience of a supply chain network to varying combinations of temporally distinct disruptions.

3 - Exploring Strategies for Private Sector Transportation in Uganda

Jarrod Goentzel, MIT, 77 Massachusetts Avenue, Cambridge, MA,
02139, United States of America, goentzel@mit.edu,
Mark Brennan, Emily Gooding

New product technology is commonly introduced in developing countries through subsidized pilot programs run by non-governmental organizations (NGOs). Low landed cost is key for further scaling up product distribution through the private sector. This study uses a pilot program for agricultural storage products in Uganda to explore strategies to reduce transportation cost.

4 - Tracking Healthcare Associated Infections at Individual Level over Dynamic Human Networks

Ziye Zhou, The Chinese University of Hong Kong, William M W
Mong Engineering Bldg., Hong Kong, Hong Kong - PRC,
zhouzy@se.cuhk.edu.hk, Chun-hung Cheng, Dobin Ng

Healthcare associated infections (HAIs) have become a major challenge to public healthcare. This work addresses the problem of tracking the transmission of HAIs at an individual level. We present a framework with three key components of time-varying contact network construction, individual-level transmission tracking and HAI parameter estimation. Experiments on human positioning data collected in a four-month tracking study in a hospital are conducted to evaluate the performance.

MA37

37-Room 414, Marriott

Health Care Modeling and Optimization VI

Contributed Session

Chair: Md Noor E Alam, Post Doctoral Fellow, Massachusetts Institute of Technology, 135 Quincy Ave, Apt 204, Quincy, MA, 02169, United States of America, mnalama@mit.edu

1 - Shift Scheduling for an Anesthesiology Residency Program

Hernan Abeledo, Associate Professor, George Washington University, 800 22 St. NW, Washington, DC, 20052, United States of America, abeledo@gwu.edu, Michael Kanter, Ian Morgan, Jean - Max Buteau, Liam Nealon

Creating shift schedules for resident physicians is a notoriously difficult task that is typically done manually by the chief residents. Shift assignments need to observe a large number of rules, as well as adhere to fairness and desirability factors while populating a very complex schedule structure. We present an integer programming model developed to schedule anesthesiology residents at the George Washington University Hospital.

2 - Shift Scheduling for Medical Residency Programs

Anthony Coudert, George Washington University, 800 22 St. NW, Washington, DC, United States of America, coudert@gmail.com, Hernan Abeledo

Creating shift schedules for resident physicians is a tedious task that is typically done manually by the chief residents. Shift assignments need to observe a large number of rules, as well as adhere to fairness and desirability factors while populating a very complex schedule structure. We present integer programming models used to schedule residency programs at the George Washington University Hospital.

3 - Open-access Outpatient Clinic Scheduling

Yu Fu, ISEN Dept. Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, yufu@tamu.edu, Amarnath Banerjee

This study aims at exploring cost-efficient offline and online scheduling methods under the open access policy which allows the visits of the same-day-request patients and walk-in patients as compensation for no-shows of regular patients to improve clinic performance and revenue benefit. The offline scheduling uses approximation and heuristic methods on scenarios and data generated by prediction and simulation. The online scheduling relies on heuristic methods and stochastic programming models.

4 - Integer Linear Programming Based Statistical Techniques for Causal Inference

Md Noor E Alam, Post Doctoral Fellow, Massachusetts Institute of Technology, 135 Quincy Ave, Apt. 204, Quincy, MA, 02169, United States of America, mnalama@mit.edu, Cynthia Rudin

Organizations are fiercely struggling to realize valuable information from large-scale data that are increasingly used for understanding important cause and effect relationships. This research developed a methodological frameworks to solve such critical problems with ILP based statistical techniques. One of the key idea is to develop robust techniques to handle uncertainty in data driven decision making, particularly as applied to healthcare.

MA38

38-Room 415, Marriott

Applied Probability I

Contributed Session

Chair: Giang Trinh

Senior Research Associate, Ehrenberg-Bass Institute, University of South Australia, 70 North Terrace, Adelaide, SA, Australia, giang.trinh@marketingscience.info

1 - Value of Communication in a One-leader, Two-followers Partially Observed Markov Game

Yanling Chang, PhD Candidate, Georgia Institute of Technology, 765 Ferst Dr, Atlanta, GA, 30332, United States of America, changyanling@gatech.edu, Alan Erera, Chelsea White

We consider a one-leader, two-followers partially observed Markov game and analyze how the value of the leader's criterion changes due to changes in the communication quality between the two followers. We present conditions under which the value of the leader's criterion degrades or improves, as a function of this communication quality and the type of game (collaborative or non-collaborative).

2 - Multi-period Corporate Survival Probability Estimation with Stochastic Covariates

Ahmad Reza Pourghaderi, Assistant Professor, Abdullah Gul University, Department of Industrial Engineering, Melikgazi, Kayseri, 38039, Turkey, pourghaderi@u.nus.edu, Ebrahim Sadreddin

We propose an econometric method to obtain maximum likelihood estimation of multi-period corporate survival probabilities conditional on macroeconomic and firm-specific covariates. We then provide an empirical implementation of the proposed method for about 300 Iran-listed Industrial firms. Our method combines traditional duration analysis of the dependence of default intensity on time varying covariates with time-series analysis of covariates.

3 - Managing Capacity with Optimal Buffer Size Selection

Melda Ormeci Matoglu, University of New Hampshire, 10 Garrison Ave., Durham, NH, 03824, United States of America, melda.ormecimatoglu@unh.edu

We model the problem of managing capacity and determining optimal buffer size in a BTO environment as a Brownian drift control problem. We seek a policy that minimizes long-term average cost. The controller can, at some cost, shift the processing rate among 2 rates and has the option of rejecting orders and idling. We show that the optimal policy follows a simple policy and determine the optimal policy parameters. We also calculate important policy performance metrics.

4 - Modeling and Predicting Purchasing Behavior with an Erlang-2 Poisson Lognormal Model

Giang Trinh, Senior Research Associate, Ehrenberg-Bass Institute, University of South Australia, 70 North Terrace, Adelaide, SA, Australia, giang.trinh@marketingscience.info

We note some practical and theoretical shortcomings of the Erlang-2 Poisson gamma mixture model or the condensed NBD, which has been successfully employed for modeling and predicting consumer purchases. We develop a new model, the Erlang-2 Poisson lognormal mixture model, which has a sounder theoretical base. We derive the conditional expectation of the new model and use it to predict future purchases. We show that the new model predicts future purchases better than the condensed NBD model.

■ MA39

39-Room 100, CC

Topics in Mental Accounting, Newsvendor and Pricing

Cluster: Operations/Marketing Interface

Invited Session

Chair: Jun Ru, Assistant Professor, University at Buffalo, 326D Jacobs, Buffalo, NY, 14260, United States of America, junru@buffalo.edu

1 - Dynamic Pricing with a Fare-lock Option

Ming Chen, Assistant Professor, California State University Long Beach, 1250 Bellflower Blvd, Long Beach, CA, 90840, United States of America, ming.chen@csulb.edu, Zhi-Long Chen

We study a dynamic pricing problem frequently seen in the airlines industry where customers are offered an option to lock a fare at a small fee for a certain period of time. The free 24 hour cancellation enforced by DOT can be viewed as a special case of this problem. This provides a valuable option for those undecided travelers when finalizing their travel plans. We build a dynamic pricing model to investigate the implications of this type of practice on both the airlines and the passengers.

2 - Mental Accounting and Payment Schemes in Manufacturer's Returns Policies

Charles Wang, Associate Professor, University at Buffalo, Buffalo, NY, United States of America, cxwang@buffalo.edu, Jun Ru

Returns policies have been used between the manufacturer and retailer in supply chains with uncertain demand. This research extends our understanding of returns policies by adopting the concept of mental accounting to describe the manufacturer's behavioral decisions under returns policies. We also investigate two alternative payment schemes that help mitigate the manufacturer's mental accounting effect in returns policies and improve channel performance.

3 - Price Discount and Capacity Planning under Demand Postponement with Opaque Selling

Zhengping Wu, Associate Professor, Syracuse University, 721 University Ave, Syracuse, NY, 13244, United States of America, zwu12@syr.edu, Jianghua Wu

We consider the opaque selling strategy of a firm that uses a price discount to induce demand postponement. Under demand postponement, the firm offers a price discount to advance customers in exchange for the option to fulfill their orders after the spot demand has been satisfied. In effect, the price discount enables the firm to create a capacity buffer for the spot demand. We characterize the firm's optimal capacity and price discount decisions.

4 - A Two Product Newsvendor Problem with Partial Demand Substitution

Jun Zhang, Associate Professor, Fudan University, 670 Guoshun Rd, Faculty Building 520, Shanghai, China, jxz063000@outlook.com, Jun Ru, Ruixia Shi

We show that a two-product newsvendor problem with partial demand substitution is equivalent to the classical newsvendor problem with the same economic parameters but an adjusted demand. By comparing the adjusted demand and the primary demand stochastically, we examine the impacts of substitution on the expected profit and optimal order quantities. Our analysis does not rely on assumptions on particular demand distributions or correlation structures.

■ MA40

40- Room 101, CC

Investigating Mobility Dynamics within Markets and Organizations

Sponsor: Organization Science

Sponsored Session

Chair: Y. Sekou Bermiss, University of Texas, Austin, TX, United States of America, ysb@austin.utexas.edu

1 - Racial Disparity in Promotion Rates of NFL Coaches

Chris Rider, Georgetown University, Washington, DC, chris.rider@georgetown.edu, Jim Wade, Anand Swaminathan, Andreas Schwab

We examine differences in the rates at which white and black coaches are promoted within the NFL between 1985 and 2012. We demonstrate continuing race-based sorting into positions with limited upward mobility chances (e.g., RB coach) and lower mobility rates conditional on attaining any position (e.g., LB coach). We discuss how high-level interventions designed to increase representation at the highest levels are likely to be ineffective absent accompanying lower level interventions.

2 - Should I Stay or Should I Go: Movement of Artists and Producers between Labels When New Music Categories Emerge

Eugene Paik, University of Arizona, Tucson, AZ, paikth@email.arizona.edu, Joseph P. Broschak

The 1950's began the rise of new genres of recorded American music. We investigate how, in the wake of new genres emerging, music label identity changes (e.g., changes in the portfolio of music genres that labels choose to produce) affected the mobility of music artists and producers between music labels.

3 - Employee Mobility and Firm Performance: An Integrative Theoretical Framework and Research Agenda

John Mawdsley, University of Illinois at Urbana Champaign, Urbana, IL, mawdsle1@illinois.edu, Deepak Somaya

We review of research on employee mobility and its organizational impacts, and casting it within a novel integrative theoretical framework. We highlight the various organizational impacts of employee mobility, describe how contextual factors moderate the transfer of human and relational capital through mobile individuals, and how constraining factors that impede employee mobility may also be used for effectuating the same organizational impacts as mobility events.

4 - Individual Status Attainment and Entrepreneurial Entry: The Mobility of Award Winning Creative Directors in the Advertising Industry

Michelle Rogan, INSEAD, Boulevard de Constance, Fontainebleau Cedex 77305, France

Michelle.Rogan@insead.edu, Andrew von Nordenflycht

This study is an investigation into the type of firms to which "stars" are likely to move. In particular, we examine the effect of stardom on the likelihood of moving to a higher status firm vs. starting or joining an entrepreneurial firm, in other words choosing status or autonomy. We test our arguments on a sample of award winning creative directors in the advertising industry. We find that industry awards provide a means of resource redistribution and new organizational foundations.

5 - Ideological Misfits: Political Affiliation and Employee Departure in the Private Equity Industry

Y. Sekou Bermiss, University of Texas, Austin, TX, United States of America, ysb@austin.utexas.edu, Rory McDonald

Building on social psychological theories of organizational fit we develop theory to explain how ideological mismatch between an individual and their immediate peers impacts their likelihood of firm departure. Tracking the movement of over 40,000 investment professionals within the U.S. private equity industry over ten years, we investigate how impact of ideological misfit that arises when individuals hold political ideologies that depart substantially from the dominant ideology of the firm.

■ MA41

41-Room 102A, CC

Joint Session MSOM-Health/HAS: Data-Driven Modeling in Healthcare II

Sponsor: Manufacturing & Service Oper Mgmt/Healthcare Operations

Sponsored Session

Chair: Yichuan Ding, UBC, 2053 Main Mall, Sauder School of Business, Vancouver, BC, V6T1Z2, Canada, daniel.ding@sauder.ubc.ca

Co-Chair: Nan Liu, Columbia University, 722 W. 168th. St., New York, United States of America, nl2320@columbia.edu

1 - What Drives the Geographical Differences in Deceased Donor Organ Procurement in the United States?

Mazhar Arikan, Assistant Professor, University of Kansas, 1300 Sunnyside Ave., Lawrence, KS, 66045, United States of America, mazhar@ku.edu, Baris Ata, Rodney Parker, John J Friedewald

The deceased-donor kidney allocation system suffers from severe shortages of available organs while there is significant variation in the procurement rates across different geographies in the US. The empirical analysis reveals that the intent of procurement increases with organ quality, the median waiting time for a transplant, and the competition among transplant centers. A counterfactual study shows that broader sharing of lower quality organs leads to an increase in the procurement rates.

2 - Dynamic Assignment of Emergency Department Patients to Primary and Secondary Inpatient Units

Derya Kilinc, Arizona State University, 699 S. Mill Ave., Tempe, AZ, 85281, United States of America, dkilinc@asu.edu, Soroush Saghaian, Stephen J. Traub

One of the main reasons for Emergency Department (ED) crowding is the long boarding time, of patients who are waiting for admission to inpatient wards. We study suitable mechanisms to overflow such patients to alternative wards. An overflow policy can improve ED waiting times and Length of Stay (LOS), but may reduce the quality of care. We study an MDP-based approach to gain insights into the impact of overflow policies on waiting times and quality of care.

3 - Data Driven Staffing of Hospital Support Staff

Cassandra Hall, PhD Student, Northwestern University, IEMS Department, Evanston, IL, CassandraHall2017@u.northwestern.edu, Sanjay Mehrotra, Seyed Iravani

We study hospital patient transport requests as a multiclass queue with server specialization and construct an approximation for the minimum number of servers required to achieve a probabilistic bound on the patient waiting time. We also explore the effects of different specialization and routing policies on performance at a given staffing level. Output is then compared with theoretical worst case waiting time bounds derived from the literature.

4 - A Clinical Decision Support System for Treatment-resistant Depression: A Pilot Study

Martin Cousineau, Desautels Faculty of Management, McGill University, 1001 Sherbrooke Street West, Montreal, QC, H3A 1G5, Canada, martin.cousineau@mail.mcgill.ca, Gustavo Turecki, Vedat Verter, Joelle Pineau

This research project aims to develop a clinical decision support system to assist psychiatrists seeking to achieve remission in treatment-resistant depression patients. This system is based on a longitudinal dataset of outpatient mental health clinic patients, and consists of (1) a predictive model of the patient outcome depending on the selected treatment, and (2) a decision-theoretic module for recommending treatment strategies based on similar patient files.

5 - An Empirical Study of Patient Prioritization in Emergency Department Triage Systems

Mahesh Nagarajan, University of British Columbia, 2053 Main Mall, Vancouver, BC, V6T1Z2, Canada, mahesh.nagarajan@sauder.ubc.ca, Eric Park, Yichuan Ding

We analyze patient choice behavior of the ED personnel who decides which patient waiting in the ED will be seen by the next available physician. We use a discrete choice framework consistent with random utility theory. The choice maker's valuation of each patient depends on both the patient's medical and operational characteristics including wait time and ED congestion. We study over 270,000 patient choices in five EDs using the Canadian Triage and Acuity Scale (CTAS).

MA42

42-Room 102B, CC

Modeling Healthcare Provider and Processes Interaction

Sponsor: Manufacturing & Service Oper Mgmt/Healthcare Operations

Sponsored Session

Chair: Vikram Tiwari, Vanderbilt University Medical Center, Nashville, TN, United States of America, vikram.tiwari@vanderbilt.edu

1 - Quantifying Case Cancellations and Add-On Case Scheduling among Patients Inpatient Preoperatively

Franklin Dexter, Professor, University of Iowa, Anesthesia, 200 Ha, Iowa City, IA, 52242, United States of America, franklin-dexter@uiowa.edu, Richard Epstein

Among 24,735 inpatient scheduled cases, $22.6 \pm 0.5\%$ (SE) of scheduled minutes cancelled after 7 AM the day before or day of surgery ($14.0\% \pm 0.3\%$ day of). Most ($83.1\% \pm 0.6\%$) cases performed were evaluated the day before surgery, $62.3\% \pm 1.5\%$ before 6:00 PM. The cancelled procedures were very diverse (Herfindahl index 0.021 ± 0.001). When cancelled, often no procedure was subsequently performed ($50.6\% \pm 0.9\%$), showing the surgical indication no longer existed or patient/family decided no surgery.

2 - The Role of Wearable Devices Data in Physician-patient Relationship

Zafar Özdemir, Professor, Miami University, Farmer School of Business, Oxford, OH, 45056, United States of America, ozdemir@miamioh.edu, Shailesh Kulkarni, Hakan Tarakci

We investigate a medical provider's optimal level of investment in remote monitoring where, unlike the current norm, the provider can initiate a face-to-

face visit or a remote treatment depending on the information streamed from the patient's wearable device. Our model provides valuable insights across a variety of payment models.

3 - Evaluating Peer-to-peer Performance of Anesthesiology Fellows using Data Envelopment Analysis

Vikram Tiwari, Vanderbilt University Medical Center, Nashville, TN, United States of America, vikram.tiwari@vanderbilt.edu, Avinash Kumar

Factors that contribute to the success of individuals at a critical care fellowship have not been well studied. We explore what aspects of the educational program and work characteristics contribute the most to an individual fellow's success as determined by year end Multidisciplinary Critical Care Knowledge Assessment Program scores and summative evaluations. We show the feasibility of using data envelopment analysis to evaluate the academic performance of fellows compared to their peers.

MA43

43-Room 103A, CC

Game Theoretic Models in Revenue Management I

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Ozan Candogan, University of Chicago, Booth School of Business, Chicago, IL, United States of America, ozan.candogan@chicagobooth.edu

Co-Chair: Santiago Balseiro, Assistant Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, srb43@duke.edu

1 - Customer Referral Incentives and Social Media

Ilan Lobel, NYU, 44 W 4th St, New York, NY, 10012, United States of America, ilobel@stern.nyu.edu, Evan Sadler, Lav Varshney

We study how to optimally attract new customers using a referral program. Whenever a consumer makes a purchase, the firm gives her a link to share with friends, and every purchase coming through that link generates a referral payment. The firm chooses the referral payment function and consumers play an equilibrium in response. We show that the optimal payment function is nonlinear and complex, and prove revenue properties of simple approximate solutions such as linear and threshold policies.

2 - Dynamic Reserve Prices for Repeated Auctions: Learning from Bids

Yash Kanoria, Assistant Professor, Columbia University, New York, NY, United States of America, ykanoria@columbia.edu, Hamid Nazerzadeh

A large fraction of online advertisements are sold via repeated second price auctions. In these auctions, the reserve price is the main tool for the auctioneer to boost revenues. We present a simple approximately incentive-compatible and optimal dynamic reserve mechanism that can significantly improve the revenue over the best static reserve when there is uncertainty in the distribution of valuations.

3 - A Dynamic Model of Crowdfunding

Mohamed Mostagir, Assistant Professor, University of Michigan Ross School of Business, 701 Tappan Ave, R5316, Ann Arbor, MI, 48109, United States of America, mosta@umich.edu, Saeed Alaei, Azarakhsh Malekian

Crowdfunding has emerged as an alternative to traditional methods of funding new products. Backers arrive over time and decide whether to pledge money to a crowdfunding campaign. If the total contribution reaches a certain threshold, the campaign is successful and production takes place. We identify a fundamental tension in these environments that leads to a sharp characterization of empirical outcomes, and we show how to determine the optimal duration and price to maximize campaign success.

4 - Effect of Network Perturbation on Aggregate Performance

Azarakhsh Malekian, Rotman School of Management, University of Toronto, Toronto, Canada, azarakhsh.malekian@rotman.utoronto.ca, Opher Baron, Ming Hu

In this work, we characterize the role of perturbing network interactions in macroeconomic aggregate performance. We then provide a fairly tight characterization of the aggregate performance under worst-case network perturbation as well as average-case random network perturbation. Finally, we identify robust networks under perturbation.

■ MA44

44-Room 103B, CC

Data Driven Pricing

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Wedad Elmaghraby, Associate Professor, University of Maryland, University of Maryland, 4311 Van Munching Hall, College Park, MD, 20742, United States of America, welmaghr@rhsmith.umd.edu

Co-Chair: Shawn Mankad, Assistant Prof Of Business Analytics, University of Maryland, 4316 Van Munching Hall, College Park, MD, 21201, United States of America, smankad@cornell.edu

1 - More than Just Words: on Discovering Themes in Online Reviews to Explain Restaurant Closures

Shawn Mankad, Assistant Prof Of Business Analytics, University of Maryland, 4316 Van Munching Hall, College Park, MD, 21201, United States of America, smankad@cornell.edu, Anand Gopal, Jorge Mejia

We complement the existing research on online reviews by proposing a novel use of modern text analysis methods to uncover the semantic structure of online reviews and assess their impact on the survival of merchants in the marketplace. We analyze online reviews from 2005 to 2013 for restaurants in a major metropolitan area in the United States and find that variables capturing semantic structure within review text are important predictors of the survival of restaurants.

2 - Cost-per-impression Pricing for Display Advertising

Sami Najafi-Asadolahi, Santa Clara University, 500 El Camino Real, Santa Clara, CA, United States of America, snajafi@scu.edu

We consider a web publisher posting display ads on its website and charging based on the cost-per-impression pricing scheme. The publisher is faced with uncertain demand for advertising slots and uncertain supply of visits from viewers. Advertisers choose ad campaigns that specify their targeted viewers. We determine the publisher's optimal price to charge and show that it can increase in the number of impressions, which is in contrast to the quantity-discount commonly offered in practice.

3 - Pricing Personalized Bundles: A New Approach and Industrial Application

Zhengliang Xue, IBM, Yorktown Heights, NY, United States of America, IBM, zxue@us.ibm.com, Zizhuo Wang, Markus Ettl

We optimize the pricing strategies for personalized bundles where a seller provides a variety of products using which customers can configure a bundle and send a request-for-quote. The seller, after reviewing the RFQ, has to determine a price based on customers' willingness to buy. Such problems are difficult because of the potential unlimited possible configurations of the bundle and the correlations among individual products. We propose a new approach and show the business value by real data.

4 - Measuring the Effects of Advertising: The Digital Frontier

Justin Rao, Researcher, Microsoft Research, 641 Avenue of Americas, New York, NY, 10014, United States of America, Justin.Rao@microsoft.com, Randall Lewis, David Reiley

Online advertising offers unprecedented opportunities for measurement. A host of new metrics have become widespread in advertising science. New experimentation platforms open the door for firms and researchers to measure the true causal impact of advertising. We dissect the new metrics, methods and computational advertising techniques currently used by industry researchers, highlighting their strengths and weaknesses, and discuss the novel analyses could impact the advertising market.

■ MA45

45-Room 103C, CC

RM in Practice

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Wei Wang, Scientist, PROS, Inc., 3100 Main Street, Suite #900, Houston, TX, 77002, United States of America, weiwang@pros.com

1 - Modeling Issues and Best Practices in Price and Revenue Optimization

Yanqi Xu, Director Of Applied Technology, Princess Cruises, 24305 Town Center Rd, Valencia, CA, 91355, United States of America, yxu@princesscruises.com

Price and revenue optimization is proven to be critical to improving the top lines in various industries where relatively fixed capacity has to be used to satisfy fluctuating demand. However, there exist ways to set up the models to achieve

better profits than others. In this talk, we will discuss some practical issues frequently encountered in the modeling of price and revenue optimization, and we will go through several real world examples to illustrate some of the best practices.

2 - Revenue Functions: Demand Aggregation for Fleet Allocation in Car Rental Industry

Manu Chaudhary, Scientist, PROS, 3100 Main Street, Suite #900, Houston, TX, 77002, United States of America, mchaudhary@pros.com

Fleet allocation for car rental industry is a multi-dimensional, large scale network optimization which is computationally expensive. We address this complexity by introducing an intermediate optimization that generates Revenue Functions which aggregate the demand forecast to a higher level. This reduces the dimensional complexity of the modified fleet allocation problem significantly and makes it feasible to run in a live production system.

3 - Identifying a More Accurate Historical Data Subset from a Noisy Historical Dataset: A Forecasting Example

Gregory Vogel, Manager, Revenue Science, Holland America Line, 300 Elliott Ave W, Seattle, WA, 98119, United States of America, gvogel@hollandamerica.com

When looking at similar products that have overlapping booking periods, noise is common. It is common practice to compile a dataset for processes such as demand forecasting by compiling the complete set of relevant history. We ask the question, can we identify a subset of history that will produce a more accurate forecast? We utilize a cruise example to demonstrate and improved forecast and present the method developed.

4 - Joint Optimization of Pricing and Marketing for Globally Maximum Profit

Sharon Xu, UCLA Statistics Department, 8125 Math Sciences, Los Angeles, CA, 90095, United States of America, sharon.xu@ucla.edu

With the recent influx of high-granularity data, businesses are able to achieve a more comprehensive understanding of their customers. To better leverage this data, we present a new way to maximize profit by jointly optimizing pricing and advertising spend. We first create a predictive model to quantify how pricing and advertising influence consumer purchase decisions, then use this to inform a model that simultaneously optimizes pricing and advertising decisions to obtain the maximum profit.

5 - An Airline RM Model with Capacity Sharing

Ang Li, Scientist, PROS, Inc., 3100 Main St. #900, Houston, TX, 77002, United States of America, ali@pros.com, Darius Walczak

We consider a single-leg airline RM problem with shared seating capacities between business and economy compartments. In particular, a curtain that separates the two compartments can be installed on the day of flight departure. We solve the control problem as a dynamic program that jointly considers the booking levels on both sides of the curtain. We then compare the optimal revenue achieved to an alternative scenario with an optimal curtain position but without capacity sharing.

■ MA46

46-Room 104A, CC

Healthcare Operations

Sponsor: Manufacturing & Service Oper Mgmt/Service Operations

Sponsored Session

Chair: Carri Chan, Columbia Business School, 3022 Broadway, Uris Hall, Room 410, New York, NY, 10027, United States of America, cwchan@columbia.edu

1 - Service Decisions with Two-dimensional Customer Heterogeneity

Tolga Tezcan, Associate Professor, London Business School, Regent's Park, London, UK, NW14SA, United Kingdom, ttezcan@london.edu, Balaraman Rajan, Avi Seidmann

In this work we analyze the operational decisions of a server dealing with customers who are heterogeneous on two dimensions. We apply the results in the context of a specialist seeing patients suffering from chronic conditions and patients who differ in their preferences to a newly introduced telemedicine technology. Our results help analyze telemedicine adoption and optimal decisions for a service provider.

2 - An Approximation for the Bed Occupancy Process in Inpatient Wards

Ohad Perry, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, ohad.perry@northwestern.edu

We consider queueing dynamics of bed-occupancy processes in inpatient wards. These are time varying, and have departures that are highly concentrated within a short time period each day, following the physicians' daily inspection round. We characterize a necessary and sufficient condition for the system to be stable, and employ a fluid approximation to prove an asymptotic periodic behavior of the system. That "periodic equilibrium" can be used to optimize systems' performance.

3 - Operations Management of a Stool Bank for Fecal Transplantations

Abbas Kazerouni, Stanford University, Electrical Engineering Department, Stanford, CA, United States of America, abbask@stanford.edu, Lawrence Wein

We describe our work with OpenBiome, a nonprofit firm that enables fecal transplants for treating *Clostridium difficile*, which is responsible for 25,000 deaths and \$1 billion annually in the U.S. We optimize the timing of new donor acquisitions and the individualized (based on donor production rate) testing frequency for each donor, with the goal of meeting nonstationary demand (increasing at 10% per month) at minimum cost.

4 - Queues with Time-varying Arrivals and Inspections with Applications to Hospital Discharge Policies

Carri Chan, Columbia Business School, 3022 Broadway, Uris Hall, Room 410, New York, NY, 10027, United States of America, cwchan@columbia.edu, Linda Green, Jing Dong

To discharge a patient from a hospital unit, a physician must determine that the patient is stable enough to be discharged. As such, patients may occupy a bed longer than medically necessary. Motivated by this phenomenon, we introduce a queueing system with time-varying arrival rates in which servers who have completed service cannot be released until an inspection occurs. We examine how such a dynamic impacts system dynamics and consider how to optimize the timing of inspections.

■ MA47

47-Room 104B, CC

MSOM Sustainability and Energy

Sponsor: Manufacturing & Service Oper Mgmt/Sustainable Operations

Sponsored Session

Chair: Yangfang Zhou, Assistant Professor, Lee Kong Chian School of Business, Singapore Management University, Singapore, Singapore, helenzhou@smu.edu.sg

1 - Investments in Renewable and Conventional Energy: Role of Operational Flexibility

Kevin Shang, Duke University, 100 Fuqua Drive, Durham, NC, United States of America, kevin.shang@duke.edu, Gurhan Kok, Safak Yucel

We study investments of a utility firm in renewable and conventional energy sources with different levels of operational flexibility, i.e., the ability to quickly ramp up or down the output of a generator. We consider supply characteristics of conventional and renewable sources to investigate their interaction with each other. We find that inflexible sources (e.g., nuclear energy) and renewables are strategic substitutes; flexible sources (e.g., natural gas) and renewables are complements.

2 - Promoting Clean Technology Products: to Subsidize Consumers or Manufacturer?

Ho-Yin Mak, University of Oxford, Said Business School, Park End Street, Oxford, United Kingdom, makho06@gmail.com, Guangrui Ma, Michael Lim, Zhixi Wan

We study the dynamic adoption process of Clean Technology Products, which is often hampered by the chicken-and-egg dilemma: at the early stage of commercialization, firms are reluctant to invest in support infrastructure before sufficient consumers adopt the products; on the other hand, consumers hesitate to adopt the products without such infrastructure. We study two lines of widely-discussed policy instruments, government subsidies and mandated information disclosure, to tackle this dilemma.

3 - Is Electricity Storage "GREEN"? A Case Study with Commercial Buildings for Reducing Demand Charge

Yangfang Zhou, Assistant Professor, Lee Kong Chian School of Business, Singapore Management University, Singapore, Singapore, helenzhou@smu.edu.sg

Electricity storage systems, e.g., grid-scale industrial batteries, are known in the literature to increase carbon emission when used for arbitrage. However, we show that when these storage systems are used for reducing demand charge (on peak load), they can potentially decrease carbon emission. We model the problem of managing electricity storage and solar panels in a commercial building (e.g., those for hotels, banks, and supermarkets), and examine the "greenness" of storage with real data.

4 - Dynamics of Capacity Investment in Renewable Energy Projects

John Birge, Professor, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu, Nur Sunar

We study the dynamics of the capacity investment for renewable power generators. Using a continuous time Brownian model, we explicitly identify the optimal dynamic capacity investment strategy of a renewable power generator. Our analysis offers important insights for renewable power generators. We also include some numerical analysis to shed light on the optimal strategy.

■ MA48

48-Room 105A, CC

Supply Chain Finance and Risk Management

Sponsor: Manufacturing & Service Oper Mgmt/IFORM

Sponsored Session

Chair: Wei Luo, IESE Business School, Av. Pearson 21, Barcelona, Spain, wluo@iese.edu

Co-Chair: Kevin Shang, Duke University, 100 Fuqua Drive, Durham, NC, United States of America, kevin.shang@duke.edu

1 - The Strategic Role of Business Insurance

Juan Serpa, Assistant Professor, Kelley School of Business, Indiana University, 2111 Lower Mall, Bloomington, IN, United States of America, juan.serpa@sauder.ubc.ca, Harish Krishnan

We show that, in a multi-firm setting, insurance can be used strategically as a commitment mechanism to prevent excessive free-riding by other firms. In the presence of wealth imbalances, contracts alone leave wealth-constrained firms with inefficiently low incentives to exert effort, and firms with sufficient wealth with excessive incentives. Insurance allows the latter to credibly commit to lower effort, thereby mitigating the incentives of the wealth-constrained firms to free ride.

2 - Supply Chain Financing with Buy-back Contracts

Tunay Tunca, University of Maryland, College Park, MD, United States of America, ttunca@rhsmith.umd.edu, Weiming Zhu

Facing a budget-constrained buyer, a novel approach for large suppliers is adopting buy-back financing schemes to relieve their downstream partners and reduce channel costs. We analyze the efficiency of these financing schemes, and explore their impact on operational decisions and contract design. We find that such contract agreements can improve channel efficiency significantly over traditional financing methods.

3 - Supply Chain Network Formation and Risk Propagation

John Birge, Professor, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu, Jing Wu

The structure of supply chain networks impacts firm's performance through direct effects from shocks to linked firms as well as indirect effects from systematic risk exposure across the entire network. This talk will discuss a motivating model of network formation in this context and its implications for firms' supply chain choices.

4 - Trade Credit and Price Elasticity of Demand

Eduard Calvo, IESE School of Business, IESE, Barcelona, Spain, ECalvo@iese.edu, Wei Luo

This paper investigates how price elasticity of demand impacts trade credit in virtually integrated supply chains. We derive a theoretical model wherein trade credit is expressed as a function of margins, financing costs and elasticity. Ceteris paribus, we predict that suppliers of products with higher demand elasticity should be paid earlier to unlock higher profits. We further test the model using data from a large Spanish supermarket chain and its virtually integrated suppliers.

■ **MA49**

49-Room 105B, CC

Energy Operations and Sustainability

Sponsor: Manufacturing & Service Oper Mgmt/Supply Chain

Sponsored Session

Chair: Nur Sunar, Assistant Professor, University of North Carolina, Kenan-Flagler School of Business, Chapel Hill, NC, United States of America, Nur_Sunar@kenan-flagler.unc.edu

1 - New Business Models for Green Technology Adoption in Split Property Rights and Rents Situations

Anton Ovchinnikov, Queen's University, 143 Union St. West, Kingston, Canada, anton.ovchinnikov@queensu.ca

In many situations, the owner of the asset that is being improved with green technology is not one that enjoys the benefits from the improvement. For example, the landlord may incur the costs of energy-efficiency upgrades, while the tenant will enjoy the savings in energy costs. Such split in property rights and rents is a major deterrent in the adoption of green technologies. I will discuss two case studies highlighting the industry practice and issues, and opportunities to resolve them.

2 - The Impact of Extended Producer Responsibility on Selling and Leasing Strategies

Ni Fang, HEC Paris, 1, Rue de la Liberation, HEC Paris, Jouy en Josas, DI, 78351, France, ni.fang@hec.edu, Andrea Masini

While product take-back legislation based on the Extended Producer Responsibility (EPR) concept is becoming an increasingly popular instrument to reduce waste, its actual operational and environmental impact remains unclear. This paper examines how EPR legislation affects the optimal channel allocation decisions of a firm that either sells, leases, or concurrently sells and leases durable products, and it discusses the competitive and environmental implications of regulation.

3 - The Buyer's Role in Improving Energy Efficiency in Supply Chains

Jason Nguyen, University of Minnesota, 321 19th Ave S, Minneapolis, MN, 55455, United States of America, nguy1762@umn.edu, Karen Donohue, Mili Mehrotra

We investigate the equipment-focused EE investment decision in the context of a supply chain where a capital constrained manufacturer sets the investment level and its buyer sets contract prices. We investigate the impact of different factors including policy incentives and global competition on the investment decisions.

■ **MA50**

50-Room 106A, CC

The Role of Behavioral Modeling Features in Revenue Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Eren Cil, University of Oregon, 1585 East 13th Avenue, Eugene, OR, United States of America, erencil@uoregon.edu

1 - What if Hotelling's Firms Can Deliver Their Products? Competitive and Social Implications

Alireza Yazdani, University of Oregon, 2250 Patterson St., Unit 220, Eugene, OR, 97405, United States of America, syazdani@uoregon.edu, Eren Cil, Michael Pangburn

We study the competition between two firms serving dispersed customers, which we model using Hotelling's classic linear city model. In the classic framework, travel costs are borne by consumers, but potentially firms could absorb those costs by making deliveries to customers. We explore the competitive and social implications of these two alternatives for serving customers demands, considering both product design and pricing decisions.

2 - Dynamic Pricing of Multiple Substitutable Products with Search Cost and Local Behavioral Influences

Sajjad Najafi, PhD Candidate, University of Toronto, RS206, 5 King's College Road, Toronto, ON, M5S 3G8, Canada, snajafi@mie.utoronto.ca, Chi Guhn Lee, Sami Najafi-Asadolahi, Steven Nahmias

We consider a seller offering n types of substitutable products over T time periods. Customers incur a search cost for inspecting the products, and may examine only a subset of the products. They are also assumed to have a local behavior in the search process. Given inventory state and time, the firm aims to find the optimal price of the products maximizing its profit.

3 - Social Loafing and Queue Driven Speedup: Evidence from a Supermarket

Yong-Pin Zhou, Associate Professor of Operations Management, University of Washington, Seattle, WA, 98195-3226, United States of America, yongpin@uw.edu, Jingqi Wang

We study factors affecting cashiers' service rate using data from a supermarket. We find that customer waiting pushes cashiers to work faster. We also observe that pooling has a negative impact on cashiers' service rate.

4 - Physician Dual Practice; When Revenue is Not the Only Thing that Matters

Vasiliki Kostami, London Business School, London Business School (MSO dept), Regent's Park, London, NW1 4SA, United Kingdom, vkostami@london.edu, Dimitrios Andritsos

Physician dual practice refers to the simultaneous practice of medicine by physicians in both public and private settings. In the presence of dual-practice, we are looking at the optimal proportion of time that physicians may be willing to invest in a private practice. How does that proportion depend on the physicians objective? And how does this affect the severity of the patients that are treated in the public versus the private clinics?

■ **MA51**

51-Room 106B, CC

Models for Fashion Operations Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Victor Martínez-de-Albéniz, Associate Professor, IESE Business School, Av. Pearson 21, Barcelona, 08034, Spain, Valbeniz@iese.edu

1 - Assortment Planning Decisions in a Two-sided Market

Ying Cao, University of Texas at Dallas, 800 W. Campbell Rd, Richardson, TX, 75080, United States of America, Ying.Cao@utdallas.edu, Dorothee Honhon, Sridhar Seshadri

We consider the problem of a firm optimizing its assortment when facing a two-sided market. The firm receives revenues from customers purchasing the products as well as from advertising company who offer to pay various amounts for reaching customers from different segments. We explore structural properties of the optimal assortment and compare it to the solutions of the one-sided market problems.

2 - Managing Online Content to Build a Follower Base: Model and Applications

Felipe Caro, University of California Los Angeles, 110 Westwood Plaza, Box 951481, Los Angeles, CA, 90095-1481, United States of America, felipe.caro@anderson.ucla.edu, Victor Martínez-de-Albéniz

Content providers typically manage a dual objective of generating interest for current content and at the same time reaching out to new audiences that may become repeat users. The pace at which content is created must thus take into account how much current content contributes to the follower base. We develop a simple model to study base build-up dynamics, and use it to optimize the total traffic received by the content provider through stochastic dynamic programming.

3 - Choosing an Assortment Rotation Strategy to Boost Sales

Kris Johnson Ferreira, Harvard Business School, Morgan Hall 492, Boston, MA, 02163, United States of America, kferreira@hbs.edu, David Simchi-levi

Assortment rotation strategies vary widely across fashion retailers; the flash sales industry uses a frequent assortment rotation strategy, introducing new products every day. We build a finite-horizon stochastic dynamic programming model to better understand the consumer's purchase decisions under this strategy. We analyze and compare our model to the setting where all products are offered for the entire selling season and explore under what conditions the retailer should employ each strategy.

4 - Estimating and Optimizing the Impact of Inventory on Consumer Choices in Fashion Retail

Victor Martínez-de-Albéniz, Associate Professor, IESE Business School, Av. Pearson 21, Barcelona, 08034, Spain, Valbeniz@iese.edu, Pol Boada

We empirically study the impact of inventory (as opposed to availability) on sales. We develop a market share model where we show that product-level inventory has a large impact on its market share within the category. This supports the idea that inventory plays a major role in helping customers choose a particular product within the assortment. We finally describe how a retailer should optimally decide its inventory levels within a category.

■ MA52

52-Room 107A, CC

Designing Services: Marketing and Operations Inter-related Issues II

Sponsor: Service Science

Sponsored Session

Chair: Rohit Verma, Professor, Cornell University, School of Hotel Administration, 338 Statler Hall, Ithaca, NY, 14853-6902, United States of America, rohit.verma@cornell.edu

1 - Investigating Performance Insights: Leveraging Online Text Reviews using Natural Language Processing

Hyun Jeong Han, National Research University Higher School of Economics, Moscow, Russia, hhyun@hse.ru, Rohit Verma, Joel Goh, Nagesh Gavirneni, Shawn Mankad

In this study, we quantify the relationship between textual content of reviews and financial performances. To achieve our research objectives and to illustrate our methodologies, we partnered with leading hotel review website and hotel-data company to obtain their reviews and performance data on many hotels in Moscow, Russia.

2 - Explore Resource Configuration and Performance Link through Thick and Thin

Jie Zhang, Assistant Professor, University of Vermont, 55 Colchester Ave., Burlington, VT, 05401, United States of America, jie.zhang@uvm.edu, Rohit Verma

We study the patterns of resource configurations at operating unit level through the peaks and troughs of a business cycle. Using a large panel dataset from the US hotel industry, we identify subgroups of distinct resource configurations and link their resource configuration choices to performance.

3 - Who Wants to Share? Understanding the Participants of the Sharing Economy

Rohit Verma, Professor, Cornell University, School of Hotel Administration, 338 Statler Hall, Ithaca, NY, 14853-6902, United States of America, rohit.verma@cornell.edu, Lu Kong, Robert Kwortnik

The models of sharing economy include renting, bartering, loaning, gifting, swapping and forms of shared ownership such as cooperative structures. However, the academic cognition of sharing economy is lagging behind the public cognition. Thus, more research questions need to be asked and answered to unveil the essence and potential of sharing economy. In this article, we try to find out who the people participant in sharing economy are and what personality traits they share.

■ MA53

53-Room 107B, CC

Behavioral Issues in Coordination and Pricing

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Elena Katok, Ashbel Smith Professor of Supply Chain Management, University of Texas at Dallas, 800 W. Campbell Rd., Dallas, TX, 75080, United States of America, ekatok@utdallas.edu

1 - An Experimental Investigation of Managing Quality through Deferred Payment Mechanisms

Andrew Davis, Cornell University, 401J Sage Hall, Ithaca, NY, 14850, United States of America, adavis@cornell.edu, Kyle Hyndman

We conduct an experiment investigating the efficacy of deferred payment mechanisms in inducing high quality products from suppliers. In particular, we explore a setting where a retailer offers a supplier a fixed fee and a bonus, where the bonus constitutes a deferred payment that is only paid out after a review period has passed and the product is deemed high quality. In one set of our treatments, in both one-shot and repeated settings, we observe significantly higher quality and efficiency.

2 - Size Matters: Supplier Coordination with Endogenously-selected Groups

James Fan, PhD Student, Pennsylvania State University, 426A Business Building, University Park, PA, 16802, United States of America, juf187@psu.edu, Tony Kwasnica

We study the endogenous selection of supplier groups via experimental coordination games. Players first choose between one of two groups, one with an entry fee and one without; they then simultaneously makes a capacity choice. The minimum choice within each group dictates profits for members. The group with an entry fee always observes higher capacity outcomes. This group also has fewer players, suggesting that players recognize the increasing difficulty of coordination in larger groups.

3 - Project Management under Risk-sharing Contracts

Sina Shokoohyar, PhD Student, University of Texas at Dallas, 7815 Mccallum Blvd, Apt. 18205, Dallas, TX, 75252, United States of America, sxs137430@utdallas.edu, Elena Katok, Anyan Qi

We study coordination between contractors in a project under the risk-sharing contracts where payoff of contractors critically depends on the lowest exerted effort. The lowest possible effort may emerge as a result of the Maxmin strategy. To improve coordination, we propose information feedback policy. We show in theory that the coordination risk can be mitigated with periodic information feedback. We also report experimental data which is in line with our theoretical findings.

4 - A Behavioral Study of Competitive Dynamic Pricing with Fixed Capacities

Bahriye Cesaret, PhD Student, The University of Texas at Dallas, 800 W Campbell Rd, Richardson, TX, 75080, United States of America, bahriye.cesaret@utdallas.edu, Elena Katok

We consider two firms that offer substitutable capacity to the same customer pool. Customers arrive sequentially to the market and demand exactly one unit of capacity, and price is the main consideration for the purchasing decisions. Each firm quotes a price for its current unit of capacity simultaneously. We use a 2x2 between-subjects design with two levels of arrival uncertainty and two different length of selling horizon. We report on the results of these laboratory experiments.

■ MA54

54-Room 108A, CC

A Practical Guide to Ranking and Selection Methods

Cluster: Tutorials

Invited Session

Chair: Dave Goldsman, Professor, Georgia Tech, School of ISyE, Georgia Tech, Atlanta, GA, 30332, United States of America, sman@gatech.edu

1 - Tutorial: A Practical Guide to Ranking and Selection Methods

Dave Goldsman, Professor, Georgia Tech, School of ISyE, Georgia Tech, Atlanta, GA, 30332, United States of America, sman@gatech.edu

We discuss the branch of statistics known as ranking and selection (R&S), which has garnered significant interest in the operations research literature. We introduce some common R&S terminology and go over a number of archetypal procedures to select (i) that one of a number of normal populations having the largest mean, (ii) the Bernoulli population having the largest success parameter, and (iii) the most-probable multinomial cell. We show how these types of procedures can be used in meaningful applications, particularly involving computer simulation.

■ MA55

55-Room 108B, CC

Innovative Uses of DEA

Cluster: Data Envelopment Analysis

Invited Session

Chair: Tim Anderson, Portland State University, 1900 SW 4th Ave, Suite LL-50-02, Portland, OR, United States of America, tim.anderson@pdx.edu

1 - Reexamining Baseball Careers for Possible Drug use with DEA

Tim Anderson, Portland State University, 1900 SW 4th Ave, Suite LL-50-02, Portland, OR, United States of America, tim.anderson@pdx.edu, Monica Morawa, John Ruggiero

This paper revisits previous work on using DEA to identify potential performance enhancing drug use with an updated DEA model, polynomial regression, and the Malmquist Productivity Index.

2 - Superfood or Not? DEA Makes the Call

Thomas Sexton, Professor, Stony Brook University, College of Business, Stony Brook, NY, 11794-3775, United States of America, thomas.sexton@stonybrook.edu, Christine Pitocco

The use of the term superfood has grown by a factor of almost 20 over the past 40 years. Yet, there is no operational definition. We use a variable returns to scale, mixed orientation DEA model to evaluate 164 foods that are listed on at least one of 8 published lists of purported superfoods. We use 35 nutrients and find that 145 of the foods are on the efficient frontier. The remaining 19 foods lie below the efficient frontier and cannot be classified as superfoods under this definition.

3 - Efficiency Analysis of Internal Combustion Engines: Naturally Aspirated vs Turbo/super-charged

Dong-Joon Lim, Portland State University, 1900 SW 4th Ave,
Suite LL-50-02, Portland, OR, United States of America,
dongjoon@pdx.edu, Tim Anderson

This study investigates the technical efficiency of NA and T/SC engines to identify varying technology adoption patterns as well as breakthrough engines over the past 10 years. The results indicate that T/SC engines are enlarging their dominance on the technology frontier and if current environmental and fuel economy regulations continue to be stiffer, a return to high displacement unblown engines is unlikely to happen without a major breakthrough in the NA technologies.

■ MA56

56-Room 109A, CC

Facility Location and Supply Chain Network Design

Sponsor: Location Analysis

Sponsored Session

Chair: Kayse Lee Maass, Ph.D. Candidate, University of Michigan,
1205 Beal Ave., Ann Arbor, MI, 48109, United States of America,
leekayse@umich.edu

1 - Selective Newsvendor Problem with Quantity-dependent Leadtime and Marketing Decisions

Jianing Zhi, The University of Alabama, 300 Alston Hall, 361
Stadium Drive, Tuscaloosa, AL, 35487, United States of America,
jzhi@crimson.ua.edu, Burcu Keskin

We consider a selective newsvendor problem with limited sales force and quantity-dependent leadtime to maximize the expected profit for a company. We evaluate our models with demands, capabilities of agents, leadtime, and waiting time tolerance of customers to estimate their impacts on the profit, ordering policies, and marketing decisions.

2 - Constrained Connected Facility Location Problems

Maria Gisela Bardossy, Assistant Professor, University of
Baltimore, 1420 N. Charles Street, Merrick School of Business,
Baltimore, MD, 21201, United States of America,
mbardossy@ubalt.edu

We investigate and propose heuristics for two variants of the Connected Facility Location (ConFL) problem: degree constrained and hop constrained. The ConFL problem combines features of the uncapacitated facility location problem with the Steiner tree problem and is known to be NP-complete. However, in certain practical applications, the number of connections at the facility nodes and/or the connections between open facilities is limited, which we address in this presentation.

3 - A Supply Chain Network Design Problem Considering Market Cannibalization

Yanzi Zhang, Tsinghua University, Beijing, China,
zhzhang@mail.tsinghua.edu.cn

The paper studies a supply chain network design problem with cannibalization of new products sales by remanufactured products. Location, inventory, and pricing decisions are considered in a two-tier supply chain network. New and remanufactured products are supplied together with price-dependent demands. The cannibalization effect of them is considered. The problem is formulated as a nonlinear program. Managerial insights are explored by numerical experiments.

4 - Stochastic Inventory Modulated Capacitated Facility Location Models

Kayse Lee Maass, Ph.D. Candidate, University of Michigan,
1205 Beal Ave., Ann Arbor, MI, 48109, United States of America,
leekayse@umich.edu, Mark Daskin, Siqian Shen

We compare various approaches to modeling a stochastic capacitated facility location problem in which processing facilities are able to accept demands in excess of the capacity constraint for short periods of time. We show that the location and allocation decisions obtained from our models can result in significantly reduced costs when compared to models that do not account for the likelihood that demands may exceed capacity on some days.

■ MA57

57-Room 109B, CC

Optimization for Wind Energy

Sponsor: ENRE – Energy II – Other (e.g., Policy, Natural Gas,
Climate Change)

Sponsored Session

Chair: Zana Cranmer, University of Massachusetts, Amherst, MA,
acranmer@umass.edu

1 - Lagged Processes and Nested Decisions: Modeling for Renewables

Warren Powell, Faculty (Advisor), Princeton University, Sherrerd
Hall, Charlton Street, Princeton, NJ, 08540, United States of
America, powell@princeton.edu, Weidong Han, Genna Gliner,
Hugo Simao

The proper modeling of wind integration in an energy system requires modeling the lags between when decisions are made and when they are implemented, the evolution of forecasts (and forecast accuracy), as well as the nesting of decisions. We describe how to correctly model these problems, and contrast our approach with popular modeling and algorithmic strategies currently used in the study of wind integration. We describe how modeling inaccuracies can lead to errors in policy conclusions.

2 - Modeling Economic and Environmental Tradeoffs in Offshore Wind Development

Zana Cranmer, University of Massachusetts, Amherst, MA,
acranmer@umass.edu, Erin Baker

Using a portfolio model to capture interactions between siting choices, we can estimate the impact of different environmental policies on the economic value of the wind resources in an area. Policies include site restrictions, maximizing continuous space for ecosystems, and establishing set backs from hot spots.

3 - Optimizing Storage Technologies to Add Value to Wind Energy

Jessika Trancik, Massachusetts Institute of Technology,
Cambridge, MA, United States of America, trancik@mit.edu

Energy storage can increase the value of wind energy if costs are sufficiently low. Evaluating diverse storage technologies on a common scale has proven a challenge, however, due to their differing cost structures. Here we present a new conceptual and quantitative model for comparing storage technologies. Some storage technologies today are found to add value to wind energy in some locations, but cost reduction is needed to reach widespread profitability.

4 - Understanding How Generation Flexibility and Renewable Energy Affect Power Market Competition

Owen Wu, Indiana University, 1309 E. 10th Street, Bloomington,
IN, 47405, United States of America, owenwu@indiana.edu,
Xiuli Chao, Majid Algaiz

We study supply function competition among power generators with different levels of flexibility. We analyze how generators' (in)flexibility affects the equilibrium behavior and market price. We also investigate the impact of intermittent renewable energy on the equilibrium, focusing on the effects of renewable energy penetration level, dispatch priority, and the production-based subsidies. We find that the economic curtailment policy increases market competition and reduces price volatility.

■ MA58

58-Room 110A, CC

Analytics in the Petrochemical and Petroleum Industries I

Sponsor: ENRE – Natural Resources II – Petrochemicals and
Petroleum

Sponsored Session

Chair: Margery Connor, Chevron, 6001 Bollinger Canyon, F-2080,
San Ramon, CA, 94583, MHCO@chevron.com

1 - Hydrocarbon Procurement with Take-or-Pay Contracts

Metin Cakanyildirim, Professor, University of Texas at Dallas,
800 W. Campbell Road SM30, Richardson, TX, United States of
America, metin@utdallas.edu, Koray Simsek, Cagri Haksoz

This paper studies a take-or-pay procurement contract for petrochemicals in the presence of spot market trading and storage capability in a dynamic setting. Main decisions are purchase and storage quantities and their relation with the take-or-pay penalty and net convenience yield. A computationally efficient formulation is sought and analyzed.

2 - Big Data in the Energy Industry

Margery Connor, Chevron, 6001 Bollinger Canyon, F-2080,
San Ramon, CA, 94583, MHCO@chevron.com

This presentation will discuss our internal efforts to build a big data platform. It will include a couple of use cases. It will also include challenges and lessons learned.

3 - Emerging Applications of Optimization in the Energy Industry

Haraldur Haraldsson, Aimmms Optimization Specialist, AIMMS,
500 108th Avenue NE, Ste. #1780, Suite 1780, Bellevue, WA,
98004, United States of America,
haraldur.haraldsson@aimms.com

With data analytics and optimization gathering focus in many organizations, there is an increased opportunity to leverage advanced analytics. We will share some examples on potential use of advanced analytics in the energy industry for future cases.

■ MA59

59-Room 110B, CC

Strategy, Innovation, and Entry

Cluster: Strategy Science

Invited Session

Chair: Hart Posen, University of Wisconsin, 4263 Grainger Hall, 975
University Avenue, Madison, WI, 53705, United States of America,
hposen@bus.wisc.edu

**1 - Spinout Formation and Parent Firm Performance:
A Multi-industry Examination**

Seth Carnahan, University of Michigan, 701 Tappan St., R4460
Ross School of Business, Ann Arbor, MI, 48104, United States of
America, scarnaha@umich.edu, Benjamin Campbell,
Rajshree Agarwal

Some scholars find an increase in firm performance when former employees create startup organizations ("spinouts"), while others find a decrease. We articulate the competing mechanisms that underlie these positive and negative results, and we argue that conflicting findings are driven largely by industry differences. We utilize a multi-industry sample based on US Census microdata that allows us to identify and test the competing mechanisms.

**2 - Spinout Formation: Do Opportunities and Constraints Benefit
High Human Capital Founders?**

Natarajan Balasubramanian, Syracuse University, 721 University
Ave, Syracuse, NY, United States of America, nabalasu@syr.edu,
Mariko Sakakibara

Using a large sample of individuals who formed spinouts and their co-workers who did not, we show industry contexts affect the relative advantage of high human capital founders. We find that such individuals are less likely to form spinouts in capital-intensive and R&D-intensive industries. This suggests that in capital intensive industries, high human capital founders face greater constraints while R&D intensive industries offer opportunities for both high and low human capital founders.

3 - Entrepreneurial Joiners

Michael Roach, Cornell University, Dyson School, Ithaca, NY,
14853, United States of America, michael.roach@cornell.edu,
Henry Sauermann

Startups rely not only on founders, but also on "joiners"—individuals attracted to entrepreneurship as an employee rather than a founder. We find that individuals with joiner interests share preferences for entrepreneurial job attributes often considered unique to founders, but differ with respect to contextual factors. This study reveals that preferences and context interrelate in unique ways to shape entrepreneurial interests and highlights joiners as a distinct type of entrepreneurial actor.

**4 - (how) Do Individual Characteristics Influence Resource Allocation
and Competitive Advantage?**

Michael Leiblein, Ohio State University, Fisher College of
Business, Columbus, OH, 43220, United States of America,
leiblein.1@osu.edu, Barclay Burns, Sheen Levine

A fundamental issue in the field of strategic management regards the identification of sources of competitive advantage. Why do firms differ and how do managers influence firm behavior? If individuals matter and theories of competitive advantage are correct, then unique individuals should differ in their resource allocation decisions and outcomes. This proposal promises to report emerging evidence associating individual characteristics, resource allocation decisions, and competitive advantage.

■ MA60

60-Room 111A, CC

Enabling Business Students to Use OR

Sponsor: INFORM-ED

Sponsored Session

Chair: Thomas Grossman, Professor, University of San Francisco, School
of Management, 101 Howard St., Suite 500, San Francisco, CA, 94105,
United States of America, tagrossman@usfca.edu

1 - Teaching Modeling to Business Students

Wendy Roth, Assistant Professor, Georgia State University,
6230 Forest Park Dr, Signal Mountain, TN, 37377,
United States of America, wroth@gsu.edu

Due to the popularity of business analytics, interest in business modeling classes appears to be increasing. When considering the student skill level as compared to a few years ago, this has resulted in a broader variety of student backgrounds, not necessarily self-selected based on a strong math background. This session will discuss some of those differences and modifications made to the classroom to help address these differences.

2 - Teaching Distribution Planning: A PBL Approach

Alex Grasas, Associate Professor, EADA Business School, Arago
204, Barcelona, Spain, agrasas@eada.edu, Helena Ramalhinho

This work presents a problem-based learning (PBL) activity that uses a decision support system (DSS) to teach one of the most fundamental topics in distribution planning: vehicle routing. This pedagogical activity, employed in a logistics and supply chain management course, also seeks to create awareness among students on the importance of DSS for complex problems. The paper is written as a teaching guide for other instructors, detailing how the activity may be carried out in class.

**3 - Spreadsheet Engineering: The Foundation for OR/MS
Applications by Business Students**

Vijay Mehrotra, Professor, University of San Francisco, School of
Management, 101 Howard St., Suite 500, San Francisco, CA,
94105, United States of America, vmehrotra@usfca.edu,
Thomas Grossman, Mouwafac Sidaoui

To access the power of OR/MS on non-trivial models, business students must first learn to apply software engineering principles to develop high quality spreadsheets. We have developed a methodology for teaching this skill to business students, many of whom have little or no relevant technical experience prior to our course. This talk describes how we successfully teach business students to build complex spreadsheet models that then serve as the foundation for OR/MS applications.

■ MA61

61-Room 111B, CC

Transmission and Generation Expansion Planning

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Enzo Sauma, Pontificia Universidad Catolica de Chile, Santiago,
Chile, esauma@ing.puc.cl

**1 - Risk-averse Transmission and Generation Planning:
A WECC Case Study**

Harry Van Der Weijde, University of Edinburgh, The King's
Buildings, Mayfield Road, Edinburgh, EH9 3JL, United Kingdom,
h.vanderweijde@ed.ac.uk, Francisco Munoz, Benjamin Hobbs,
Jean-paul Watson

We investigate the effects of risk aversion on optimal transmission and generation expansion planning. To do so, we formulate a stochastic model in which transmission and generation planners minimize a weighted average of expected costs and their conditional values at risk. This model is then applied to a 240-bus representation of the Western Electricity Coordinating Council, in which we examine the impact of risk aversion on levels and spatial patterns of investment, costs, and prices.

2 - Robust Transmission Expansion Planning

Antonio Conejo, Prof., The Ohio State University, 286 Baker
Systems Engineering, 1971 Neil Avenue, Columbus, OH, 43210,
United States of America, conejonavarro.1@osu.edu

This presentation discusses a number of critical issues to successfully design and implement transmission expansion planning algorithms using an adaptive robust optimization approach. These issues include formulation format, selection of robust sets, sensitivity analysis, and out-of-sample simulation.

3 - The Economic Effects of Interregional Trading of Renewable Energy Certificates in the WECC

Francisco Munoz, Assistant Professor, Universidad Adolfo Ibañez, Diagonal Las Torres 2640, Santiago, Chile, elpanchomunoz@gmail.com, Benjamin Hobbs, Andres Perez, Enzo Sauma

In the U.S., individual states enact RPSs for renewable electricity production with little coordination. Using a co-optimization (transmission and generation) planning model, we quantify the long run economic benefits of allowing flexibility in the trading of Renewable Energy Credits (RECs) among the U.S. states that belong to the WECC. We find that up to 90% of the economic benefits are captured if approximately 25% of unbundled RECs are allowed to be acquired from out of state.

4 - Reliable Transmission Expansion Planning for Large Renewable Energy Penetration

David Pozo, PUC, Ave. Vicuna MAckenna 4860, Santiago, Chile, davidpozocamara@gmail.com, Alexandre Moreira, Alexandre Street, Enzo Sauma

We presents a novel approach to jointly address transmission network and renewable capacity expansion planning dealing with renewables variability under multiple n - K security criteria. An adjustable robust optimization approach is presented to circumvent the tractability issues associated with conventional contingency-constrained methods relying on explicitly modeling the whole contingency set and renewables generation scenarios. The adjustable robust model is formulated as a trilevel problem.

■ MA62

62-Room 112A, CC

OR Models for Ocean and River Energy

Sponsor: ENRE – Environment I – Environment and Sustainability

Sponsored Session

Chair: Alberto Lamadrid, Assistant Professor, Lehigh University, 27 Memorial Drive, Bethlehem, PA, 18015, United States of America, ajlamadrid@lehigh.edu

Co-Chair: Larry Snyder, Associate Professor, Lehigh University, 200 West Packer Ave., Mohler Lab, Bethlehem, PA, 18015, United States of America, larry.snyder@lehigh.edu

1 - Portfolio Assessment of Run-of-River Hydrokinetic Power Generation

Seth Blumsack, Associate Professor, Pennsylvania State University, 153 Hosler Building, University Park, PA, 16802, United States of America, sethb@psu.edu, Mehdi Shahriari, Frank Liu, Ben Hodges

Spatially distributed run-of-river hydrokinetic power generation resources are a portfolio of assets whose value varies with prices and output. We quantify the locational contribution of hydrokinetic generation to the value of a spatial portfolio and derive a variance decomposition indicating how variance in portfolio value depends on variance in output, prices and spatial co-fluctuations. Individual sites have nearly uniform value contributions over fast time scales, but not longer time scales.

2 - Towards a Holistic Modeling of River Networks

Radu Marculescu, Professor Of Electrical And Computer Engineering, Carnegie Mellon University, Dept. of ECE, Pittsburgh, PA, 15213, United States of America, radum@cmu.edu, Diana Marculescu, Paul Bogdan

River dynamics are dependent on both terrain and environmental conditions. While AR-based models can be sufficiently accurate for forecasting river dynamics, we show that spatio-temporal variability can only be uncovered through a multi-fractal spectrum formalism. Moreover, a network-based model of cloud movement can estimate precipitation levels, thereby providing a first step towards modeling the complete hydrological cycle and developing control methods for run-of-river power projects.

3 - Hydro-structural Design Optimization for Marine Hydrokinetic Turbines

Ashwin Vinod, Graduate Student, Lehigh University, 19 Memorial Drive West, Mechanical Engineering & Mechanics, Bethlehem, PA, 18015, United States of America, asv312@lehigh.edu, Arindam Banerjee

An optimization methodology for a fixed pitch horizontal axis hydrokinetic turbine will be presented using a combination of a coupled hydro-structural analysis and genetic algorithm based optimization. Preliminary hydro-structural analysis indicates low hydrodynamic performance and high flap-wise bending stresses developed in turbine blades. A multi-objective optimization methodology is used to design a variable chord, twisted blade turbine which yielded improved hydro-structural performance.

■ MA63

63-Room 112B, CC

Daniel H. Wagner Prize Competition I

Cluster: Daniel H. Wagner Prize Competition

Invited Session

Chair: Allen Butler, President & CEO, Daniel H. Wagner Associates, Inc. 2 Eaton Street, Hampton, VA 23669, United States of America, Allen.Butler@va.wagner.com

1 - Using Analytics to Enhance Shelf Space Management in a Food Retailer

Teresa Bianchi-Aguar, University of Porto and LTPlabs, INESC TEC & Faculty of Engineering, Portugal, mtbaguiar@fe.up.pt, Elsa Silva, Luis Guimarães, Maria Antónia Carravilla, José F. Oliveira, Jorge Liz, João Gönther Amaral, Sérgio Lapela

This talk describes a collaboration with the leading Portuguese food retailer, addressing the allocation of products to shelves. The result is GAP, a DSS that is today used on a daily basis. GAP has a modular structure and systematically applies tailor-made mathematical programming models combined with heuristics. It is able to incorporate different merchandising rules, allowing the company to test several product allocation strategies with a trade-off between customization and optimization.

2 - Strategic Re-design of Urban Mail and Parcel Networks at La Poste

Stefan Spinler, Professor, WHU-Otto Beisheim School of Management, Burgplatz 2, Vallendar, 56179, Germany, stefan.spinler@whu.edu, Alain Roset, Matthias Winkenbach

We devise a decision model that allows La Poste, the French postal operator, to assess the benefits of merging the urban mail and parcel delivery networks which used to be run as separate entities. Based on data from the French city of Nantes, we find that merging the mail and parcel delivery yields cost benefits of around 31% which prove to be robust under various scenarios tested. These findings corroborated management's expectation of cost savings and entailed a new organizational structure.

■ MA64

64-Room 113A, CC

Joint Session DAS/HAS: Dependencies in Pharmaceutical Portfolio Management: Challenges and Pragmatic Approaches

Sponsor: Decision Analysis

Sponsored Session

Chair: Chris Dalton, Syncopation Software, 6 State Street, Suite 308, Bangor, ME, 04401, United States of America, cdalton@syncopation.com

1 - Assessing Technical Risk Dependencies in Pharmaceutical Drug Development

Elayne Ko, Pfizer, 500 Arcola Road, Collegeville, PA, 19426, United States of America, Elayne.Ko@pfizer.com

The presentation explores the process and framework of evaluating pharmaceutical R&D investment projects with technical risk dependencies. This occurs when either 1) compounds in the portfolio share the same mechanism of action or 2) a compound is being developed for more than one indication. Assuming probability independence and simply aggregating individual compound evaluations into portfolio view would not adequately reflect the risks of the compounds.

2 - Play the Portfolio Game

Chris Dalton, Syncopation Software, 6 State Street, Suite 308, Bangor, ME, 04401, United States of America, cdalton@syncopation.com, Phil Beccue, Elayne Ko

This segment will feature an interactive portfolio management exercise designed to foreshadow and highlight the central concepts of the talks that follow. Participants will work in small groups, selecting the best portfolio they can from a pool of risky projects. Uncertainties will be resolved throughout the session, so that a final portfolio value can be calculated. There will be prizes for the winning team.

3 - Global Uncertainties in Pharma R&D Portfolio Management

Chris Dalton, Syncopation Software, 6 State Street,
Suite 308, Bangor, ME, 04401, United States of America,
cdalton@syncopation.com

R&D portfolio management in pharma tends to be focused on individual project risk factors, technical and commercial. Global risk factors affecting many projects are usually ignored, on the theory that while they may change the value of the portfolio they are unlikely to alter the project ranking. The possibility of far reaching changes in government policy suggests that this assumption should be tested. This talk examines the impact of some potential policy changes on a notional portfolio.

4 - Manufacturing Investments in Pharmaceutical R&D: Should I Pull the Trigger?

Phil Beccue, White Deer Partners, Westlake Village, CA,
United States of America, phil@beccue.com

Capital investments to manufacture biopharmaceuticals require long lead times and large expenditures that require board approval. These facilities produce multiple products in highly competitive markets with uncertain demand, and if not planned carefully, can result in a loss of economic value or inefficient allocation of scarce resources. Based on recent case studies, we will explore how decision analytics helps guide manufacturing choices.

■ MA65

65-Room 113B, CC

From Value of Information to Sensitivity Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Emanuele Borgonovo, Professor, Bocconi University, Via Roentgen 1, Milan, 20136, Italy, emanuele.borgonovo@unibocconi.it

1 - Importance Measures and Value of Information

Alessandra Cillo, Assistant Professor, Bocconi University,
Via Roentgen 1, Milan, Italy, alessandra.cillo@unibocconi.it,
Emanuele Borgonovo

The importance measures are sensitivity indices. Despite their wide use, no work has systematically addressed the relationships among them. We provide new probabilistic relationships that link each measure to the remaining ones. These new relationships also allow us to introduce new importance measures, value of information based. We compare an importance measure and the value of information-based measure, which depends upon the same measure: interesting differences emerge.

2 - Integral Sensitivity in Linear Programming

Richard Wendell, Professor, University of Pittsburgh, Katz
Graduate School of Business, Pittsburgh, PA, 15238, United States
of America, wendell@katz.pitt.edu, Emanuele Borgonovo,
Greg Buzzard

Herein we provide a general framework merging two well known sensitivity analysis approaches, namely, the tolerance sensitivity and global sensitivity approaches. This unification leads to a series of novel results, ranging from analytical formulae for computing global sensitivity measures to conditions ensuring that uncertainty in the parameters is immaterial. Moreover, the results provide the basis for a numerical approach for assessing key problem drivers and determining tolerance regions.

3 - Robust Importance Measures

Emanuele Borgonovo, Professor, Bocconi University,
Via Roentgen 1, Milan, 20136, Italy,
emanuele.borgonovo@unibocconi.it

Importance measures are probabilistic indicators that deliver information about key risk drivers. They are defined for aleatory uncertainty. We show that, relying on their probabilistic meaning, one can obtain a natural extension of importance measures also when probabilities are not known.

■ MA66

66-Room 113C, CC

Air Traffic Management and Airline Operations

Sponsor: Aviation Applications

Sponsored Session

Chair: Peng Wei, Assistant Professor, Iowa State University, Aerospace Engineering Department, 2312 Howe Hall, Ames, IA, 50011, United States of America, pwei@iastate.edu

1 - Modeling Airport Operations for Capacity Planning by Airport Planners and Individual Carriers

L. Douglas Smith, University of Missouri-St. Louis, St. Louis, MO,
United States of America, ldsmith@umsl.edu, Jan Fabian Ehmke,
Deng Pan, Liang (leon) Xu, Ziyi Wang

We discuss a blend of statistical modelling, LP optimization and discrete-event simulation that was used in the construction, calibration, validation and application of a model for capacity planning at commercial airports. With results from simulated scenarios, we examine the effects of changing usage of runways, taxiways, ramps and gates under different traffic conditions. We also see how concentration of activity at hub airports can cause flight delays to cascade for individual carriers.

2 - Real-time Gate Assignment

Diego Klabjan, Northwestern University, Evanston, IL 60208,
United States of America, Professor, d-klabjan@northwestern.edu

Due to unpredictable events airlines have to frequently adjust gate assignments. We propose a network flow model that also considers crew and passenger connections. A thorough computational study is presented based on data from a big US airport.

3 - An Alternative Approach to Capacity Allocation at Congested Airports

Amedeo Odoni, Professor, MIT, Room 33-219, MIT,
77 Mass Ave, Cambridge, MA, 02139, United States of America,
arodoni@mit.edu, Alexandre Jacquillat

Current slot allocation at congested airports worldwide is based on long-standing guidelines developed by IATA. An alternative approach, developed after extensive research, will be outlined: it is more responsive to airline preferences, integrates airport operating capabilities, minimizes interference with airline competitive scheduling and is based on achieving user-specified performance goals, instead of being solely driven by arbitrary and administratively-determined capacity constraints.

4 - Airline Passenger Origin-Destination Reaccommodation with Spare Aircraft

Peng Wei, Assistant Professor, Iowa State University, Aerospace Engineering Department, 2312 Howe Hall, Ames, IA, 50011, United States of America, pwei@iastate.edu

The researchers at Amadeus have presented a method to formulate airline passenger origin-destination reaccommodation into a multi-commodity flow problem, for which they also designed the solution algorithm. In this paper we consider the Airline Passenger Origin-destination Reaccommodation with Spare Aircraft, which no one has tackled before.

■ MA67

67-Room 201A, CC

City Logistics and Sustainable Urban Freight Systems - II

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Johanna Amaya, Rensselaer Polytechnic Institute, 110 8th St. JEC 4037, Troy, NY, 12180, United States of America, amayaj@rpi.edu

1 - Public Sector Initiatives Sustainable Urban Freight Systems Part I

Johanna Amaya, Rensselaer Polytechnic Institute, 110 8th St.
JEC 4037, Troy, NY, 12180, United States of America,
amayaj@rpi.edu, Jose Holguin-Veras,
Carlos A. Gonzalez-Calderon, Stacey Hodge, Michael Browne,
Miguel Jaller, Jeffrey Wojtowicz, Cara (xiaokun) Wang,
Daniel Haake, Ivan Sanchez-Diaz

Transportation policy should ensure freight is moved efficiently as it is a physical manifestation of the economy. In this study, planners are provided with guidelines to implement initiatives addressing freight issues. Initiatives were organized as part of a continuum, from supply to demand side; underpinned by stakeholder engagement. This paper discusses pricing, incentives, taxation; logistical management; and freight demand/land use, along with a methodology to identify potential initiatives

2 - Quantifying the Impacts of City Logistics Strategies in the Mexico City Metropolitan Area

Miguel Jaller, Assistant Professor, University of California, Davis,
One Shields Ave, Ghausi Hall, 3143, Davis, CA, 95616, United
States of America, mjaller@ucdavis.edu, Sergio Sanchez,
Joanne Green

This paper discusses the assessment of the potential impacts of city logistics strategies proposed for the Metropolitan Area of the Mexico City Valley: off-hour delivery programs; cargo consolidation to decrease empty trips; and preferential truck routes. The analyses consider the impacts on travel distances, travel times, accidents, emissions and health impacts under various scenarios. The paper discusses the proposed strategies, the methodology, information and the assumptions adopted.

3 - Factors Influencing the Performance of Urban Consolidation Schemes

Sonke Behrends, Chalmers University of Technology, Technology
Management and Economics, Logistics and Transportation,
Gothenburg, Sweden, sonke.behrends@chalmers.se

Many urban consolidation centers (UCC) have struggled to operate on a commercial basis and are either terminated or depend on government subsidies. Hence there is a general scepticism about their commercial viability among practitioners. This paper contributes to a better understanding under which preconditions UCCs can be feasible. This paper quantifies a UCCs impact on the key stakeholders in urban logistics and analyses the relevance of several factors for the UCC performance.

4 - Land Use Patterns, Logistics, and Emissions

Erica Wygonik, RSG, 55 Railroad Row #101,
White River Junction, VT, 05001, United States of America,
ewygonik@gmail.com, Nathan Mayes, Anne Goodchild

This work compares and contrasts two approaches to quantifying the relationships between landuse, logistics, and emissions. These two approaches are used to consider of a variety of delivery strategies, including personal travel to stores and delivery services on cost, CO2 emissions, as well as criteria pollutants. Conclusions can be drawn as to the most efficient distribution strategies under different urban forms.

5 - Economic and Environmental Comparison of Different Order Scheduling Policies

Dincer Konur, Assistant Professor, Missouri University of Science
and Technology, 206 EM 600 W. 14th St., Rolla, MO, 65409,
United States of America, konurd@mst.edu, James Campbell

This study analyzes a continuous review inventory model with multiple carriers under carbon trading regulation. We analyze and compare the optimal carrier selection and order splitting decisions with single sourcing and two alternative delivery schedules for multi-sourcing, namely, sequential ordering and sequential delivery. For each of the three order scheduling policies, a solution method is proposed and these policies are compared in terms of both economic and environmental performance.

■ MA68

68-Room 201B, CC

Electric Vehicles II

Sponsor: Transportation, Science and Logistics

Sponsored Session

Chair: M. Hadi Amini, PhD Fellow, Carnegie Mellon University,
5700 Centre Ave, Apt 317, Pittsburgh, PA, 15206,
United States of America, amini@cmu.edu

1 - Routing Aspects of Electric Vehicle Users and Their Effects on Network Performance

Shubham Agrawal, Purdue University, West Lafayette, IN 47906,
United States of America, shubham@purdue.edu, Amit Kumar,
Srinivas Peeta, Hong Zheng

This study investigates the dynamic equilibrium for mixed traffic involving Battery Electric Vehicles (BEVs) and Internal Combustion Engine Vehicles (ICEVs). The BEVs' routing behavior with preference to minimize battery consumption and reduce range anxiety is modeled and analyzed. Due to the energy efficiency considerations in route selection for BEVs, the network performance in terms of total travel time is analyzed under different market penetrations of BEVs.

2 - A Continuum Approximation Model for Electric Vehicle Sharing

Xiaopeng Li, University of South Florida, Department of Civil and
Environmental Engineering, 4202 E. Fowler Avenue, Tampa, FL,
33620, United States of America, xiaopengli@usf.edu,
Jiaqi Ma, Jianxun Cui, Fang Zhou, Amir Ghiasi

This paper proposes a Continuum Approximation (CA) model for design of a one-way Electrical Vehicle (EV) sharing system that serves a metropolitan area. This

model determines the optimal EV sharing station locations and the corresponding EV fleet sizes to minimize the comprehensive system cost (including station construction investment, vehicle maintenance, transportation, and vehicle balancing) under stochastic and dynamic trip demands.

3 - Modeling Network Equilibrium with Mixed Flows of Electric and Gasoline Vehicles

Xiaozheng He, Research Associate, Purdue University,
Nexttrans Center, 3000 Kent Avenue, West Lafayette, IN, 47906,
United States of America, seanhe@purdue.edu, Srinivas Peeta,
Hong Zheng

This study develops a variational inequality formulation for the network equilibrium of mixed traffic flows consisting of electric and gasoline vehicles, where energy consumption is modeled as a function of traffic flow and considered in the drivers perceived travel cost. Numerical examples illustrate the impact of energy prices on network equilibrium and provide insights for policy-making to promote the usage of electric vehicles.

4 - On the Effect of Electric Vehicle Parking Lots' as Dispatchable Loads on the Power System Loss

M. Hadi Amini, PhD Fellow, Carnegie Mellon University, 5700
Centre Ave, Apt. 317, Pittsburgh, PA, 15206, United States of
America, amini@cmu.edu, Marija D. Ilic, Orkun Karabasoglu

We investigate the effect of parking lots characteristics (charging rate, capacity in terms of number of EVs, and location in the power network) on the network's hourly loss and daily energy loss. Parking lots are modeled as EV demand aggregators. To this end, we define four scenarios to determine the effect of charging rate and distribution of EVs over the network on the system loss. We also evaluate the effect of EV parking lot's location on the system loss.

■ MA69

69-Room 201C, CC

Facility Logistics III

Sponsor: TSL/Facility Logistics

Sponsored Session

Chair: Pratik Parikh, Associate Professor, Wright State University,
207 Russ, 3640 Col Glenn Hwy, Dayton, OH, 45435,
United States of America, pratik.parikh@wright.edu

1 - Multiple-shelf Space Optimization in Automated Dispensing Cabinets

Nazanin Esmaili, PhD Candidate, University of Pittsburgh,
1048 Benedum Hall, Pittsburgh, PA, United States of America,
nae22@pitt.edu, Bryan Norman, Jayant Rajgopal

We propose a novel MIP approach for stocking Automated Dispensing Cabinets (ADCs) in a hospital so as to maximize savings in expected staff effort required to retrieve out-of-stock items from central storage. We investigate both position-free and grid-based position paradigms to allocate shelf space optimally under constraints designed to reduce selection errors. We also develop model enhancements to facilitate solving large real-world instances, and investigate the robustness of the results.

2 - Consideration of Product Exposure in Retail Design

Corinne Mowrey, Wright State University, 3640 Colonel Glenn
Hwy., Dayton, OH, 45435, United States of America,
mowrey.4@wright.edu, Pratik Parikh, Kevin R. Gue

We discuss an approach to quantify exposure, what the customer sees; an important aspect of retail design. We consider that some locations are exposed to shoppers more frequently than others, referred to as the intensity of exposure, and explore how intensity changes with rack orientation. Accounting for bi-directional traffic flow, we explore the effect rack orientation has on exposure and investigate how optimal rack orientation for a pathway changes when the amount of directional flow varies.

3 - Covering and Connectivity Constraints in Designing a Loop Flow Pattern

Ardavan Asef Vaziri, Professor, California State University,
Northridge, 18111 Nordhoff Street, Northridge, CA, 91330-8245,
United States of America, ardavan.asef-vaziri@csun.edu,
Gilbert Laporte

The shortest loop covering the workcenters in a facility layout is an instance of the generalized traveling salesman problem. The optimal solution to this problem is a promising design for most types of conveyors and power-and-free systems where the length of the loop is the main driver of the total costs. This design further provides a promising solution to minimize the total loaded and empty flow in systems such as automatic guided vehicles. Our formulation is in the favor of this requirement.

4 - A Network Design Model for Dual-channel Commerce with Uncertain Demand

Guoqing Zhang, Professor, University of Windsor,
401 Sunset, Windsor, ON, Canada, gzhang@uwindsor.ca

We study the supply network problem with dual-channel, where a manufacturer or a retailer sells their products from both direct channel and traditional retail channel. An optimization model is established to examine central and local distribution/fulfilling center strategies, and determine inventory levels at each location and market allocation with taking into account uncertain demands from both channels.

■ MA70

70-Room 202A, CC

Rail Safety and Risk Analysis

Sponsor: Railway Applications

Sponsored Session

Chair: Xiang Liu, Assistant Professor, Rutgers University, CoRE 606,
96 Frelinghuysen Road, Piscataway, NJ, 08854-8018,
United States of America, xiang.liu@rutgers.edu

1 - Using Text Mining and Data Visualization to Analyze Railroad Grade Crossing Accidents

Trefor Williams, Professor of Civil Engineering, Rutgers
University, 96 Frelinghuysen Rd, Piscataway, NJ, 08540,
United States of America, tpw@rci.rutgers.edu, John Betak

This paper will discuss how probabilistic topic modeling, clustering, text visualization and data visualization have been used to study the nature of accidents that occur at grade crossing. The data analyzed were from the Federal Railroad Administration grade crossing accident database. The paper will illustrate how trucks, particularly tractor-trailer trucks have been identified as a major cause of highway-railroad accidents from analysis of the text fields of grade crossing accident reports.

2 - Comparative Train Accident Analysis for Class I U.S. Freight Railroads

Zhao Wang, Graduate Research Assistant, University of Illinois at
Urbana-Champaign, 205 N. Mathews Ave., B-118 Newmark
Engineering Laboratory, MC, Urbana, IL, 61801, United States of
America, zwangl144@illinois.edu, Christopher Barkan,
Mohd Rapik Saat

This paper studies the U.S. Class I freight train accident rates between 2004 and 2013. By utilizing train accident data and statistical theories, the investigation compares and contrasts train accident rates, trends, accident cause distributions, and accident severity between two time periods. The decreasing trend in accident rate and the changing trend in accident cause distributions are analyzed.

3 - Fault Tree Analysis of Train Accidents on Shared-use Rail Corridor

Chen-Yu Lin, Graduate Research Assistant, University of Illinois
at Urbana-Champaign, 205 N. Mathews Ave., Urbana, IL, 61801,
United States of America, clin69@illinois.edu, Mohd Rapik Saat,
Christopher Barkan

Safety issues regarding shared-use rail corridors are emerging due to the introduction of faster and more frequent passenger trains. In this research, a general risk framework is presented for shared-use rail corridors. A standard risk management procedure is implemented to identify potential hazards and evaluate the risk associated with them. Fault tree analysis is performed to hazards with higher level of risk. An example fault tree for a specific hazard, adjacent track accident, is presented.

4 - Risk-based Rail Inspection and Repair

Xiang Liu, Assistant Professor, Rutgers University, CoRE 606,
96 Frelinghuysen Road, Piscataway, NJ, 08854-8018,
United States of America, xiang.liu@rutgers.edu

Broken rails are the leading causes of freight-train derailments in the United States. Each year, the railroad industry spends millions of dollars on rail inspection and repair. This research develops a simulation-based risk analysis model to optimize ultrasonic rail inspection and repair strategies.

■ MA71

71-Room 202B, CC

Alternative Fuel Vehicles and Sustainable Transportation II

Sponsor: TSL/Urban Transportation

Sponsored Session

Chair: Jee Eun Kang, Assistant Professor, University at Buffalo,
409 Bell Hall, Buffalo, NY, United States of America,
jeeeunka@buffalo.edu

1 - Locating Battery Exchange Facilities on Lines and Trees

Pitu Mirchandani, Arizona State University, Tucson, AZ,
United States of America, pitu@asu.edu, Yazhu Song

We introduce a new location problem for battery exchange facilities (BEF) for Electric Vehicles. First we study the problem of location feasibility on lines. Given feasibility, the location problem becomes “where should BEFs be located to minimize a charge-related objective”. e.g., the objective of minimizing the maximum distance between BEFs minimizes the anxiety of the drivers. Scenarios include single OD pair, multiple OD pairs, round trips, etc. Extensions to tree networks is discussed.

2 - Design for EV Market Systems

Namwoo Kang, Research Fellow, University of Michigan, 2350
Hayward Street, Ann Arbor, MI, 48109, United States of America,
nwkang@umich.edu, Panos Papalambros, Fred Feinberg

Electric Vehicle (EV) market systems are generally run by three key players: EV manufacturers, charging station operators, and government. This study presents a decision-making framework for the players to maximize profits and greenhouse gas reductions by quantitative modeling and linking of consumer demand prediction (marketing), charging station siting (operations), EV powertrain design (engineering), and investment allocations (public policy). Several scenarios and case studies are examined.

3 - Optimal Deployment of Charging Lanes in Transportation Networks

Zhibin Chen, University of Florida, 365 Weil Hall, Gainesville,
United States of America, yafeng@ce.ufl.edu, Fang He,
Yafeng Yin

This paper attempts to develop a mathematical model to optimally deploy in a large-scale highway network charging lanes that charge electric vehicles while they are on the move. We first describe network flow equilibrium conditions under a particular deployment plan of charging lanes, and then formulate the design of charging lanes as a mathematical program with equilibrium constraints.

4 - Modeling Intra-household Interactions for the Use of Battery Electric Vehicles

Yashar Khayati, Graduate Research Assistant, State University of
New York at Buffalo, 327 Bell Hall, Buffalo, NY, 14226, United
States of America, yasharkh@buffalo.edu, Jee Eun Kang

This study assesses the potential use of Battery Electric Vehicles in place of conventional Internal Combustion Engine Vehicles at household level. A sequential activity allocation and insertion heuristic is developed to implement on HAPPEV. The results show that if BEVs would be used at household level the travel disutility of households can be decreased about \$42 per day in average. In comparison, if a BEV is used to do exact same activity pattern the average saving for the day is only \$7.

■ MA72

72-Room 203A, CC

2015 QSR Best Student Paper Competition

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Eunshin Byon, Assistant Professor, University of Michigan,
1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America,
ebyon@umich.edu

1 - 2015 QSR Best Student Paper Award

Eunshin Byon, Assistant Professor, University of Michigan, 1205
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Best Student Paper Award recognizes excellence among QSR student members. Four finalists for the Best Student Paper Award will make presentations. The winner will be announced at the QSR business meeting during the conference.

2 - Real-time Monitoring for Additive Manufacturing using Online Sparse Estimation Based Classification

Kaveh Bastani, Research Assistant, Virginia Tech University,
106 Durham Hall (MC 0118) 1145 Perry Str, Blacksburg, VA,
United States of America, kaveh@vt.edu, Zhenyu Kong

The objective of this work is to realize real-time monitoring of additive manufacturing processes using multiple sensor signals. To achieve this objective, an approach invoking the concept of sparse estimation called online sparse estimation-based classification (OSEC) is proposed. The OSEC approach is equipped with a novel computationally fast sparse estimation algorithm to facilitate real-time monitoring applications.

3 - Diagnostic Monitoring of Multivariate Process via a LASSO-BN Formulation

Yan Jin, University of Washington, 530 NE 103rd St, Seattle, WA,
98125, United States of America, yanjin@uw.edu,
Guan Wang, Shuai Huang, Houtao Deng

Fault detection and root-cause diagnosis are usually considered as two separate tasks in most existing process monitoring methods. While they could reinforce each other, we propose a diagnostic monitoring approach that unifies monitoring and root-cause diagnosis by integrating process monitoring, Bayesian network, and sparse learning.

4 - Multi-stage Nanocrystal Growth Identifying and Modeling via In-situ TEM Video

YanJun Qian, PhD Candidate, TAMU, 1501 Harvey Rd,
Apt 806, College Station, TX, 77840, United States of America,
qianyanjun09@gmail.com

While in-situ transmission electron microscopy technique has caught a lot of recent attention, one of the bottlenecks appears to be the lack of automated and quantitative analytic tools. We introduce an automated tool suitable for analyzing the in-situ TEM videos. It learns and tracks the normalized particle size distribution and identifies the phase change points delineating the stages in nanocrystal growth. We furthermore produce a quantitative physical-based model.

5 - Rul Prediction Based on Noisy Condition Monitoring Signals using Constrained Kalman Filter

Junbo Son, PhD Candidate, University of Wisconsin-Madison,
1513 University Avenue, Madison, WI, 53706, United States of
America, json5@wisc.edu, Shiyu Zhou, Chaitanya Sankavaram,
Yilu Zhang, Xinyu Du

In this paper, a robust statistical prognostic method is proposed to predict the remaining useful life of individual units based on condition monitoring signals that are contaminated by severe noises. The proposed method defines a set of inequality constraints so that satisfactory prediction accuracy can be achieved regardless of the noise level. The advantageous features of the proposed method is demonstrated by both numerical studies and a case study with real world automotive battery data.

MA73

73-Room 203B, CC

IEEE T-ASE Invited Session: Healthcare and Service Systems Automation

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Jingshan Li, Professor, 1513 University Ave, Madison, WI,
53706, United States of America, jli252@wisc.edu

1 - N-k Power Problem in the Power Systems: A Budget Allocation Perspective

Loo Hay Lee, National University of Singapore,
Department of Industrial & Systems, Engineering, Singapore,
iseleelh@nus.edu.sg, Chun-hung Chen, Ek Peng Chew,
Giulia Pedrielli, Haobin Li, John Shortle, Yue Liu

In the stochastic N-k power network problem, N choose k failures result in a probability of the entire system to fail (unsafe system). We want to determine if the system is unsafe, when failures are estimated through noisy simulations, by optimal computing budget allocation. The solution method is based on the likelihood of the system to be safe (unsafe), whose estimation is sequentially improved to be given as input to a tailored budget allocation that also considers the observed system state.

2 - Integrating OCBA and GA to Find the Approximate Pareto Patient Flow Distribution

Jie Song, Peking University, Room 512, Fangzheng Building,
Beijing, China, songjie@coe.pku.edu.cn, Zekun Liu, Yunzhe Qiu

We develop a methodology to find the optimal macro-level patient flow distribution in terms of multi-dimension inputs and outputs for the hierarchical

healthcare system. The proposed method integrates the discrete event simulation, the multi-objective optimization, and the simulation budget allocation to comprehensively improve the overall system performances. A case study based on the real data is carried out to validate and implement the proposed method.

3 - Improving Response-Time Performance in Acute Care Delivery: A Systems Approach

Xiaolei Xie, Department of Industrial Engineering, Tsinghua
University, 614 Shunde Building, Tsinghua University, Beijing,
China, xxie@tsinghua.edu.cn, Colleen Swartz, Paul Depriest,
Jingshan Li

In response to a patient with acute physiological deterioration, we study the probability that an appropriate decision is made within a desired time period, referred to as response time performance (RTP). First, a closed formula to evaluate RTP is derived by assuming exponential response time, which is followed by bottleneck analysis. Then, under general case, an approximation approach is proposed to evaluate RTP. Finally, a case study is introduced to illustrate the applicability of the method.

4 - Spatiotemporal Differentiation of Myocardial Infarctions

Chen Kan, University of South Florida, 4202 E. Fowler Ave.
ENB118, Tampa, FL, United States of America,
chenkan@mail.usf.edu, Hui Yang

This paper presents a novel warping approach to quantify the dissimilarity of disease-altered patterns in 3-lead VCGs. The hypothesis testing shows that there are significant space-time differences between healthy and diseased subjects. Further, we optimize the embedding of each VCG as a feature vector in the high-dimensional space that preserves the dissimilarity distance matrix. Experimental results demonstrated that this novel approach improves the performance of predictive models.

MA74

74-Room 204A, CC

Data Analytics for Quality Control and Improvement I

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Kaibo Liu, Assistant Professor, UW-Madison, 1513 University
Avenue, Madison, WI, 53706, United States of America,
kliu8@wisc.edu

1 - A Distribution Free Procedure for Fault Identification in High-Dimensional Processes

Mehmet Turkoz, Rutgers University, 16 Rachel Terrace,
Piscataway, NJ, 08854, United States of America,
turkoz@scarletmail.rutgers.edu, Sangahn Kim, Young-seon
Jeong, Myong K (MK) Jeong, Elsayed Elsayed, K.N. Al-khalifa,
Abdel Magid Hamouda

In a process with high-dimension, identifying which variables cause an out-of-control signal is a challenging issue for quality problems. Even though there are many procedures for fault identification, most of them assume the normal distribution. However, many real life problems come from multivariate non-normal distribution. We present a new fault identification method that does not assume any specific probability distribution.

2 - Broaching Process Modeling Based on Non-repeating Cyclic Signals

Meg Tian, Graduate Student, Virginia Tech, 250 Durham Hall,
Blacksburg, VA, 24060, United States of America,
tian0414@vt.edu, Jaime Camelio, Ran Jin, Lee Wells

Broaching is often used to produce complex contours by sequentially removing material via multiple cutting teeth. The broaching force signal exhibits a non-repeating cyclic pattern. A new approach is proposed to model the non-repeating cyclic signals and thus detect changes in a broaching process.

3 - Heterogeneous Recurrence T^2 Charts for Monitoring and Control of Nonlinear Dynamic Processes

Yun Chen, University of South Florida, 4202 E. Fowler Ave.
ENB118, Tampa, FL, United States of America,
yunchen@mail.usf.edu, Hui Yang

This paper presents a new approach of heterogeneous recurrence T^2 control chart for online monitoring and anomaly detection in nonlinear dynamic processes. An effective partition scheme is firstly developed to delineate local recurrence regions in the multi-dimensional continuous state space. Further, we designed a new fractal representation of state transitions among recurrence regions, and then develop new measures for on-line monitoring and predictive control of process recurrences.

4 - Optimize the Signal Quality of Health Index via Data Fusion for Degradation Modeling and Prognostics

Abdallah Chehade, UW-Madison, 1513 University Avenue,
Madison, WI, 53706, United States of America,
chehade@wisc.edu, Changyue Song, Kaibo Liu

In this talk, a new signal-to-noise ratio (SNR) metric that is tailored to the needs of degradation signals is proposed. By maximizing this new metric, we develop a data fusion model to construct a health index (HI) via fusion of multiple degradation-based sensor data. The case study was based on the degradation dataset of aircraft gas turbine engines, which will demonstrate the effectiveness of developed HI for better characterization and prediction of the health condition of units.

■ MA75

75-Room 204B, CC

New Research Topics on Innovation

Cluster: New Product Development

Invited Session

Chair: Manuel Sosa, Associate Professor of Technology and Operations Management, INSEAD, 1 Ayer Rajah Ave., Singapore, Singapore, manuel.sosa@insead.edu

1 - Technology Readiness Levels at 40: A Study of State-of-the-art Use, Challenges, and Opportunities

Alison Olechowski, MIT, School of Engineering, Cambridge,
United States of America, alisono@mit.edu, Steven Eppinger,
Nitin Joglekar

Since their introduction by NASA in the 1970s, the Technology Readiness Levels (TRLs) have become a widely used scale for assessing technology maturity during new product and system development. We empirically investigate current TRL usage in a cross-industry study, identifying challenges related to TRL implementation and use in technology-related decision-making. Some challenges are already addressed by uncommon best practices however others are opportunities for new methods and models.

2 - Idea Generation and the Role of Feedback

Joel Wooten, University of South Carolina, Columbia, SC 29208,
United States of America, joel.wooten@moore.sc.edu, Karl Ulrich

In many innovation settings, ideas are generated over time and managers face a decision about if and how to provide in-process feedback about the quality of submissions. We use innovation tournament field experiments to examine the effect of feedback on idea generation and show individual-level differences between no feedback, random feedback, and directed feedback.

3 - Sole Inventor vs Team of Inventors: What's Best?

Tian Chan, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676,
Singapore, TianHeong.Chan@insead.edu,
Jurgen Mihm, Manuel Sosa

History has often attributed sole individuals as the source of innovative breakthroughs. However, recent research has shown that teams of individuals are the ones that tend to produce breakthroughs. In this work we use patent data covering both function and form to systematically analyze the source of successful innovations. Our work moves towards reconciling the sole versus team conundrum by finding evidence of situations where the sole individual shine, and of situations where they do not.

■ MA76

76-Room 204C, CC

Simulation Optimization and Ranking and Selection

Sponsor: Simulation

Sponsored Session

Chair: Demet Batur, Assistant Professor, University of Nebraska-Lincoln, CBA 209, Lincoln, NE, 68588, United States of America, dbatur@unl.edu

1 - Probability of Correct Selection: More May Not Be Better!

Yijie Peng, Fudan University, School of Management, Shanghai,
China, 10110690016@fudan.edu.cn, Michael Fu, Jianqiang Hu,
Chun-hung Chen

We present a simple counterexample where the probability of correct selection decreases with additional sampling under certain allocation schemes. We then characterize the general setting where this phenomenon may occur, which highlights the importance of an appropriate allocation scheme. Simulation experiments illustrate our findings.

2 - Asymptotic Validity of the Bayes-inspired Indifference Zone Procedure

Saul Toscano-palmerin, 113 Lake Street, Ithaca, NY, 14850,
United States of America, st684@cornell.edu, Peter Frazier

This talk considers the indifference-zone (IZ) formulation of the ranking and selection problem. Conservatism leads classical IZ procedures to take too many samples in problems with many alternatives. The Bayes-inspired Indifference Zone (BIZ) procedure, proposed in Frazier (2014), is less conservative than previous procedures, but its proof of validity requires strong assumptions. In this talk, we present a new proof of asymptotic validity that relaxes these assumptions.

3 - Reconstructing Input Models via Simulation Optimization

Aleksandrina Goeva, Boston University, 111 Cummington Mall,
Boston, MA, 02215, United States of America, agoeva@bu.edu,
Henry Lam, Bo Zhang

We consider the inverse problem of calibrating the distribution of a stochastic input model from only output data, in contexts where the input-output relation is accessible via stochastic simulation. We take a nonparametric approach, and formulate this problem as a stochastic program by maximizing the entropy of the input distribution subject to moment or tail-probability matching between simulation and empirical output. We propose an iterative scheme to approximately solve the program.

4 - Quantile Based Comparison for System Selection

Demet Batur, Assistant Professor, University of Nebraska-Lincoln,
CBA 209, Lincoln, NE, 68588, United States of America,
dbatur@unl.edu, Fred Choobineh

We present a fully-sequential selection procedure for comparing simulated systems based on a quantile of interest. The quantile of interest corresponds to a specific quantile of the simulated probability distribution of a comparison metric. The procedure is designed to asymptotically guarantee the selection of the best system or the best set of equivalent systems with a pre-specified probability of correct selection.

■ MA77

77-Room 300, CC

Supply Chain Management V

Contributed Session

Chair: Pritha Dutta, Doctoral Student, University of Massachusetts, Amherst, Isenberg School of Management, Amherst, MA, 01003, United States of America, pdutta@umass.edu

1 - The Value of Conversion for a Refinery Firm with Both Forward and Spot Procurement

Mengmiao Chen, Fudan University, Lidasan Building, School of
Management, 670 Guishun Rd, Yangpu District, Shanghai, China,
12110690007@fudan.edu.cn

Our work analyzes the optimal procurement strategy, processing, and production decision of a refinery firm with both forward and spot procurement (hereafter, "dual sourcing"). Also the firm is capable of converting which improves the quality. A four-stage stochastic model is applied to investigate the value of dual sourcing and conversion. We find that both dual sourcing and conversion adds value to the refinery by improving the quality, unit profit, and enlarging the feasible producing region.

2 - Do Responsible Buyers Source from Responsible Suppliers?

Hsiao-Hui Lee, Assistant Professor, University of Hong Kong, KKL
814 School of Business, Hong Kong - ROC, hhlee@hku.hk

I examine the role of corporate social responsibility (CSR) in supply-chain formation. I first introduce the CSR similarity between buyers and suppliers as a selection criterion and examine why good (bad) buyers source from good (bad) suppliers. However, concerns over sourcing cost moderates the CSR similarity effect for good buyers, explaining why good buyers buy from bad suppliers. Supplier transparency (CSR signals) serves as a moderator to explain why bad buyers buy from good suppliers.

3 - The Effect of Commitment Completeness on Opportunism

Alex Scott, Penn State University, 463A Business Building,
University Park, PA, 16802, United States of America,
alexscott@psu.edu

Buyers often solicit non-contractual commitments from suppliers to provide services as the need arises. The level of detail of these commitments vary because, ceteris paribus, more detailed commitments are costlier and more time-consuming to develop than less detailed commitments. In this study, we examine how commitment completeness interacts with active and passive opportunism. We explore this question using a transactional dataset in the for-hire trucking sector.

4 - Firm's Green Supply Chain Performance: Effects of Outsourcing to Emerging Markets

Pritha Dutta, Doctoral Student, University of Massachusetts, Amherst, Isenberg School of Management,, UMass, Amherst, MA, 01003, United States of America, pdutta@umass.edu, Adams Steven

"Outsourcing" and "sustainability" are the two most significant buzz words in the realm of supply chain management today. The past decade has seen a growing trend of outsourcing and off-shoring of operations by companies. This is also an age where firms are becoming more and more aware of their corporate social responsibilities and environmental impacts. Hence in this paper we intend to study the effect of a company's outsourcing/off-shoring policies on the overall green performance.

■ MA78

78-Room 301, CC

Supply Chain Risk Management III

Contributed Session

Chair: Sungyong Choi, Assistant Professor, Yonsei University, 1 Yonseidae-gil, Wonju, Korea, Republic of, sungyongchoi@gmail.com

1 - Do Credit Agencies Predict the Financial Strength of a Supply Chain?

Gurkan Akalin, Eastern Illinois University, 905 A Street, Apt. 4, Charleston, IL, 61920, United States of America, gurkanakalin@hotmail.com

This study shows the results from our research about the effectiveness of Credit Agencies in predicting the strength of a company's supply chain.

2 - Inventory Control Policy in a Decentralized Assembly System: The Role of Vendor Inventory Liability

Guo Li, Dr., Beijing Institute of Technology, No. 5 Zhongguancun South Street, Beijing, 100081, China, lg4229682@163.com, Xu Guan

We investigate a decentralized assembly system that consists of one dominant manufacturer and multiple suppliers who produce the complementary components. The manufacturer initially sets a VILP to control the suppliers' delivery times, and multiple suppliers simultaneously determine when to deliver their components. We yield many interesting results based on their decision.

3 - Ripple-Effect and Structure Dynamics in the Supply Chain

Dmitry Ivanov, Professor Dr., Berlin School of Economics and Law, Badensche Str. 50, Berlin, 10825, Germany, divanov@hwr-berlin.de

This study aims at presenting the ripple effect in the supply chains in terms of structure dynamics framework. The supply chain structure dynamics framework is presented. We show an example of considering the ripple effect and structure dynamics in a supply chain design and planning obtained in a practical project for a multi-stage production-distribution network. Finally we identify gaps in current research and delineate future research avenues.

4 - Product Recalls, Category Effects and Competitor Response

Ram Bala, Santa Clara University, 500 El Camino Real, Santa Clara, CA, 95050, United States of America, rbala@scu.edu, Pradeep Bhardwaj, Pradeep Chintagunta

Product recalls are ubiquitous in a variety of industries. We focus on product categories where an individual firm's product recall may have negative consequences for the entire category. In such contexts, competitors in the category would have to respond to the recall through their sales effort. We provide a prescriptive road map for firms facing this decision based on several factors such as the anticipated category level loss and economies of scope in sales resource use across categories.

5 - A Parametric Study of Risk-Averse Inventory Models

Sungyong Choi, Assistant Professor, Yonsei University, 1 Yonseidae-Gil, Wonju, Korea, Republic of, sungyongchoi@gmail.com

I study a few dynamic risk-averse inventory models using additive utility functions. I add Markovian behavior of purchasing costs in my models. Such Markovian purchasing costs can reflect a market situation in a global supply chain such as random fluctuations at exchange rates or the existence of product spot markets. I provide my parametric analytical results with finite and infinite MDP (Markovian Decision Process) problems.

■ MA79

79-Room 302, CC

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - SAS JMP Division – Interactive and Visual Data Analysis with JMP 12 Pro

David Revenew, JMP Academic Ambassador, SAS JMP Division

JMP Statistical Discovery Software is interactive and visual desktop software for Windows and Mac, with a complete array of integrated graphical and statistical procedures. We will demonstrate JMP tools for data analysis, visualization and exploration, including, Graph Builder, E, bubble plots, the data filter, and our popular mapping tools. In addition to interactive techniques for Univariate and Bivariate analysis we will look at methods for Multivariate analysis including Clustering, Principal Components and Data Mining.

2 - AnyLogic – anyLogistix – Every Supply Chain is Unique, Capture Yours!

Timofey Popkov, Director of Business Development and Co-owner, AnyLogic

Supply chain optimization software must capture the uniqueness of your supply chain as well as produce results quickly. The supply chain is the backbone of your business, it is what distinguishes you from competitors and enables you to win business. Experience a complete solution, anyLogistix, which allows you to design carefully, continuously analyze, and adjust to environmental changes. Learn how to maintain a competitive advantage in your industry through supply chain optimization.

Monday, 11:00am - 12:30pm

■ MB01

01-Room 301, Marriott

Military O.R. and Applications IV

Sponsor: Military Applications

Sponsored Session

Chair: Michael Hirsch, ISEA TEK, 620 N. Wymore Rd., Ste. 260, Maitland, FL, 32751, United States of America, mhirsch@iseatek.com

1 - Sea Escort Transportation

Azar Sadeghnejad Barkousa, SUNY at Buffalo, 4545 Chestnut Ridge Rd, Apt. 221A, Amherst, NY, 14228, United States of America, azarsade@buffalo.edu, Rajan Batta, Moises Sudit

Increasing number of violent pirate attacks causes a significant threat to the global shipping industry, with annual costs estimated at up to US\$12 billion. On the other hand, countries facing piracy are usually poor countries whose governments are unable to invest as much money as needed to protect the area. In this study we model the assignment and scheduling of escort ships along with commercial ships in danger zones to maximize protection with limited number of escort vessels.

2 - Anthropometric Casualty Estimation Methodologies for Modeling and Simulation

Daniel Rice, Technology Solutions Experts, Inc., 209 W. Central Street, Natick, MA, United States of America, daniel.rice@tseboston.com, Medhat Korna, Daniel Louzeiro, Ashley Drag

The design of Personal Protective Equipment (PPE) is critical to soldier survivability for a range of combat operations. Digital human modeling, simulation, and analysis play a critical role in supporting this technology priority. This research provides new capabilities for analysis of PPE fit and form for a range of body shapes and sizes through the use of high-resolution digital 3D models for improved analysis capabilities to support scientists engaged in the design of future PPE systems.

3 - Combining Simulation and Optimization to Increase Insights

Walt Degrange, Principal Operations Research Analyst, CANA Advisors, 6727 Falconbridge Rd., Chapel Hill, NC, 27517, United States of America, wdegange@canallc.com, Benjamin Thengvall

This research uses a simulation modeling USMC Maritime Prepositioning Force (MPF) exercises in ExtendSim and an optimization tool (OptDef) to increase the insight gained over using a simulation or optimization individually. We start by demonstrating the methodology with a small scale model and then increase the size of the model to test the robustness of the technique. We also cover the pros and cons of using this combination and lessons learned through integrating these tools.

4 - Command and Control Metrics in Studies of Unit Structure and Effectiveness

Doug Samuelson, InfoLogix, Inc., 8711 Chippendale Court, Annandale, VA, 22003, United States of America, samuelsondoug@yahoo.com

The recent Marine Corps Combat Development Command study, "Composition of the Infantry Battalion," raised a number of issues, especially: better metrics to assess likely leader effectiveness; leadership structures, communication methods and protocols; decision-making about logistics and intelligence; and the extent to which joint training improves coordinated effect. We summarize findings to date and sources cited and suggest future assessments of unit structure and resulting effectiveness.

■ MB02

02-Room 302, Marriott

MAS Tutorial: A Brief Introduction To Predictive Analytics

Sponsor: Military Applications

Sponsored Session

Chair: Greg Parlier, Past President, MAS of INFORMS, 255 Avian Lane, Madison, AL, 35758, United States of America, gparlier@knology.net

1 - A Brief Introduction to Predictive Analytics

Thomas Willemain, Smart Software, Inc., Niskayuna, NY, United States of America, TomW@smartcorp.com

This tutorial will introduce a few key methodologies in the field of predictive analytics: extrapolative time series forecasting, linear and logistic regression, and tree models including random forests. The emphasis will be on matching methods to problems, understanding the inputs required by and outputs supplied by the methods, and perspectives on the strengths and weaknesses of the methods.

■ MB03

03-Room 303, Marriott

Supply Chain Scheduling

Cluster: Scheduling and Project Management

Invited Session

Chair: Zhi-Long Chen, Professor, University of Maryland, Robert H. Smith School of Business, College Park, MD, 20742, United States of America, zchen@rhsmith.umd.edu

1 - Integrated Production and Delivery with Multiple Factories and Customers

Joseph Leung, New Jersey Institute of Technology, 4202 GITC, Department of Computer Science, Newark, United States of America, joseph.y.leung@njit.edu, Xun Zhang, Ba-Yi Cheng, Kai Li

We consider a scheduling problem where machines are geographically distributed and hence the production costs are different. The delivery costs are also different, depending on where the products are produced. Given a threshold U of the total cost, we want to minimize the makespan or total completion time, subject to the constraint that the total cost is not more than U . Heuristics are proposed and their performances are evaluated through computational studies.

2 - Personnel Scheduling and Supplies Provisioning in Emergency Relief Operations

Lian Qi, Rutgers Business School, Department of Supply Chain Management & Rutgers, United States of America, lianqi@business.rutgers.edu, Lei Lei, Michael Pinedo, Shengbin Wang, Jian Yang

The practice of emergency operations often involves travelling of medical teams and distribution of medical supplies. The coordination of the scheduling of the medical teams and supplies is critical. We introduce a math programming based rolling horizon heuristic that is able to quickly find near optimal solutions. A polynomial time solvable case, which leads to the design of the proposed heuristic, is discussed. Managerial insights drawn from numerical studies are provided.

3 - Makespan Minimization on Parallel Machine Subject to Machine Release Times and Minimum Total Completion Time

Yumei Huo, Associate Professor, City University of New York, College of Staten Island, 2800 Victory Blvd. 1N-215, Staten Island, NY, 10314, United States of America, Yumei.Huo@csi.cuny.edu

We study the preemptive bi-criteria scheduling problem on m parallel machines such that machines have different release times and once the machines are released, they are always available. The goal is to minimize the makespan subject to the constraint that the total completion time is minimized. We show that there is an optimal polynomial time algorithm for this problem.

4 - Latest Developments in Supply Chain Scheduling

Zhi-Long Chen, Professor, University of Maryland, Robert H. Smith School of Business, College Park, MD, 20742, United States of America, zchen@rhsmith.umd.edu

Supply chain scheduling studies detailed order scheduling issues in the supply chain and addresses a variety of applications in the real world. Supply chain scheduling is a relatively new area with about 15 years of history. A large body of literature on supply chain scheduling problems has appeared in academic journals including some surveys. Research interest in this area is still growing. We report the latest developments in this area.

■ MB04

04-Room 304, Marriott

Panel: Topics for PhD students

Sponsor: Minority Issues Forum

Sponsored Session

Chair: Maria Mayorga, Associate Professor, University of North Carolina, Dept. of Industrial & Systems Engineering, Campus Box 7906, Raleigh, NC, 27695-7906, United States of America, memayorg@ncsu.edu

1 - Topics of Interest for PhD Students

Moderator: Maria Mayorga, Associate Professor, University of North Carolina, Dept. of Industrial & Systems Engineering, Campus Box 7906, Raleigh, NC, 27695-7906, United States of America, memayorg@ncsu.edu

This session will serve as a panel discussion on topics of interest for PhD students nearing graduation. Topics include: - deciding on industry versus academia - how to prioritize objectives towards then end of the PhD Process - work/life balance when pursuing tenure - networking to achieve a desired faculty position - how to position yourself when pursuing the market - networking at conferences such as INFORMS

■ MB05

05-Room 305, Marriott

Tutorial: Analyzing Social Media with LIWC

Cluster: Social Media Analytics

Invited Session

Chair: Sara Beth Elson, Behavioral Scientist, MITRE Corporation, 7515 Colshire Drive, McLean, VA, United States of America, Selson@mitre.org

1 - Tutorial: Analyzing Social Media with LIWC

Sara Beth Elson, Behavioral Scientist, MITRE Corporation, 7515 Colshire Drive, McLean, VA, United States of America, Selson@mitre.org

This tutorial will introduce the Linguistic Inquiry and Word Count (LIWC) software – a tool that can enable users to track emotion levels expressed in social media across time. Attendees will walk through an example of how to analyze social media using LIWC and how to view the emotion levels expressed.

■ MB06

06-Room 306, Marriott

Tutorial in Financial Services

Sponsor: Financial Services

Sponsored Session

Chair: Bo Zhang, IBM Research, 1101 Kitchawan Road, Route 134, Yorktown Heights, NY, 10594, United States of America, zhangbo@us.ibm.com

1 - Exchange-Traded Funds: Price Dynamics and Trading Strategies

Tim Leung, Professor, Columbia University, 116th Street, New York, NY, 10027, United States of America, tl2497@columbia.edu

The ETF market has been growing at a robust pace with over \$1.8 trillion in assets under management with 4,200+ products. Some ETFs, called leveraged ETFs, has gained popularity as they offer accessibility and liquidity for leveraged positions. This tutorial gives an overview of the market of ETFs & their derivatives, and discuss the associated mathematical problems. We begin by studying the price dynamics of ETFs, followed by a risk analysis of dynamic and static portfolios of ETFs.

■ MB07

07-Room 307, Marriott

Assessing Systemic Risk

Cluster: Risk Management

Invited Session

Chair: John Birge, Professor, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu

1 - Inventory Pooling under Correlated Fat-tail Demands

Zhen Liu, Options Clearing Corp (OCC), One North Wacker Drive, Suite 500, Chicago, IL, 60606, United States of America, zhenliu@alum.northwestern.edu

We study inventory pooling problem in Eppen (1979) under multivariate Normal Inverse Gaussian demands. We obtain the optimal inventory level in a closed form by employing standardized NIG density function, and express the optimal expected costs in terms of unit NIG loss function. Our results complement Bimpikis and Markakis (2015) by considering the correlation of demands. We further consider transshipment problem of Dong and Rudi (2004) under NIG demands, and provide some analytical results.

2 - Assessing Systemic Risk in Financial Systems under Uncertainty

Jiming Peng, Associate Professor, University of Houston, Houston, TX, 77204, United States of America, jopeng@uh.edu, Aein Khabazian

We consider the issue of assessing systemic risk under uncertainty in a financial system based on the linear optimization model proposed by Eisenberg and Noe (2001). The coefficients of this model representing interbank liabilities and non-interbank assets are assumed to be known and constant. However, in real world application these coefficients are typically unknown and subject to market fluctuation, respectively. We develop robust and worst case optimization to account for the uncertainties.

■ MB08

08-Room 308, Marriott

Green Business Models

Cluster: Business Model Innovation

Invited Session

Chair: Vishal Agrawal, Assistant Professor, Georgetown University, Washington, DC, United States of America, va64@georgetown.edu

Co-Chair: Ioannis Bellos, Assistant Professor, George Mason University- ISOM Area, Enterprise Hall, 4400 University Drive, MS 5F4, Fairfax, VA, 22030, United States of America, ibellos@gmu.edu

1 - Competition and Firms' Willingness to Implement Industrial Symbiosis

Nagesh Gavirneni, Associate Professor, Cornell University, 325 Sage Hall, Ithaca, NY, United States of America, nagesh@cornell.edu, Yunxia Zhu, Vaidy Jayaraman, Milind Dawande

Industrial Symbiosis is a resource-sharing strategy that encourages traditionally separate industries to exchange water, energy and by products. Inspired by the paper-sugar industrial complex, we model and analyze symbiotic systems and establish that competition from firms that produce only regular (both regular and green) products encourages (discourages) implementation of industrial symbiosis.

2 - Is Buying Grocery Online Good for the Environment?

Ekaterina Astashkina, INSEAD, Boulevard de Constance, Fontainebleau, 77305, France, ekaterina.astashkina@insead.edu, Elena Belavina, Karan Girotra

Buying groceries online is catching on. We compare the carbon footprint of offline and online grocery retail. The different economics in the two lead to distinct supply chain structures, inventory management policies and customer ordering behavior, and, consequently, differences in transportation and food waste related emissions.

3 - Adoption of Residential Solar Energy Systems under Third-party Ownership and Direct Ownership

Ernesto Guerra, University of California Berkeley, Berkeley, CA, United States of America, ernestoguerra@berkeley.edu, Jose Guajardo

We formulate an empirical model to characterize the adoption of solar energy systems under third-party ownership and direct ownership in the U.S. residential market. The analysis is developed in the context of government incentives and supply-side determinants.

4 - The Potential of Servicing as a Green Business Model

Vishal Agrawal, Assistant Professor, Georgetown University, Washington, DC, United States of America, va64@georgetown.edu, Ioannis Bellos

In recent years, manufacturers in various industries have begun to orient their practices towards selling the use of the product as opposed to selling the product itself. We investigate the economic and environmental implications of the manufacturer's design and pricing decisions under different forms of servicing business models.

■ MB09

09-Room 309, Marriott

Best Dissertation Award Finalists – Technology, Innovation Management and Entrepreneurship Section

Sponsor: Technology, Innovation Management & Entrepreneurship

Sponsored Session

Chair: Jianxi Luo, Assistant Professor, Singapore University of Technology and Design, 8 Somapah Rd, Singapore, 487372, Singapore, luo@sutd.edu.sg

1 - Managing Informal Networks for Innovation

Russell Funk, Assistant Professor, University of Minnesota, 321 19th Avenue South, #3-354, Minneapolis, MN, 55455, United States of America, rfunk@umn.edu

This dissertation examines how informal networks affect innovation in organizations. Using data on nanotechnology and pharmaceutical firms, the first two studies show that the overall structure of collaboration among inventors differs dramatically across organizations and these differences matter for innovation performance. Motivated by these findings about the contingent benefits of network configurations, study three examines strategies for changing networks using data from online communities.

2 - Property Rights Theory and Ownership of Firm-specific Advantages within the Multinational Firm

Catherine Magelssen, Assistant Professor, London Business School, Sussex Place, Regent's Park S342, London Business School, London, NW1 4SA, United Kingdom, cmagelssen@london.edu

This dissertation extends property rights theory to inside the firm. I examine how multinational firms allocate ownership rights to knowledge assets to subsidiaries within the firm. The ownership of knowledge assets has implications on the internal distribution of risk, incentives, resources, and power. Using a unique dataset, I examine the determinants of the internal structure of ownership of knowledge assets and the impact of ownership on innovation within the multinational firm.

3 - Three Essays on Technological Changes and Competitive

Advantage: Evidence from the Newspaper Industry

Alessio Cozzolino, Assistant Professor in Strategy, University College Dublin, UCD Quinn School of Business, Dublin, Ireland, alessio.cozzolino@ucd.ie

The dissertation explores the relationship between technological change and competitive advantage, studying the transformation of the Italian newspaper industry after the Internet (1995-2014). Using quantitative and qualitative methods, and building on a hand-collected longitudinal database and on a large set of interviews, Alessio theorizes and tests the consequences of a new type of technological change, one that destroys incumbents' complementary assets while preserving their core know-how.

4 - Shifting LOCI of Innovation: A Study of Knowledge Boundaries, Identity and Innovation at NASA

Hila Lifshitz-assaf, NYU, 100 Bleecker street, 13B, New York, NY, 10012, United States of America, h@nyu.edu

This dissertation explores how the ability to innovate is being transformed by the Web and the information age, as well as the challenges and opportunities it entails. It is based on an in-depth longitudinal field study at NASA, exploring their experiment with online open innovation platforms and communities. I investigate the impact of using open innovation on the process of knowledge and innovation production, on R&D professionals, and its boundary conditions for successful problem solving.

■ MB10

10-Room 310, Marriott

Economics of Digital Goods and Services

Sponsor: E-Business

Sponsored Session

Chair: Mingdi Xin, Assistant Professor, University of California, Irvine, Paul Merage School of Business, SB1-3423, Irvine, CA, 92697, United States of America, mingdi.xin@uci.edu

1 - Modeling the Dynamics of Network Technology Adoption and the Role of Converters

Soumya Sen, University of Minnesota, Minneapolis, MN, United States of America, ssen@umn.edu, Youngmi Jin, Kartik Hosanagar, Roch Guerin

We study the role of converters in the adoption of competing network technologies by heterogeneous users. Converters can play an ambiguous role in the adoption process: they allow entrants to overcome the effect of incumbent's user base but also introduce performance degradation and functionality limitations. Our analysis reveals a number of interesting and unexpected outcomes in this competition between network technologies.

2 - The Diffusion and Business Value of User Generated Content on Social Media: Evidence from Twitter

Lanfei Shi, University of Maryland Smith School of Business, Van Munching Hall, College Park, MD, 20742, United States of America, lanfeishi@rhsmith.umd.edu, Siva Viswanathan, Tianshu Sun

Social media platforms and user generated content (UGC) have become valuable marketing aids to firms; however, there is little systematic understanding of whether, and how, the diffusion of UGC through these platforms creates value for firms. Collaborating with one of the leading IT firms in the US, we examine the conditions under which the diffusion of UGC on Twitter adds value, with a specific focus on the role of content and user characteristics in creating value.

3 - Piracy and Information-goods Supply Chain

Antino Kim, PhD Candidate, Foster School of Business, University of Washington, University of Washington, Seattle, WA, 98195-3200, United States of America, antino@uw.edu, Atanu Lahiri, Debabrata Dey

In the presence of a retailer between the manufacturer and consumers of information goods, the legal channel faces two menaces; the internal issue of channel coordination and the external issue of piracy. We develop an economic model to study the interaction of the two.

4 - Issues in Supporting Older Versions of Software: A Game-theoretic Model

Atanu Lahiri, University of Texas at Dallas, Jindal School of Management, Richardson, TX, 75080-3021, United States of America, atanu.lahiri@utdallas.edu, Debabrata Dey, Abhijeet Ghoshal

A software manufacturer needs to stop supporting older versions of its product to encourage consumers to upgrade to the newest version. Consumers, however, can respond by holding out, to compel the manufacturer to do exactly the opposite, as it cannot really afford leaving too many nodes vulnerable in the user network. What should the manufacturer do then, and what are the welfare implications?

■ MB11

11-Franklin 1, Marriott

Discrete Decision Making and Computation

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Ruiwei Jiang, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, ruiwei@umich.edu

1 - A Comparison of SMIP Decomposition Methods

Semih Atakan, PhD Student, University of Southern California, University Park Campus, Los Angeles, CA, 90089, United States of America, atakan@usc.edu, Suvrajeet Sen

Many practitioners appear to use deterministic equivalent formulations (DEF), and off-the-shelf MIP solvers to address their SMIP problems. Since such approaches do not scale well, they have to remain satisfied with models that allow only a handful of scenarios. In contrast, SMIP decomposition is able to provide solutions to models whose DEF contain millions of mixed-integer variables in both stages. We compare results from a variety of such decomposition methods.

2 - Cut Generation Enhanced by Learning for Two-stage Stochastic Linear Programming

Yiling Zhang, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, United States of America, zyiling@umich.edu, Siqian Shen

We propose a new decomposition and cut generation paradigm for solving two-stage stochastic linear programs with complete recourse. Specifically, we "learn" from the Benders cuts and solution bounds from previous iterations (via Thomson Sampling or Imitation Learning approaches), to online select a subset of subproblems for deriving new cuts that could converge to optimum more quickly. Computational results are provided to demonstrate the efficacy of the approach.

3 - Forced and Natural Nestedness

David Morton, Professor, Northwestern University, IEMS Department, Evanston, IL, 60208, United States of America, david.morton@northwestern.edu, Michael Nehme, Ali Koc

We consider two combinatorial optimization problems in which we seek nested solutions. For the first, we formulate two types of two-stage stochastic integer programs to force nestedness. For the second, we maximize a supermodular gain function subject to a resource-availability constraint, and give conditions which ensure nested solutions at certain budget increments. A stochastic facility location problem, a graph clustering problem, and a chance-constrained program illustrate ideas.

4 - An Abstract Model for Branching and its Application to Mixed Integer Programming

Pierre Le Bodic, Georgia Tech, Atlanta, GA, United States of America, lebodid@gatech.edu, George L. Nemhauser

We present an abstraction of Mixed-Integer Programs (MIPs) to a simpler setting in which it is possible to analytically evaluate the dual bound improvement of choosing a given variable. We then discuss how the analytical results can be used to choose branching variables for MIPs, and we give experimental results that demonstrate the effectiveness of the method on MIPLIB instances where we achieve a 7% node improvement over the default rule of SCIP, a state-of-the-art MIP solver.

■ MB12

12-Franklin 2, Marriott

Recent Algorithmic Developments in Deterministic Global Optimization

Sponsor: Optimization/Mixed Integer Nonlinear Optimization and Global Optimization

Sponsored Session

Chair: Yash Puranik, Carnegie Mellon University, Pittsburgh, PA, United States of America, ypp@andrew.cmu.edu

1 - Lagrangean Disjunctive Branch and Bound for Linear Generalized Disjunctive Programs

Francisco Trespalacios, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, ftrespal@andrew.cmu.edu, Ignacio E. Grossmann

In this work we present a novel Lagrangean relaxation of the continuous relaxation of the (HR) reformulation of linear GDPs. This Lagrangean relaxation is simpler to solve than the (HR) and, even more relevant, its solution (a continuous LP) always yields 0-1 values for the binary variables. We present a disjunctive branch and bound for linear GDPs that exploits the proposed Lagrangean relaxation of the HR.

2 - A Novel Strategy for General Polynomial Partitions in Multiparametric Programming

Stratos Pistikopoulos, Texas A&M University, Artie McFerrin Dept. of Chem. Eng., College Station, TX, 77843, United States of America, stratos@tamu.edu, Richard Oberdieck

Currently, the solution to multiparametric mixed-integer programming problems is presented as a polyhedral partitioning of the considered parameter space, because no strategy exists to explicitly handle any nonconvex partitions. In this work, we demonstrate a novel approach which allows for the handling of general, polynomial partitions in multiparametric programming using a combination of suitable linearizations and global optimization strategies.

3 - Polyhedral Cut Generation for Global Optimization of Problems with Edge-concave Intermediates

Yash Puranik, Carnegie Mellon University, Pittsburgh, PA, ypp@andrew.cmu.edu, Nikolaos Sahinidis

We describe a branch-and-cut implementation for obtaining facet defining cuts that utilizes a highly efficient solution strategy for linear separation problems. These cuts are valid for edge-concave functional forms which admit polyhedral convex envelopes. Computational performance results of this implementation are presented on standard test libraries.

4 - Recent Developments in BARON for Global Optimization of NIPS and MINLPS

Mustafa Kilinc, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, United States of America, mkilinc@andrew.cmu.edu, Nikolaos Sahinidis

We report recent developments in the integer arsenal of branch-and-reduce and their implementation in the global optimization software BARON. Extensive computational results will be presented on problems from a collection of test sets.

■ MB13

13-Franklin 3, Marriott

Distributed Stochastic Optimization for Large-Scale Machine Learning

Sponsor: Optimization/Optimization Under Uncertainty
Sponsored Session

Chair: Qihang Lin, The University of Iowa, 21 East Market Street, Iowa City, IA, 52245, United States of America, qihang-lin@uiowa.edu

1 - Adding vs. Averaging in Distributed Primal-dual Optimization

Chenxin Ma, PhD Student, Lehigh University, 200 West Packer Avenue, Bethlehem, PA, 18015, United States of America, machenxin622@gmail.com, Peter Richtárik, Virginia Smith, Martin Jaggi, Michael Jordan, Martin Takac

Reducing communication makes the efficient aggregation of partial work from different machines more challenging. We present a novel generalization of the recent communication efficient primal-dual coordinate ascent framework (CoCoA). Our framework, CoCoA+, allows for additive combination of local updates to the global parameters at each iteration, whereas previous schemes only allowed conservative averaging.

2 - DSCOVER: A Randomized Asynchronous Algorithm for Distributed Learning with Parameter Server

Adams Wei Yu, PhD Student, Carnegie Mellon University, Pittsburgh, PA, United States of America, adamsyuwei@gmail.com, Qihang Lin, Lin Xiao, Weizhu Chen

Machine learning with big data often involves big models, where the number of variables in a model can be too large for frequent communication and synchronization. In this case, we can set up a parameter server to maintain the overall model and coordinate updates of subsets of the parameters at different machines. We propose an algorithm DSCOVER, which exploits the double partitions in both data and model to gain parallelism, and applies periodic variance reduction to achieve linear convergence.

3 - Massively Distributed Optimization: Beyond the Traditional Setting

Jakub Konecny, University of Edinburgh, James Clerk Maxwell Building, 5406, Peter Guthrie Tait Road, Edinburgh, EH9 3DF, United Kingdom, J.Konecny@sms.ed.ac.uk, Brendan McMahan

The purpose of this work is to present a new, increasingly important setting for distributed optimization in machine learning. Main assumption is that we have a very large number of computers available, each of which has access to relatively small number of training examples. This is arising if the data are not stored on datacenters owned by companies, but instead kept at users' devices, a arising trend driven primarily by privacy concerns. We demonstrate that encouraging results are achievable.

■ MB14

14-Franklin 4, Marriott

Statistical Optimization

Sponsor: Optimization/Optimization Under Uncertainty
Sponsored Session

Chair: Mengdi Wang, Assistant Professor, Princeton University, 302 Trinity Ct #2, Princeton, NJ, 08540, United States of America, mengdiw@princeton.edu

1 - Minimax-optimal Private-preserving Sparse PCA in Distributed Systems

Jian Ge, Princeton University, Operations Research and Financial Engine, Sherrerd Hall, Charlton Street, Princeton, NJ, 08544, United States of America, jiangex@exchange.Princeton.EDU

We propose a distributed private-preserving sparse PCA (DPS-PCA) algorithm that generates a minimax-optimal sparse PCA estimator in polynomial time under differential privacy constraints. Data providers can use this algorithm to collaboratively analyze the union of their data sets in a distributed system while limiting the disclosure of their private information.

2 - Upper Bounds for the Correlated Bayesian Information Filtering Problem

Bangrui Chen, Cornell University, 55 Lois Ln, Ithaca, NY, 14850, United States of America, bc496@cornell.edu, Peter Frazier

We present a Bayesian sequential decision-making formulation of the information filtering problem, in which an algorithm presents items (blog posts, scientific papers, emails) arriving in a stream, learning relevance from user feedback on presented items. Our formulation uses a linear model, and is similar to a Bayesian linear bandit. We compute an upper bound on the value of the optimal policy, which allows computing an optimality gap for heuristic policies, and motivates an index policy.

3 - Statistical Limits of Convex Relaxations

Zhaoran Wang, Graduate Student, Princeton University, Sherrerd Hall, Charlton Street, Princeton, NJ, United States of America, zhaoran@exchange.Princeton.EDU, Quanquan Gu, Han Liu

In this paper, we study the statistical limits of convex relaxations. Particularly, we consider two problems: Mean estimation for sparse principal submatrix and edge probability estimation for stochastic block model. We exploit the sum-of-squares relaxation hierarchy to sharply characterize the limits of a broad class of convex relaxations. Our result shows statistical optimality needs to be compromised for achieving computational tractability using convex relaxations.

4 - Post-regularization Confidence Bands for High Dimensional Nonparametric Models with Local Sparsity

Junwei Lu, Princeton University, Sherrerd Hall, Charlton St., Princeton, NJ, 08540, United States of America, junweil@princeton.edu, Mladen Kolar, Han Liu

We propose a novel high dimensional nonparametric model named ATLAS which is a generalization of the sparse additive model. We aim to estimate high dimensional function using a novel kernel-sieve hybrid regression estimator that combines the local kernel regression with the B-spline basis approximation. We show the estimation rate of true function in the supremum norm. We also propose two types of confidence bands for true function.

■ MB15

15-Franklin 5, Marriott

Unconstrained and Bound-Constrained Optimization

Sponsor: Optimization/Nonlinear Programming
Sponsored Session

Chair: Daniel Robinson, Assistant Professor, Johns Hopkins University, 3400 N. Charles Street, Baltimore, MD, 21218, United States of America, daniel.p.robinson@gmail.com

1 - A Solver for Nonconvex Bound-constrained Quadratic Optimization

Daniel Robinson, Assistant Professor, Johns Hopkins University, 3400 N. Charles Street, Baltimore, MD, 21218, United States of America, daniel.p.robinson@gmail.com, Hassan Mohy-ud-din

I present a new method for optimizing quadratic functions subject to simple bound constraints. If the problem happens to be strictly convex, the algorithm reduces to an efficient method by Dostal and Schöberl. Our algorithm, however, is also able to efficiently solve nonconvex problems. During this talk I will present the algorithm, a sketch of the convergence theory, and numerical results for convex and nonconvex problems.

2 - Handling Negative Curvature in Gradient Methods for Unconstrained and Bound Constrained Optimization

Wei Guo, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, weg411@lehigh.edu, Frank E. Curtis

A gradient-descent method is proposed for unconstrained and bound constrained optimization. Emphasis is placed on techniques for computing appropriate step sizes when negative curvature is present. It extends Barzilai-Borwein two-point step size method, its variants and gradient projection method for unconstrained and bound constrained optimization. Global convergence is guaranteed under mild assumptions. Numerical results illustrate the benefits of the method in the presence of non-convexity.

3 - A Trust Region Algorithm with a Worst-case Iteration Complexity of $O(\epsilon^{-(3/2)})$

Mohammadreza Samadi, Lehigh University, 200 West Packer, Bethlehem, PA, 18015, United States of America, mos213@lehigh.edu, Daniel Robinson, Frank E. Curtis

We present a trust region method for unconstrained nonconvex optimization that is able to drive the norm of the gradient of the objective below a prescribed threshold $\epsilon > 0$ after at most $O(\epsilon^{-(3/2)})$ iterations, while maintaining standard global and fast local convergence guarantees through employing modified step acceptance criteria and a novel trust region updating mechanism. We also present ideas for the constrained case and show numerical results.

4 - A Modified DC Algorithm for Solving Linear Programs with Equilibrium Constraints

Francisco Jara-Moroni, Northwestern University, 2145 Sheridan Road, Room C210, Evanston, IL, 60208, United States of America, franciscojaramoroni2013@u.northwestern.edu, Jong-Shi Pang, Andreas Waechter

We propose a method for finding local optima of linear programs with equilibrium constraints. The complementarity restriction is handled by a penalty term that can be expressed as the difference of convex functions. The reformulated problem is solved to optimality by the difference-of-convex functions algorithm with some variations exploiting the specific structure of the penalization.

■ MB16

16-Franklin 6, Marriott

Trends in Optimization

Sponsor: Optimization/Linear and Conic Optimization

Sponsored Session

Chair: Angelia Nedich, University of Illinois, Urbana, IL, United States of America, angelia@illinois.edu

1 - Convex Optimization for Low Rank Models

Madeleine Udell, Postdoctoral Fellow, Caltech, CMS, Mail Code 9-94, Pasadena, CA, 91125, United States of America, madeleine.udell@gmail.com

Many of the most popular methods for unsupervised learning can be formulated as a kind of bi-convex optimization problem which we call a low rank model, including nonnegative matrix factorization, matrix completion, sparse and robust PCA, and k-means. In this talk, we discuss three approaches to fitting low rank models: alternating minimization, stochastic gradient methods, and methods based on convex relaxations.

2 - Resolution of Misspecified Constrained Optimization Problems via Augmented Lagrangian Schemes

Hesam Ahmadi, Student, Pennsylvania State University, 107 Holerman Hall, University Park, PA, 16802, United States of America, ahmadi.hesam@gmail.com, Necdet Serhat Aybat, Uday Shanbhag

We consider a misspecified optimization problem that requires minimizing of a convex function $f(x; y)$ in x over constraint set represented by $h(x; y)=0$ where y is an unknown (or misspecified) vector but can be learnt by a distinct learning problem. We develop joint first-order augmented Lagrangian scheme for computing x while learning y . Iteration complexity analysis is provided when penalty parameters are constant.

3 - Convex and Stochastic Optimization under Indirect Observations

Niao He, Georgia Tech, Atlanta, GA
United States of America, nhe6@gatech.edu

We examine convex optimization problems involved with misspecified parameters or distributions, while only a limited number of indirect observations are available. We establish safe and computationally tractable approximations of these problems and equip them with efficient algorithms. We show that in several important cases, the estimates yielded by our approach exhibit consistency and sublinear convergence. We also demonstrate the efficiency of our approach through several examples.

■ MB17

17-Franklin 7, Marriott

Cliques and Clique Relaxations

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Sergiy Butenko, Texas A&M University, 4037 ETB, College Station, TX, United States of America, butenko@tamu.edu

1 - Characterizing and Detecting Independent Union of Cliques

Zeynep Ertem, Texas A&M, 2400 Central Park Ln, Apt. 407, College Station, TX, United States of America, zeynepertem@tamu.edu, Sergiy Butenko, Yiming Wang

This paper introduces maximum independent union of cliques problem for which maximum clique and maximum independent set solutions are lower bound. We present structural properties as well as complexity results. We show IP formulation, B&B algorithm and the heuristic approaches.

2 - The Maximum S-stable Cluster Problem

Chitra Balasubramaniam, Texas A&M University, College Station, TX, United States of America, bcvidayanath@tamu.edu, Sergiy Butenko

We introduce a new clique relaxation model called s-stable cluster, that restricts the size of the independent set found in the cluster, and is applicable in areas that employs data mining techniques. In particular, the structural properties of the model will be explored, and exact algorithms for solving the maximum s-stable cluster problem will be presented.

■ MB18

18-Franklin 8, Marriott

Big Data Analytics: Methodology and Applications

Cluster: Modeling and Methodologies in Big Data

Invited Session

Chair: Danica Xiao, PhD Candidate, University of Washington - Seattle, 3900 Northeast Stevens Way, Seattle, WA, 98195, United States of America, xiaoc@uw.edu

1 - "Big Data" in Bioenergy Supply Chain

Shiyang Huang, Iowa State University, 0076 Black Engineering, Ames, IA, 50011, United States of America, shuang@iastate.edu, Guiping Hu

We study the development of bioenergy and its supply chain, which consists of large numbers of independent stakeholders and sophisticated spatial and environmental information. We introduce "Big data" optimization methodologies into the study to mine the hidden information that can help in promoting the bioenergy production.

2 - Learning from Business Transactions Data

Sunil Kothari, Researcher, Hewlett-Packard, 1501 Page Mill Road, Bldg 2U, Palo Alto, CA, 94304, United States of America, sunil.kothari@hp.com, Zhijun Yin, Gary Dispoto, Jun Zeng, Gregory Player

In a contractual environment, the engagement starts with the sales process and continues through the contract period generating valuable data across the life cycle of the contract period. HP's managed print services business generates transaction data covering the entire life cycle of a contract. We apply the machine learning techniques to counter the notion that price alone determines the win/loss outcome for a deal and predict the win/loss probabilities for deals currently in the pipeline.

3 - An Integer Programming Formulation of Training Set Selection

Walter Bennette, Research Engineer, Air Force Research Laboratory, 26 Electronic Parkway, Rome, NY, 13441, United States of America, wdbennette@gmail.com

Aspects of a data set can make building a useful classifier difficult. Training Set Selection (TSS) addresses some of these aspects by selecting a subset of the data in such a way that learning from the reduced data set leads to a better model. This work utilizes an integer programming formulation of TSS that relies on column generation to obtain an improved selection of training instances. We then inform current state of the art genetic algorithms for TSS with our formulation.

4 - Applications of Big Data Summarization through Polyhedral Uncertainty Sets

Anushka Chandrababu, Research Scholar, IIITB, 26/C, Electronic City, Bangalore, India, anushka.babu@iiitb.org, Prasanna Gns

We present our works of summarizing structured or unstructured big data into polyhedral uncertainty sets, orders of magnitude smaller than the original data using a generalized multi-dimensional German tank method. Relational algebraic operations to check disjointness, subset or intersecting relationships between such polyhedral objects can be performed. We show the results of such big data summarization using real world data to solve specific business needs.

5 - Assessing Demand Trends using Real Time Order

Transaction Data

Parvaneh Jahani, University of Louisville, 781 Theodore Burnett Ct., Apt. 2, Louisville, KY, 40217, United States of America, p0jaha01@louisville.edu, Suraj Alexander

Assessing demand trends using real time order transaction data is essential aspect of warehouse management system. Selecting the method of demand forecasting differs for different demand trends. We propose a new approach for classification of Stock Keeping Units (SKUs) demand trends using Control Charts Pattern Recognition (CCPR). After demand trend class recognition, the best method of forecasting is selected. Bootstrapping method is used for forecasting intermittent demand time series.

6 - Unsupervised Ensemble, or Consensus Clustering, Consists in Finding the Optimal Combination Strategy

Ramazan Ünlü, University of Central Florida, 12100 Sterling University Ln, Apt. 2-2419, Orlando, FL, United States of America, ramazanunlu@gmail.com

Unsupervised ensemble, or Consensus clustering, consists in finding the optimal combination strategy of individual clusterings that is robust with respect to the selection of the algorithmic clustering pool. In this paper, we propose a weighting policy for this problem that is based on internal clustering quality measures and compare against other popular approaches.

■ MB19

19-Franklin 9, Marriott

OR and AI

Sponsor: Computing Society

Sponsored Session

Chair: Scott Sanner, Asst. Professor, Oregon State University, 1148 Kelley Engineering Center, Corvallis, OR, 97331, United States of America, ssanner@gmail.com

1 - Pruning in Decision Diagrams for Optimization

Christian Tjandraatmadja, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, ctjandra@andrew.cmu.edu, Willem-Jan Van Hoeve

Many enumerative techniques to solve discrete optimization problems benefit greatly from using bounds to prune the search tree. We study the application of pruning strategies to decision diagrams, which can be viewed as a compact form of enumeration trees. In particular, we discuss how pruning strategies can be incorporated in relaxed and restricted decision diagrams to obtain improved primal and dual bounds.

2 - Concise Representation of Near-optimal Solutions with Decision Diagrams

Thiago Serra, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, tserra@cmu.edu, John Hooker

Decision diagrams have recently been used to compactly encode sets of solutions to discrete optimization problems. In this talk we study Sound Decision Diagrams (SDDs), which encode near-optimal solutions along with worse feasible and infeasible solutions. We provide a formal characterization of SDDs and algorithms to find those with minimum size. Empirical results show that SDDs are smaller than conventional decision diagrams representing the same near-optimal solution set as its gap increases.

3 - Stochastic Optimization of the Scheduling of a Radiotherapy Center

Antoine Legrain, Polytechnique Montreal, C.P. 6079, Succursale Centre-ville, Montreal, QC, H3C 3A7, Canada, antoine.legrain@polymtl.ca, Marie-andr   Fortin, Nadia Lahrichi, Louis-Martin Rousseau, Marino Widmer

Radiotherapy centers can improve their efficiency by optimizing the utilization of the linear accelerators. We propose an online method to schedule patients on such machines taking into account their priority, the maximum waiting time, and the preparation of this treatment (dosimetry). We have implemented a genetic algorithm and a constraints program, which schedule the dosimetry. This approach ensures the beginning of the treatment on time and thus avoids the cancellation of treatment sessions.

■ MB20

20-Franklin 10, Marriott

Decision Analytics in Cloud

Cluster: Cloud Computing

Invited Session

Chair: Yue Tan, The Ohio State University, 1971 Neil Ave, Columbus, OH, 43210, United States of America, tanyue01@gmail.com

1 - Cyber Vulnerability Maintenance Policies for Universities

Chengjun Hou, Graduate Research Associate, The Ohio State University, 1971 Neil Ave., Columbus, Oh, 43210, United States of America, hou.91@buckeyemail.osu.edu, Theodore Allen

The case study application of Markov decision processes and generalizations to a real world University policy design problem are described. Related mathematical issues are briefly explored. The derived policy includes incentives for not continuing the use of vulnerable software. The magnitude of saving in dollars is estimated.

2 - throughput Scalability of Fork-join Queueing Networks with Blocking

Yun Zeng, The Ohio State University, 1971 Neil Ave, Columbus, OH, United States of America, zeng.153@buckeyemail.osu.edu, Augustin Chaintreau, Don Towsley, Cathy Xia

With emerging applications such as cloud computing and big data analytics, modern information networks are growing increasingly complex. A critical issue concerns the throughput performance as the system expands to large scale. This paper models the distributed information processing systems as fork-join queueing networks with blocking. We present necessary and sufficient conditions to ensure throughput scalability. Algorithms to check these features for given networks are proposed.

3 - Data-driven Decision Making via Adaptive Control for Cyber Password Management

Yue Tan, The Ohio State University, 1971 Neil Ave, Columbus, OH, 43210, United States of America, tanyue01@gmail.com, Cathy Xia

Cyber attacks have been widely recognized as a major international and domestic cyber security threat. Although an increasing number of high technology mechanisms have been developed, passwords remain as the frontline against cyber attacks both for personal and organizational security settings in cloud services. In this talk, we present a data-driven adaptive control framework that converges to the optimal password expiry duration which balances between accounts safety and user experience.

■ MB21

21-Franklin 11, Marriott

Re-Designing the (US) Healthcare System

Sponsor: Health Applications

Sponsored Session

Chair: Aurelie Thiele, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, aut204@lehigh.edu

1 - Designing Narrow Network Plans for Healthcare:

A Bi-objective Optimization Approach

Victoire Denoyel, ESSEC Business School, Avenue Bernard Hirsch, Cergy, 95000, France, victoire.denoyel@essec.edu, Aurelie Thiele, Laurent Alfandari

We build a quantitative decision model for healthcare payers willing to offer Narrow Network (NN) plans to customers. NN have received significant attention in the implementation of the Affordable Care Act. A payer selects a limited list among all possible providers, and steers patients to these providers by limiting coverage to this list. Our research question is: how to select a limited number of providers so as to reduce the cost for the payer without decreasing the utility for customers?

2 - The Effects of Ambulatory Surgery Centers on Hospital's Financial Performance

Cheng Wang, Lehigh University, 621 Taylor Street, Department of Economics, Bethlehem, PA, 18015, United States of America, chw410@lehigh.edu

Ambulatory surgery centers (ASCs), which treat surgical patients who do not need an overnight stay, are a health care service innovation that has proliferated in the U.S. in the past four decades. This paper examines the effect of ASCs on the net patient revenues and total operating costs of hospitals. Overall, results suggest that ASCs are competitors to general hospitals.

3 - Examining Change in Hospital Quality and Efficiency after ACA using Dynamic Network DEA

Yasar Ozcan, Professor, Virginia Commonwealth University,
P.O. Box 980203, Richmond, VA, 23298-0203,
United States of America, ozcan@vcu.edu, Jaya Khushalani

Dynamic Network DEA was used to examine change in both quality and efficiency of hospitals between 2009 and 2013, pre and post Affordable Care Act (ACA). Quality and efficiency improved significantly with no trade-off between the two. Urban and teaching hospitals were less likely to improve quality and efficiency together.

4 - Robust Decisions for the Partially Diversified Disease Management Model

Shuyi Wang, Lehigh University, 200 W Packer Ave,
Bethlehem, PA, United States of America, shw210@lehigh.edu

We discuss a model to help pharmaceutical companies determine the optimal strategy under high uncertainty for a business model called the Partially Diversified Disease Management Model, which includes disease care pathways as well as health management, diagnostics & devices, and medication, and incentivizes patients' health. Our MIP provides a tradeoff between diversification and specialization.

5 - When is the Outside Care Utilization Optimal for Acos? Trade-off Between Cost, Access, and Quality

Tannaz Mahootchi, Postdoctoral Research Associate,
Northeastern University, 360 Huntington Ave, Boston, MA,
02115, United States of America, t.mahootchi@neu.edu

Accountable Care Organizations (ACOs) are responsible for the health outcomes and the care expenses of their patients. We investigate the details of patient diversion process to an alternative provider when the primary ACO is experiencing congestion. ACOs choose the alternative provider based on the performance measures and the costs of patient diversion. We derive the transfer price and the performance measures that makes the diversion decision optimal.

■ MB22

22-Franklin 12, Marriott

Learning and Random Graphs

Sponsor: Applied Probability

Sponsored Session

Chair: Marc LeLarge, INRIA-ENS, 23 Avenue d'Italie, Paris, France,
marc.lerlarge@ens.fr

1 - Typical Distances in Directed Random Graphs

Mariana Olvera-Cravioto, Associate Professor, Columbia
University, New York, NY, 10027, United States of America,
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We study the distance between two randomly selected nodes in a directed configuration model under the assumption that the degree distributions have finite variance. In particular, we show that the distance grows logarithmically in the size of the graph. The method of proof uses a coupling between a graph exploration process and a weighted branching tree, since unlike the undirected case, we need to keep simultaneous control of both the in-degrees and the out-degrees.

2 - Competitive Contagion in Networks

Moez Draief, Imperial College London and Huawei Research
Paris, South Kensington Campus, London, United Kingdom,
moez.draief@huawei.com

There has been a growing interest, over the past few years, in studying models of competing products/opinions on social networks. The question of interest is what is the impact of the first adopters of a product on the outcome of a series of adoption by other nodes in the system influenced by those initial nodes. More precisely, the decision of a node to adopt a product is influenced by the behaviour of its neighbours in the social network. This raises challenging and intriguing mathematical, algorithmic and game theoretic questions. In this talk, I will present an overview of recent developments in this topic.

3 - Learning in Networks: Multi-armed Bandits with Structure

Richard Combes, Assistant Professor, Centrale-Supelec, Plateau de
Moulon, 3 rue Joliot-Curie, Gif-Sur-Yvette, 91192, France,
richard.combes@supelec.fr

The design of networks and online services can often be mapped to a multi-armed bandit problem with structure. With this approach, problems such as link adaptation, resource allocation, or ad-display optimization can be solved in a provably optimal manner. Namely, the learning speed of the proposed schemes matches a fundamental limit verified by any scheme. A review of the relevant mathematical tools and literature is provided.

4 - Community Detection with the Non-backtracking Operator

Marc LeLarge, INRIA-ENS, 23 Avenue d'Italie, Paris, France,
marc.lerlarge@ens.fr, Charles Bordenave, Laurent Massoulié

Community detection consists in identification of groups of similar items within a population. In the context of online social networks, it is a useful primitive for recommending either contacts or news items to users. We will consider a particular generative probabilistic model for the observations, namely the so-called stochastic block model and prove that the non-backtracking operator provides a significant improvement when used for spectral clustering.

5 - Rumor Source Obfuscation

Peter Kairouz, Graduate Research Assistant, University of Illinois
at Urbana Champaign, 408 E Clark St, Apt. 6, Champaign, IL,
61820, United States of America, kairouz2@illinois.edu,
Sewoong Oh, Pramod Viswanath

Anonymous messaging platforms have recently emerged as important tools for sharing one's thoughts without the fear of being judged by others. Such platforms are crucial in nations with authoritarian regimes where the right to free expression depends on anonymity. Existing messaging protocols are vulnerable against adversaries who can collect metadata. We introduce a novel messaging protocol and show that it spreads the messages fast and achieves perfect obfuscation of the source.

■ MB23

23-Franklin 13, Marriott

Role of Information in Large-scale Stochastic Resource Allocation Problems

Sponsor: Applied Probability

Sponsored Session

Chair: Kuang Xu, Stanford University, Stanford, CA,
United States of America, kuangxu@stanford.edu

1 - Centralized Seat Allocation for Engineering Colleges in India

Yash Kanoria, Assistant Professor, Columbia University, New
York, NY, United States of America, ykanoria@columbia.edu

The central government funds over 75 engineering colleges in India with 50,000 seats a year, and a diversity of programs and admissions criteria. We deploy a new, centralized, seat allocation mechanism, that accounts for the preferences of students as well as the admissions criteria for different colleges/programs using a deferred acceptance inspired approach.

2 - Learning to Optimize via Information-directed Sampling

Daniel Russo, Stanford University, 218 Ayrshire Farm Lane,
Apt. 102, Stanford, CA, 93405, United States of America,
djrusso@stanford.edu, Benjamin Van Roy

We offer a fresh, information-theoretic, perspective on the exploration/exploitation trade-off and propose a new algorithm—information-directed sampling—for a broad class of online optimization problems. We establish a general expected regret bound and demonstrate strong simulation performance for the widely studied Bernoulli, Gaussian, and linear bandit problems. Simple analytic examples show information-directed sampling can dramatically outperform Thompson sampling and UCB algorithms.

3 - Online Advertising Matching in the Large Market

Jian Wu, Cornell University, Ithaca, NY, United States of America,
jw926@cornell.edu, Peter Frazier, J. G. Dai

We study online advertising matching in a large market asymptotic regime, in which the number of opportunities and the number of advertisers increase simultaneously. We develop a matching policy based on the LP solution to a certain deterministic problem. Under certain conditions, we prove that the policy is asymptotically optimal under the fluid-scaling to maximize click-through-rate (CTR) while satisfying all contractual agreements with overwhelming probability.

4 - Robust Scheduling in a Flexible Fork-join Network

Yuan Zhong, Columbia University, 500 W. 120th Street,
New York, NY, 10027, United States of America,
yz2561@columbia.edu, Ramtin Pedarsani, Jean Walrand

We consider a general flexible fork-join processing network, motivated by applications in e.g., cloud computing, manufacturing, etc, in which jobs are modeled as directed acyclic graphs, and servers are flexible with overlapping capabilities. A major challenge in designing efficient scheduling policies is the lack of reliable estimates of system parameters. We propose a robust scheduling policy that does not depend on system parameters, and analyze its performance properties.

■ MB24

24-Room 401, Marriott

Data Mining and Network Inference for Social and Health Application II

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Sung Won Han, New York University, 650 First Avenue, New York, NY, United States of America, sungwonhan2@gmail.com

Co-Chair: Chen Kan, University of South Florida, 4202 E. Fowler Ave. ENB118, Tampa, FL, United States of America, chenkan@mail.usf.edu

1 - Optimizing Display Advertising in Online Social NetworksZeinab Abbassi, PhD Candidate, Columbia University,
1214 Amsterdam Ave, 450 CSB, New York, NY, 10027,
United States of America, za2153@columbia.edu

Conventional online advertising methods need to be customized for OSNs. We propose probabilistic models and study the problem: given a number of impressions, what is the optimal order of users to show the ad to, to maximize the expected number of clicks? We show that this problem is hard to approximate. Therefore, we propose several heuristic algorithms. We evaluate the performance of these heuristics on real data sets, and observe that our two-stage heuristic outperforms baselines.

2 - Blood Donation Tailoring Problem to Improve Blood Supply ManagementGuven Kaya, PhD Student, Industrial Engineering, University of
Houston, E206 Engineering Bldg 2, Houston, TX, 77204,
United States of America, gkaya@central.uh.edu, Ali Ekici

Blood donation tailoring is to identify blood donation types and collect blood products. Donors perform donation types that provide blood products to patients, having collection/inventory/spoilage costs. We collect data about donation types with demand, cost, time, eligibility percentages, compatibility from blood banks. We develop MIP models to find collected/spoiled/carried blood product amount on single and multi-period settings. We provide results based on data from blood donation centers.

■ MB26

26-Room 403, Marriott

Data Analytics Applications for Smart Industries

Cluster: Globalization and International Activities

Invited Session

Chair: Grace Lin, Data Analytic Technology and Applications (DATA),
Data Analytic Technology and Applications (DATA), Taipei,
Taiwan - ROC, gracelin@iii.org.tw**1 - Is the Conventional Association Analysis Practical for Big Data Analytics? New Perspectives on Application and Computation**Hao-Ting Pai, Data Analytics Technologies & Applications
Research Institute, Institute for Information Industry,
Taiwan - ROC, httpai@iii.org.tw

Association analysis has been proven an NP-Complete problem. Owing to the inevitable challenge, it is necessary to devise an alternative way of discovering representative patterns. We present relative patterns discovery (named RPD) for big data analytics, which possesses four features: effectiveness, efficiency, panorama, and scalability.

2 - Towards Industry 4.0: Applying Big Data Analytics to Improve Manufacturing PerformanceFish Yu, Data Analytics Technologies & Applications Research
Institute, Institute for Information Industry, Taiwan - ROC,
fishyu@iii.org.tw

As a step towards the development of cyber-physical systems which play an important role in the transformation of manufacturing industry to the next generation known as Industry 4.0, this talk describes a log analytics framework that is capable of collecting, managing and analyzing large amount of machine data to enable real-time and predictive decision-making across various manufacturing processes. Experimental results using realistic data from semiconductor packaging tools show the effectiveness of the proposed framework.

3 - Green Multi-temperature Logistics using Time-dependent Data AnalysisWei-Ting Chen, Data Analytics Technologies & Applications
Research Institute, Institute for Information Industry, Taiwan -
ROC, weitingchen@iii.org.tw

Multi-temperature food logistics contributes a considerable amount of greenhouse gas due to fuel burn and HFCs and PFCs generated by refrigeration. In this talk,

we will introduce how to estimate emissions depend on various levels of traffic condition, temporal demand patterns, delivery time windows, and different temperature control techniques. It helps carriers to respond to green policies of governments.

4 - Emerging Trends in ICT: using Big Data Analytics to Infuse New Energy into Smart Tourism IndustryTim Lin, Data Analytics Technologies & Applications Research
Institute, Institute for Information Industry, Taiwan - ROC,
timlin@iii.org.tw

As many leading global organizations have applied Big Data Analytics to various public and commercial areas, valuable applications such as consumer insight, business operations optimization, and service innovation have been continuously increasing. In this talk, we will introduce a smart tourism solution which provides tourists real-time, personal, and proactive services by leveraging Big Data Analytics, resulting in a deep and authentic experience. The developed solution can support tourism-related businesses to connect with prospective customers and build responsive, efficient, and health smart cities and homelands.

■ MB27

27-Room 404, Marriott

Advances in Multiobjective Programming

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Margaret Wiecek, Department of Mathematical Sciences,
Clemson University, Clemson, SC, 29634, United States of America,
wmalgor@clemson.edu**1 - Parametric Simplex Algorithm for Linear Vector Optimization Problems**Firdevs Ulus, Princeton University, ORFE, Sherrerd Hall,
Princeton, NJ, 08544, United States of America,
fulus@princeton.edu, Birgit Rudloff, Robert Vanderbei

A parametric simplex algorithm for linear vector optimization problems is proposed. The efficiency of the algorithm is compared with Benson's algorithm and the multiobjective simplex algorithm. For nondegenerate problems it outperforms Benson's algorithm and is on par with the multiobjective simplex algorithm. For degenerate problems Benson's algorithm excels the simplex-type algorithms; however, the proposed algorithm performs much better than the multiobjective simplex algorithm.

2 - An LP-based Branch-and-bound Algorithm for Biobjective Mixed Integer ProgramsNathan Adelgren, Clemson University, Department of
Mathematical Sciences, Clemson, SC, 29634, United States of
America, nadelgr@g.clemson.edu, Akshay Gupta

We introduce a new LP-based branch-and-bound (BB) method for solving biobjective mixed integer linear programs (BOMILP). New branching, fathoming, cutting plane and node relaxation techniques are incorporated into a traditional BB framework. Computational results show that this method is competitive with current techniques for BOMILP.

3 - The Quadrant Shrinking Method for Solving Triobjective Integer ProgramsMartin Savelsbergh, Prof. H. Milton Stewart School of Industrial
& Systems Engineering, Georgia Institute of Technology, 765 Ferst
Dr NW, Atlanta, GA, 30332-0205, United States of America,
martin.savelsbergh@isye.gatech.edu, Hadi Charkhgard,
Natashia Boland

We present a new variant of the full (p-1)-split algorithm for finding all nondominated points of a triobjective integer program. The algorithm is easy to implement and solves at most $3n+1$ integer programs, where n is the number of nondominated points. Computational experiments demonstrate its efficacy.

4 - Optimizing a Linear Function Over the Efficient Set of a Multi-objective Integer ProgramHadi Charkhgard, University of Newcastle, University Drive,
Callaghan, Australia, hadi.charkhgard@gmail.com,
Natashia Boland, Martin Savelsbergh

We present a new algorithm to optimize a linear function over the set of efficient solutions of a multi-objective integer program. Because the algorithm maintains both a lower and an upper bound on the optimal objective value, it can easily be converted into a fast approximation algorithm. Finally, we demonstrate that the algorithm can be used to efficiently compute the nadir point of a multi-objective integer program.

■ MB28

28-Room 405, Marriott

Economic Models of Auctions

Cluster: Auctions

Invited Session

Chair: Brian Baisa, Assistant Professor, Amherst College, 100 Boltwood Ave, Amherst, MA, 01002, United States of America, bbaisa@amherst.edu

1 - A Detail-free and Efficient Auction for Budget Constrained Bidders

Brian Baisa, Assistant Professor, Amherst College, 100 Boltwood Ave, Amherst, MA, 01002, United States of America, bbaisa@amherst.edu

I study auctions for divisible goods where bidders have private values and private budgets. My main result shows that when bidders have full-support beliefs over their rivals' types, a clinching auction played by proxy-bidders implements a Pareto efficient outcome. Bid behavior is derived using two rounds of iterative deletion of weakly dominated strategies. This contrasts with recent work that shows efficient auction design is incompatible with dominant strategy incentive compatibility.

2 - Weak Cartels and Collusion-proof Auctions

Jinwoo Kim, Associate Professor, Seoul National University, 1 Gwanak-ro Gwanak-gu, Seoul, Korea, Republic of, jjkim72@gmail.com, Yeon-koo Che, Daniele Condorelli

We study collusion in auctions by cartels whose members cannot exchange side-payments (i.e., weak cartels). We provide a complete characterization of outcomes that are implementable in the presence of weak cartels, identifying the set of circumstances under which standard auctions are susceptible to them. We then solve for optimal collusion-proof auctions and show that they can be made robust to the specific details of how cartels are formed and operated.

3 - Multi-unit Auctions with a Large Bidder

Justin Burkett, Wake Forest University, Box 7505, Winston-Salem, NC, 27104, United States of America, burkettje@wfu.edu, Brian Baisa

Recent work in IPV settings shows that the uniform-price and discriminatory auctions are approximately efficient if there are many bidders with relatively small demands bidding for a homogenous good. We study a setting where a large bidder competes against a continuum of small bidders, and show that the small bidders prefer the uniform-price over the discriminatory auction, the large bidder has the reverse ranking, and there is no clear efficiency or revenue ranking between the two formats.

4 - A Truthful-in-expectation Mechanism for the Generalized Assignment Problem

Salman Fadaei, Technische Universität München, Munich, Germany, salman.fadaei@tum.de, Martin Bichler

We propose a truthful-in-expectation, 1-1/e-approximation mechanism for the generalized assignment auction. In such an auction, each bidder has a knapsack valuation function. We present a novel convex optimization program for the problem which yields an MIDR allocation rule. We show how to implement the convex program in polynomial time using a fractional greedy algorithm which approximates the optimal solution within an arbitrarily small error.

■ MB29

29-Room 406, Marriott

Joint Session Analytics/MIF/HAS: Healthcare Analytics

Sponsor: Analytics

Sponsored Session

Chair: Shannon Harris, Katz Graduate School of Business, 241 Mervis Hall, Pittsburgh, PA, 15213, United States of America, sharris@katz.pitt.edu

1 - Optimal Staffing of Revenue Centers in Healthcare Delivery Organizations

Jerome Niyirora, SUNY Polytechnic Institute, 100 Seymour Rd, Utica, NY, 13502, United States of America, jerome.niyirora@gmail.com, Jamol Pender

In the operations management literature, little attention is paid to profitability in healthcare delivery organizations. But such an important issue cannot be overlooked since an unprofitable organization is unlikely to meet the quality of service demands. To address this issue, we introduce a nonstationary queueing model and apply optimal control theory to derive a new closed form square root staffing formula to allow for optimal staffing based on the cost-to-revenue ratio.

2 - Managing Customer Arrivals in Service Systems with Multiple Servers

Christos Zacharias, Visiting Assistant Professor, University of Miami, School of Business Administration, Miami, FL, United States of America, czacharias@miami.edu, Michael Pinedo

We analyze a discrete multi-server queueing model for scheduling customer arrivals in service systems with parallel servers. Theoretical and heuristic guidelines are provided for the effective practice of appointment overbooking to offset no-shows. The benefits of resource-pooling are demonstrated in containing operational costs and increasing customer throughput.

3 - A Hierarchical Bayes Model of No-show Rates

Joseph Johnson, Associate Professor, University of Miami, 5250 University Drive, 501 Kosar Epstein Building, Coral Gables, FL, 33146, United States of America, jjohnson@bus.miami.edu, Yu Tang, Yutian Li

Patient no-shows in US clinics can sometimes shoot up to 80%. Accurate predictions of no-shows help clinics optimally schedule appointments. We develop a Hierarchical Bayes logit model which improves prediction accuracy over the widely-used simple logit model. The accuracy gain arises from the individual patient-level coefficients provided by the Bayesian method. Comparison of model fit on 12-months of appointment data shows that the Bayesian model vastly outperforms the simple logit model.

4 - Appointment Scheduling with No-shows and Cancellations

Shannon Harris, Katz Graduate School of Business, 241 Mervis Hall, Pittsburgh, PA, 15213, United States of America, sharris@katz.pitt.edu, Jerrold H. May, Luis Vargas

Appointment no-shows and cancellations can be disruptive to clinic operations. Scheduling strategies such as overbooking or overtime slot assignments can assist with mitigating these disruptions. We propose a scheduling model that accounts for both no-show and cancellation rates, and show properties of optimal scheduling models under specific conditions.

■ MB30

30-Room 407, Marriott

Practice Presentations by INFORMS Roundtable Companies I

Sponsor: INFORMS Practice

Sponsored Session

Chair: Stefan Karisch, Digital Aviation Optimization & Value Strategy, Boeing Commercial Aviation Services, 55 Inverness Drive East, Englewood, CO, 80112, United States of America, stefan.karisch@jeppesen.com

1 - Optimization Models for Planning and Dispatch in Large-scale Freight Operations

Ted Gifford, Distinguished Member Of Technical Staff, Schneider National, Inc., P.O. Box 2545, Green Bay, WI, 54306, United States of America, GiffordT@schneider.com

Schneider National operates a fleet of 13,000 tractors and 48,000 trailers in a random network and accepts 10,000 customer orders daily. In order to maximize revenue and asset utilization, Schneider current employs math programming models providing real-time decision support for load acceptance, asset re-positioning and dispatch assignment. We will describe a number of these models and the operational challenges that accompany them, as well as enhancements and new models in development.

2 - Management Science at Bank of America Merrill Lynch

Russ Labe, Director, Analytics & Modeling, Bank of America, 1500 Merrill Lynch Drive, First Floor, Pennington, NJ, 08534, United States of America, russ.labe@bankofamerica.com

This paper will discuss the impact of analytics at Bank of America Merrill Lynch. Russ Labe, Director of Analytics & Modeling, will provide an overview of his group and discuss a few examples of business issues, analytic approaches, and results. He will also discuss how OR/MS drives business benefits, lessons learned, and best practices.

3 - Predictive Modeling at Scale

Kathy Lange, Sr. Director, Global Analytics Practice, SAS, SAS Campus Drive, Cary, NC, 27518, United States of America, Kathy.Lange@sas.com

Most organizations realize that analytics can help them become more competitive, more profitable, save money, or improve lives. Now they need to expand their analytical impact. This presentation will discuss new capabilities that address how organizations can scale up the modeling process, how to generate many hundreds or thousands of predictive models simultaneously, automating the creation and management of models.

■ MB31

31-Room 408, Marriott

Data Mining and Predictive Analytics in Health Care

Sponsor: Data Mining

Sponsored Session

Chair: Lior Turgeman, Data Mining and Operations Research, Joseph M. Katz Graduate School of Business, Roberto Clemente Dr, Pittsburgh, PA 1526, Pittsburgh, United States of America, tur.lior@gmail.com

1 - Predicting Hospital Readmission using Patient Encounter Data

Atish Sinha, Professor, University of Wisconsin-Milwaukee, Lubar School of Business, Milwaukee, WI, 53201-0742, sinha@uwm.edu, Amit Bhatnagar, Arun Sen

Under the Affordable Care Act, readmission rate has become a critical issue for hospitals. We analyze patient encounter data, obtained from an HIE, during a two-year period for a chain of hospitals. Our model incorporates two sets of factors, consumer demographics and encounter data, to predict readmission likelihoods and durations.

2 - A Mixed-ensemble Predictive Model for Hospital Readmission

Lior Turgeman, Data Mining and Operations Research, Joseph M. Katz Graduate School of Business, Roberto Clemente Dr, Pittsburgh, PA 1526, United States of America, tur.lior@gmail.com, Jerrold H. May, Johnson Moore, Youxu Cai Tjader

We present a novel approach for predictive modeling, using a mixed-ensemble classifier. The approach integrates a C5.0 tree as the base ensemble classifier, and a support vector machine (SVM) as a secondary classifier. By implementing our method for predicting hospital readmission of CHF patients, we were able to overcome some of the limitations of both C5.0 and SVM, as well as to increase the classification accuracy for the minority class, particularly when strong predictors are not available.

3 - A Decision Analytic Approach to Modeling Heart Transplant Survival

Asil Oztekin, Assistant Professor Of Operations & Information Systems, Participating Faculty Of Biomedical Engineering & Biotechnology Program, University of Massachusetts Lowell, One University Ave. Southwick 201D, Lowell, MA, 01850, United States of America, Asil_Oztekin@uml.edu, Ali Dag, Fadel Megahed

Due to the scarcity of donor hearts for transplantation, an accurate prediction of transplantation success plays an important role in the matching procedure between donors and recipients. A decision analytic framework based on Bayesian Belief Network is deployed here to address this issue. The results indicate that this decision analytic methodology yields superior results than the ones in the transplantation literature. It is a generic model which can be implemented in other transplant cases.

■ MB32

32-Room 409, Marriott

Big Data Analytics in Genomics

Cluster: Big Data Analytics in Computational Biology/Medicine

Invited Session

Chair: Michael Hoffman, Scientist, Assistant Professor, Princess Margaret Cancer Centre/University of Toronto, Toronto Medical Discovery Tower 11-311, 101 College St, Toronto, ON, M5G 1L7, Canada, michael.hoffman@utoronto.ca

1 - A Spectral Approach for the Integration of Functional Genomics Annotations for Genetic Variants

Iuliana Ionita-laza, Assistant Professor, Columbia University, 722 West 168 St, New York, NY, 10032, United States of America, ii2135@columbia.edu

Over the past few years, substantial effort has been put into the functional annotation of variation in human genome sequence. Such annotations can play a critical role in identifying putatively causal variants among the abundant natural variation that occurs at a locus of interest. The main challenges in using these various annotations include their large numbers, and their diversity. I will discuss an unsupervised approach to derive an integrative score of these diverse annotations.

2 - Big Data Regression and Prediction in Functional Genomics

Weiqiang Zhou, Johns Hopkins University Bloomberg School of Public Health, 615 N Wolfe Street, Rm E3638, Baltimore, MD, 21205, United States of America, kenandzhou@hotmail.com, Hongkai Ji

The rapid growth of functional genomic data makes it possible to build models for predicting one high-throughput genomic data type from another data type. This can be formulated as a challenging big data regression problem which involves fitting millions of high-dimensional regressions simultaneously. To cope with the high dimensionality and heavy computation, we developed BIRD algorithm that leverages the correlation structure in the data to make computation fast and predictions accurate.

3 - Semi-automated Human Genome Annotation using Chromatin Data

Michael Hoffman, Scientist, Assistant Professor, Princess Margaret Cancer Centre/University of Toronto, Toronto Medical Discovery Tower 11-311, 101 College St, Toronto, ON, M5G 1L7, Canada, michael.hoffman@utoronto.ca

Segway is an integrative method to identify patterns from multiple functional genomics experiments. It discovers joint patterns in multiple genomic datasets using a dynamic Bayesian network model, simultaneously segmenting the genome and identifying clusters of similar segments. We apply Segway to ENCODE ChIP-seq and DNase-seq data and identify patterns associated with transcription start sites, gene ends, enhancers, and repressed regions.

4 - Identifying Genetic Risk Factors for Complex Traits using Functional and Association Data

Jo Knight, Centre for Addiction and Mental Health, 250 College Street, Toronto, Canada, jo.knight@camh.ca, Mike Barnes, Mike Weale, Sarah Gagliano

Our aim is to identify the genetic risk variants that contribute to disease. Genome wide association studies have identified some but many remain unknown. We seek to combine the association data with functional characteristics of the genome. Machine learning is used to derive a score to indicate whether a genetic variant is likely to be causal based on large amounts of functional data. We combine the functional score and the association score together in a Bayesian framework.

■ MB33

33-Room 410, Marriott

Joint Session HAS/MSOM-Healthcare: Health Care Operations

Sponsor: Health Applications

Sponsored Session

Chair: Tolga Tezcan, Associate Professor, London Business School, Regent's Park, London, UK, NW14SA, United Kingdom, ttezcan@london.edu

Co-Chair: Nicos Savva, London Business School, Park Road, London, NW14SA, United Kingdom, nsavva@london.edu

1 - Why is Big Data Underutilized?

Kraig Delana, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, kdelana@london.edu, Nicos Savva, Tolga Tezcan

The advent of big data has brought the opportunity to track customer needs and offer service proactively. Motivated by a healthcare application we develop a queueing and game theoretic model to show that enrolling in such a data-tracking scheme generates positive externalities in the form of reduced waiting times. Nevertheless, we show that self-interested consumers will under-utilize this opportunity, leading to a welfare loss.

2 - A Two-sided Mechanism to Coordinate the Influenza Vaccine Supply Chain

Kenan Arifoglu, University College London, Gower Street, London, WC1E 6BT, United Kingdom, k.arifoglu@ucl.ac.uk

Rational consumer behavior and uncertain yield lead to frequent supply/demand mismatches in the influenza (flu) vaccine supply chain. To eliminate the inefficiency in the flu vaccine supply chain, we propose a two-sided mechanism which implements tax/subsidy payments on the demand side and a transfer payment on the supply side and aligns consumers' and vaccine manufacturer's incentives with the social optimum. The two-sided mechanism improves social welfare significantly.

3 - Analysis of Triage Systems in Emergency Departments

Ozlem Yildiz, Simon Business School, University of Rochester, CSH 4-333, Simon Business School, Rochester, NY, 14627, United States of America, oyildiz@london.edu, Tolga Tezcan, Michael Kamali

We study triage method decisions in emergency departments and provide a policy for determining when to apply provider triage (PT) based on operational and financial considerations using a queueing framework. We obtain closed-form expressions for the range of arrival rates in which PT economically outperforms traditional nurse triage using a steady-state many-server fluid approximation. We show via simulation experiments that the proposed policy performs within 0.82% of the best solution.

4 - Who is Better off in a Focused Factory and Why?**A Comparison of On-site and Off-site Surgery**

Michael Freeman, University of Cambridge, Cambridge, CB2
1AG, United Kingdom, mef35@cam.ac.uk, Stefan Scholtes

We study a teaching hospital with a substantial off-site "focused factory" operation for elective surgery and compare outcomes of patients in the focused factory with outcomes of similar patients operated on on-site. In line with OM theory, we find superior performance at the off-site focused factory. We then use the off-site plant to explore the reasons why operations at the on-site plant are less efficient and less effective.

■ MB34

34-Room 411, Marriott

Supply Chain Analytics: Public Food Safety Applications

Sponsor: Health Applications

Sponsored Session

Chair: Retsef Levi, J. Spencer Standish (1945) Professor of Operations Management, Sloan School of Management, MIT, 100 Main Street, BDG E62-562, Cambridge, MA, 02142, United States of America, retsef@mit.edu

1 - Chicken Jerky Pet Treats Reveal Troubling Supply Chain Vulnerabilities

Shannon Stewart, Research Scientist, MIT Center for Biomedical Innovation, 77 Massachusetts Ave, E19-604, Cambridge, MA, 02139, United States of America, srstew@mit.edu, Amine Anoun, Stacy Springs, Retsef Levi, Karen Zheng, Sabrina Cheng, Louis Chen, James Leung, Tyngwei Chen

For the last eight years, the FDA has been grappling with an ongoing contamination of jerky treats for pets that are made in China. To date, 5,800 dogs have been sickened by the products, and 1,000 have died. Careful analysis of the clinical signs, product ingredients, and associated supply chains has revealed vulnerabilities in the supply chain. We will explore supply chain structures in China and learn how they can lead to unsafe practices that have important implications for product quality.

2 - A Data Driven Approach to Mitigate Risk in Global Food Shipments

Amine Anoun, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, aanoun@mit.edu, Tauhid Zaman, Retsef Levi, Shannon Stewart

Investigating global shipping data can help predict high risk behavior among companies. We collect over 67,000 bills of lading for honey shipments and focus on global shipping patterns to investigate whether signals produced in shipping documents are predictive of adulteration. We identify features that may be predictive of high risk behavior, then develop a Bayesian statistical model to predict which shippers are at risk of committing some form of adulteration.

3 - Risk Drivers in Farming Supply Chains

Karen Zheng, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, yanchong@mit.edu, Retsef Levi, Shujing Wang

We study how the structure of a farming supply chain impacts the quality risk for agricultural products. We develop a methodology to quantify the dispersion of a farming supply chain and use farm-level data from different agricultural industries to test the hypothesis that a more distributed farming supply chain is subject to higher quality risk. Our results suggest that dispersion is a key driver to quality risk for food products.

■ MB35

35-Room 412, Marriott

Relief Distribution Management

Sponsor: Public Sector OR

Sponsored Session

Chair: Marie-Eve Rancourt, Assistant Professor, University of Quebec in Montreal, Case Postale 8888, Succursale Centre-vil, Montreal, QC, H3C 3P8, Canada, marieeve@mit.edu

1 - Assignment and Scheduling of Community Health Workers

Karen Smilowitz, Northwestern University, 2145 Sheridan Road, Evanston, IL, United States of America, ksmilowitz@northwestern.edu, Paige Von Achen, Avi Kenny, Ross Feehan, Mallika Raghava

We present location-routing models for the assignment and scheduling of community health workers and their supervisors in remote settings. This work is a collaborative project with Last Mile Health, an NGO with the aim to expand access to health care in rural Liberia.

2 - Locating and Sizing FEMA's Disaster Recovery Centers

Julia Moline, FEMA, FEMA, Washington, DC, United States of America, julia.moline@fema.dhs.gov, Jarrod Goentzel, Erica Gralla

We create a data-driven decision process for Federal Emergency Management Agency's (FEMA) Disaster Recovery Centers (DRCs) program. We develop thresholds and optimization models to dynamically locate, size, and staff DRCs. We apply the process to recent disaster response scenarios and show that FEMA could have reduced cost significantly while providing sufficient capacity.

3 - Aid Transportation Procurement Analysis: The Case of the World Food Programme in Kenya

Feyza Sahinyazan, PhD Candidate, McGill University, 1001 Rue Sherbrooke Ouest Room 520, Montreal, QC, H3A 1G5, Canada, feyza.sahinyazan@mail.mcgill.ca, Vedat Verter, Marie-Eve Rancourt

In East Africa, a region which suffers from chronic insecurity, The World Food Programme usually contracts with third-party carriers based on a competitive bidding mechanism; however, collected bids show inconsistencies with high variances. In such a context, determining fair market prices is a complex task. In this study, we analyze the factors that can explain these variances, such as seasonality and road condition. We provide recommendations for better transportation procurement practices.

4 - Facilitating Production of Grain Storage Products in Uganda

Mark Brennan, MIT, 77 Massachusetts Avenue, MIT, E38-648, Cambridge, MA, 02139, United States of America, mbrenn@mit.edu, Emily Gooding, Jarrod Goentzel

Using local manufacturing and distribution capacity in a humanitarian or development context has the potential to be more effective and sustainable. Examining the crop storage sector in Uganda, this study explores how NGOs quickly scaling up local capacity can help risk-averse firms increase profit and reduce costs through supply chain coordination.

■ MB36

36-Room 413, Marriott

Community-Based Operations Research I

Sponsor: Public Sector OR

Sponsored Session

Chair: Michael P. Johnson, Associate Professor, University of Massachusetts Boston, 100 Morrissey Blvd., McCormack Hall, Room 3-428A, Boston, MA, 02125-3393, United States of America, Michael.Johnson@umb.edu

1 - The Humanitarian Pickup and Distribution Problem

Michal Tzur, Professor, Tel Aviv University, Industrial Engineering Department, Tel Aviv, 69978, Israel, tzur@eng.tau.ac.il, Ohad Eisenhandler

We study the logistic challenges of a food bank that coordinates food rescue operations on a daily basis, using limited resources. We model it as a routing-allocation problem, with the aim of maintaining equitable allocations to the different agencies, while delivering as much as possible in total. We then present characteristics of the optimal solution to the problem, an efficient algorithm to solve sub-problems of it, and heuristic approaches to solve the problem.

2 - Community-Engaged Decision Modeling for Local Economic Development

Michael P. Johnson, Associate Professor, University of Massachusetts Boston, 100 Morrissey Blvd., McCormack Hall, Room 3-428A, Boston, MA, 02125-3393, United States of America, Michael.Johnson@umb.edu, Sandeep Jani

Main Street organizations develop local development initiatives that support economic and social goals. This requires appropriate data and capacity to apply analytic methods. We discuss a pilot study for Boston Main Streets that links values, data, communication, analysis and action. Results demonstrate the benefits of qualitative and quantitative methods to enable practitioners to make best use of primary and secondary data for decision-making and information systems design.

3 - Introducing Pro Bono Analytics

David Hunt, Manager, Oliver Wyman, One University Square,
Suite 100, Princeton, NJ, 08540, United States of America,
David.Hunt@oliverwyman.com, Michael P. Johnson

Pro Bono Analytics is a new initiative within INFORMS to match INFORMS members willing to volunteer their operations research and advanced analytical skills with non-profit organizations working in underserved and developing communities. This presentation will provide an overview of the Pro Bono Analytics program, describe how OR/analytics professionals can make a difference, and show how you can become a Pro Bono Analytics volunteer.

4 - Predicting Areas of Low HPV Vaccination Coverage to Target Vaccination Promotion Efforts

Brittany Green, University of Cincinnati, Carl H. Linder School of Business, 2925 Campus Green Dr., Cincinnati, OH, 45221, United States of America, brittanydianeg@gmail.com, Josh Haupt, Louis Luangkesorn

The Jewish Healthcare Foundation is trying to promote Human Papillomavirus (HPV) vaccination efforts in southwestern Pennsylvania. HPV is a sexually transmitted disease which can be prevented with a three dose vaccine. However, vaccination rates among adolescents is short of target rates. We develop a predictive model of vaccination coverage based on the National Immunization Survey. We then apply this model to census data to identify zip codes to target for HPV vaccination promotion programs.

■ MB37

37-Room 414, Marriott

Health Care Modeling and Optimization V

Contributed Session

Chair: Karti Puranam, Assistant Professor, La Salle University, 1900 W Olney Ave, Philadelphia, PA, 19141, United States of America, puranam@lasalle.edu

1 - Differential Impact of Health it on Duplicate Testing

Sezgin Ayabakan, Assistant Professor, University of Baltimore, 1420 N Charles St, Baltimore, MD, 21201, United States of America, sayabakan@ubalt.edu, Indranil Bardhan, Zhiqiang Zheng, Kirk Kirksey

We investigate and compare the impact of intra- and inter- hospital information sharing technologies on duplicate radiology and laboratory tests for Congestive Heart Failure patients. We use a comprehensive dataset of 39,600+ visits across outpatient clinics of 68 hospitals in North Texas from 2005 to 2012 in our quasi-experimental approach. Our results support the need for implementation of health information exchanges as a potential solution to reduce incidences of duplicate tests.

2 - Manpower Planning for Health Care Services

Utpal Bhattacharya, Dr., Indian Institute of Management Indore, Prabandh Sikhar, Indore, MP, 453556, India, utpalb@iimind.ac.in

The article Manpower planning for health care services “ introduces various key issues on management of manpower system for health care services. The motivation in this article is to make a study on how to choose proper type of manpower as and when required, upgrading the existing people, managing the attrition rate by using various measures, giving promotions to the employees, in order to keep healthy atmosphere in the organization.

3 - Optimal Block Scheduling for the Operating Room Suite: From Tactical to Strategic Planning

Thomas Sexton, Professor, Stony Brook University, College of Business, Stony Brook, NY, 11794-3775, United States of America, thomas.sexton@stonybrook.edu, Kenneth Rosenfeld, Melissa Dolan, Kelly Stickle, Herbert Lewis

We present a multicriteria nonlinear optimization model for allocating operating room time among surgical services in a major academic medical center. The model incorporates three objectives: the hospital's financial success; its overall mission; and its contribution to community needs. These factors elevate OR scheduling from the tactical realm, with its focus on utilization, to the strategic realm, in which the OR suite is viewed as central to the hospital's higher-level objectives.

4 - Can Obesity be Completely Eradicated by Physical Activity?

He Huang, Beijing Institute of Technology, Beijing, 100081, China, huanghe@bit.edu.cn, Yaohui Pan, Yahong Chen, Tianmei Wang, Zhijun Yan

The inter-person dynamics of obesity epidemic have rarely been revealed. We develop a belief decision model to simulate the spreading of two competing obesity-related behaviors from people to people. Results show that both behaviors have thresholds, below which obesity will be quickly eradicated, and that social discrimination may play contrary effects in different cases.

5 - An Ordering Heuristic for RBCS under Multiple Independent Sources of Supply

Karti Puranam, Assistant Professor, La Salle University, 1900 W Olney Ave, Philadelphia, PA, 19141, United States of America, puranam@lasalle.edu, Marilyn Lucas, David Novak

We introduce a multi-period, perishable inventory model under two independent sources of supply, where blood is randomly transferred from hospitals to a large blood bank. We formulate a dynamic program to solve the multi-period cost minimization problem. We compare our results to the ordering policy that was followed in practice.

■ MB38

38-Room 415, Marriott

Applied Probability II

Contributed Session

Chair: Chiel Van Oosterom, PhD Student, Eindhoven University of Technology, P.O. Box 513, Eindhoven, 5600MB, Netherlands, c.d.v.oosterom@tue.nl

1 - Statistical Inference Theory using Truncated Statistics with Applications

Byung Rae Cho, Professor, Clemson University, 152 Freeman Hall, Clemson, SC, 29634, United States of America, bcho@clemson.edu, Russell Krenek

There are many production situations where specification limits on a process are implemented externally, and the end product is typically reworked or scrapped if its performance does not fall in the tolerance range. As such, the actual distribution after inspection becomes truncated. The purpose of this presentation is to develop a set of hypothesis testing procedures under this truncated environment and explore application areas.

2 - Development of Convolutions for Industrial and Service Processes

Russell Krenek, Graduate Student, Clemson University, 129 Freeman Hall, Clemson, SC, 29634, United States of America, rkrenek@g.clemson.edu, Byung Rae Cho

Understanding truncated random variables and their roles in production inspection processes is a key to modern industry, as this type of review arises in many engineering applications. It is important to note that these production inspection processes require the convolution of truncated distributions due to multiple production stages. This paper focuses on the development of the convolutions resulting from truncated normal and truncated skew normal random variables, and their applications.

3 - Condition-based Repair Prioritization in Repairable Inventory Supply Chains

Chiel Van Oosterom, PhD Student, Eindhoven University of Technology, P.O. Box 513, Eindhoven, 5600MB, Netherlands, c.d.v.oosterom@tue.nl, Geert-Jan Van Houtum

We propose a model for exploiting condition information to dynamically prioritize repairs in a capacitated repair shop. The repair shop supports a system with a number of different repairable components. The system is down whenever a component fails and no ready-for-use spare part is available for that component. The objective in prioritizing repairs is to maximize the long-run availability of the system.

4 - Calendar-based Age Replacement Policy with Dependent Renewal Cycles

Maliheh Aramon Bajestani, University of Toronto, Unit 804, 141 Davisville Ave, Toronto, ON, M4S 1G7, Canada, maramon@mie.utoronto.ca, Dragan Banjevic

We introduce an age-based replacement policy in which the preventive replacements are restricted to specific calendar times. This policy is logistically applicable in industries, having large and geographically diverse populations of deteriorating assets with different installation times. Using the theory of Markov chains with general state space and a suitably defined ergodic measure, we analyze the policy, minimizing the long-run expected cost per time unit.

■ MB39

39-Room 100, CC

Contracts, Quality, and Pricing for OM-Marketing

Cluster: Operations/Marketing Interface

Invited Session

Chair: Haresh Gurnani, Professor, Wake Forest University, School of Business and Center for Retail, Winston Salem, NC, 27106, United States of America, gurnanih@wfu.edu

Co-Chair: Shouqiang Wang, Assistant Professor, Clemson University, 131D Surrine Hall, Clemson, SC, 29672, United States of America, shouqiw@clemson.edu

1 - Signaling Trustworthiness using a Buy-back Contract

Shouqiang Wang, Assistant Professor, Clemson University, 131D Surrine Hall, Clemson, SC, 29672, United States of America, shouqiw@clemson.edu, Haresh Gurnani

Not all suppliers are trustworthy: retailers face risk dealing with suppliers who may not honor their buy-back contracts. We examine whether an upstream manufacturer is able to signal her trustworthiness via the buy-back contract terms (i.e., the wholesale and return prices) offered to a retailer; and if so, how such a buy-back contract needs to be structured.

2 - Optimal Design of Sales Service Channel

Huaqing Wang, Asst Professor, University of Wisconsin Stout, 262 JHTW, 410 10th Ave E, Menomonie, United States of America, wangh@uwstout.edu, Haresh Gurnani, Yu Tang

Customers buying certain products may lack functional knowledge and need help after purchase. The retailer (or manufacturer) can invest in pre-sales effort to educate customers; We study the service channel design problem with different structures and show that the retailer would even be worse off in a cost-sharing contract.

3 - Quality Provision with Heterogeneous Consumer Reservation Utilities

Rachel Chen, Associate Professor, University of California, Davis, CA, United States of America, rachen@ucdavis.edu, Lian Qi, Leon Chu

This paper examines a firm's quality and price decisions when consumers differ in both their willingness-to-pay for quality and in their reservation utility for the basic product. We find that the optimal quality may increase with a negative shift in consumers' reservation utilities. When the firm offers a vertically differentiated product line, the concern for cannibalization may distort the quality upwards under heterogeneous reservation utilities.

4 - Dynamic Matching in a Two-sided Market

Yun Zhou, University of Toronto, 105 St. George Street, Toronto, Canada, Yun.Zhou13@Rotman.Utoronto.Ca, Ming Hu

A two-sided market often shares a common structure that engages three parties: the supply side, the demand side and an intermediate firm facing intertemporal uncertainty on both supply/demand sides. We propose a general framework of dynamically matching supply with demand of heterogeneous types (with horizontally or vertically differentiated types as special cases) by the intermediary firm and explore the optimal and heuristic matching policies.

■ MB40

40- Room 101, CC

Nonmarket Strategy

Sponsor: Organization Science

Sponsored Session

Chair: Jiao Luo, University of Minnesota, 321-19th Ave S, Suite 3-365, Minneapolis, MN, 55455, United States of America, luoj@umn.edu

1 - Radical Repertoires: The Incidence and Impact of Corporate-Sponsored Social Activism

Mary-hunter McDonnell, The Wharton School, University of Pennsylvania, Philadelphia, PA, marymcd@wharton.upenn.edu

This article explores situations in which firms respond to contentious social activist challenges by openly sponsoring social movements. I empirically explore the emergence and implications of a new strategic phenomenon in non-market strategy – the corporate-sponsored boycott – in which firms voluntarily cooperate with social movement organizations to protest contested social practices of other companies or entities at higher orders of market organization, such as industries and states.

2 - When Does a Stakeholder Attack Become a Reputational Crisis? Stakeholder Capital and the Micro-Foundations of Corporate Reputation

Sinziana Dorobantu, New York University, New York, NY, sdoroban@stern.nyu.edu, Witold J. Henisz, Lite Nartey

We provide and demonstrate empirical support for theoretical arguments on the micro-foundations of corporate reputation thereby explaining which stakeholder attacks are more likely to become organizational reputational crises that destroy financial value. We evaluate stakeholder reactions to attacks targeting 19 gold mining firms between 2000 and 2008 as reported in over 20,000 media articles, and link these reactions to the daily abnormal returns of these publicly traded companies.

3 - Micro-foundations of Corporate Social Responsibility and Irresponsibility

Olga Hawn, UNC Kenan-Flagler Business School, Chapel Hill, NC, United States of America, Olga_Hawn@kenan-flagler.unc.edu, Catherine Shea

This study examines how two fundamental dimensions of social perception—warmth and competence—mediate and moderate the effects of corporate social responsibility (CSR) and irresponsibility (CSI) on specific outcomes. The results of our experimental studies suggest that firms from high-warmth countries receive lower benefits for CSR and pay higher penalties for CSI than firms from low-warmth countries; furthermore, this effect reverses when combined with high competence.

4 - The Economic Case for CSR: Competitive Advantage of For-profit Firms in the Market for Social Goods

Jiao Luo, University of Minnesota, 321-19th Ave S, Suite 3-365, Minneapolis, MN, 55455, United States of America, luoj@umn.edu, Aseem Kaul

We develop a formal model of CSR, examining competition between a for-profit firm and a nonprofit in the supply of social goods. We argue that firms can benefit both stakeholders and shareholders only if their CSR efforts are sufficiently differentiated from those of non-profits. Thus, our paper makes an economic case for CSR, specifying conditions under which CSR is Pareto optimal, and highlighting the potentially divergent effects of CSR activities for shareholders and stakeholders.

■ MB41

41-Room 102A, CC

New Development in Health Care Operations

Sponsor: Manufacturing & Service Oper

Mgmt/Healthcare Operations

Sponsored Session

Chair: Lauren Lu, Associate Professor, University of North Carolina at Chapel Hill, Kenan-Flagler Business School, Chapel Hill, NC, 27599, United States of America, lauren_lu@unc.edu

Co-Chair: Feng Lu, Assistant Professor, Purdue University, 403 W State St, West Lafayette, IN, 47907, United States of America, lu428@purdue.edu

1 - Do Mandatory Overtime Laws Improve Quality? Staffing and Operational Flexibility of Nursing Homes

Lauren Lu, Associate Professor, University of North Carolina at Chapel Hill, Kenan-Flagler Business School, Chapel Hill, NC, 27599, United States of America, lauren_lu@unc.edu, Feng Lu

During the 2000s, over a dozen U.S. states passed laws that prohibit health care employers from mandating overtime for nurses. Using a nationwide panel dataset from 2004 to 2012, we find that these mandatory overtime laws reduce the service quality of nursing homes. This outcome can be explained by two undesirable changes in the staffing hours of registered nurses: decreased hours of permanent nurses and increased hours of contract nurses per resident day.

2 - The Hidden Costs of Hospitals' "Custom Contracting" with Group Purchasing Organizations

Avi Seidmann, Simon Business School, University of Rochester, Rochester, NY, 14627, United States of America, avi.seidmann@simon.rochester.edu, Vera Tilson, Rajib Saha

Most hospitals in the US join Group Purchasing Organizations (GPOs) to lower procurement costs by demand aggregation. Some larger hospitals further negotiate private deals through custom contracts directly with the GPO vendors. We present a game-theoretic model where the decisions by the hospitals and the vendor are endogenous, and we prove that – counter to the industry's expectations – the resulting savings for the hospitals are always lower when the GPOs go for custom contracting.

3 - Resource Pooling and Flexibility to Improve ED Boarding

Aaron Ratcliffe, Assistant Professor, University of North Carolina at Greensboro, 438 Bryan Building, P.O. Box 26170, Greensboro, NC, 27402, United States of America, aaron.ratcliffe@uncg.edu, Alex Mills

ED boarding worsens health outcomes and compromises hospital care. We investigate how resource pooling can improve ED boarding by aligning ED admissions with inpatient discharges using a dynamic queueing control model. We compare strategies which jointly manage inpatient resources under a traditional and pay-for-performance setting.

4 - Optimal Mobile Healthcare Delivery Aimed at Minimizing Social Healthcare Costs

Jiu Song, Nanyang Technological University, 50 Nanyang Avenue, Singapore 639798, Singapore, Jiusong@ntu.edu.sg, Fang Liu, Pengfei Guo, Yulan Wang

Developing countries set up mobile health programs to improve public health service and people's access to medical care in the remote regions. We model the disease progression following a discrete time Markov chain and focus on improving the efficiency of the mobile healthcare delivery system. We identify conditions under which mobile healthcare is beneficial, and find the optimal duration a mobile hospital visits a community. We provide some managerial insights through numerical study.

■ MB42

42-Room 102B, CC

Joint Session MSOM-Health/HAS: Designing Healthcare Systems to Improve Patient and Provider Experience

Sponsor: Manufacturing & Service Oper
Mgmt/Healthcare Operations

Sponsored Session

Chair: Vera Tilson, Simon School of Business, University of Rochester, Rochester, NY, 14627, United States of America, vera.tilson@simon.rochester.edu

1 - Slow First, Fast Later: Empirical Evidence of Speed-up in Service Episodes of Finite Duration

Aditya Jain, Baruch College, New York City, New York, NY, United States of America, aditya.jain@baruch.cuny.edu, Sarang Deo

In service episodes of finite duration with time-varying dynamics, operating variables that affect work speed have not been rigorously studied. We employ the trade-off faced by workers between cost of providing service and cost of customer wait to identify two previously unexplored drivers of work speed: time within the episode and anticipated remaining workload. We empirically test our predictions using data from a high volume, tertiary care outpatient department.

2 - Designing a Network of Accident-and-emergency Facilities to Improve Cost Efficiency for the Elderly

Houyuan Jiang, University Senior Lecturer, University of Cambridge, Judge Business School, Cambridge, United Kingdom, h.jiang@jbs.cam.ac.uk, Manmohan Sodhi

We concern ourselves with the elderly in an Accident-and-Emergency system. The system, while already stressed with a rapidly increasing load, faces an increasing percentage of the elderly as in many other countries, and closure of facilities due to costs. We characterize the sufficient and necessary conditions for one Accident-and-Emergency to have a split or pooled system and for a network of two Accident-and-Emergency departments to be merged or operated separately.

3 - Dynamic Exam Room Allocation to Improve Patient Wait Time and Provider Satisfaction

Sarah Kadish, Director Performance Measures And Improvement, Dana-Farber Cancer Institute, 450 Brookline Avenue, Boston, MA, 02215, United States of America, Sarah_Kadish@dfci.harvard.edu, Beth Overmoyer, Kristen Camuso, Courtney Haskett, Chris Reilly, Lillian Pedulla, Craig Bunnell

Allocation of exam rooms drives capacity, provider efficiency, and patient wait time. We sought to improve our algorithm for allocating rooms from a static provider-to-room ratio to a dynamic model, utilizing a Real-Time Locating System. Post-implementation, 83% of providers reported the rooming process was efficient compared with 43% at baseline, corroborated by a statistically significant reduction in patient wait time.

4 - Regional Routing Model for Healthcare Pickup and Delivery Networks

Joseph Szmerekovsky, Professor Of Management, North Dakota State University, Richard H. Barry Hall, # 350, Fargo, ND, 58108, United States of America, joseph.szmerekovsky@ndsu.edu, Luke Holt

We study a healthcare distribution network with delivery deadlines. It involves a large geographic road network visiting hospitals, clinics, and long-term care facilities. Supply chain planners are forced to determine route schedules that provide appropriate service levels while considering time constraints. We present a vehicle routing model that minimizes the system costs associated with vehicle routes.

■ MB43

43-Room 103A, CC

Innovation, Technology Management and Networks

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Nur Sunar, Assistant Professor, University of North Carolina, Kenan-Flagler School of Business, Chapel Hill, United States of America, Nur_Sunar@kenan-flagler.unc.edu

1 - A Simple Model of Cascades in Networks

Asu Ozdaglar, Massachusetts Institute of Technology, 32 Vassar St, Cambridge, MA, United States of America, asuman@mit.edu, Yongwhan Lim, Alex Teytelboym

We consider a stochastic linear threshold model of cascades in networks. We define a new measure of an agent's ability to influence a cascade in a given network, called cascade centrality, which is the expected size of the cascade when the agent is the only seed in the network. We provide analytical characterizations of cascade centrality for certain network topologies. We also study a competition model in which firms seed their products and products diffuse according to the threshold model.

2 - Risk Aversion, Information Acquisition, and Technology Adoption

James Smith, Duke University, Fuqua School of Business, Durham, NC, United States of America, jes9@duke.edu, Canan Ulu

We study the impact of risk aversion and uncertainty on technology adoption decisions using a dynamic programming model: in each period, the consumer may adopt or reject the technology or pay to acquire a signal about the technology's uncertain benefit. With risk neutrality, the value functions and optimal policies satisfy natural monotonicity properties. However, with risk aversion, the policies need not be monotonic unless we impose additional assumptions on the utility functions involved.

3 - Innovation Internalization in Technology-intensive Supply Chains

Vish Krishnan, UCSD, La Jolla, CA, 92037, United States of America, vkrishnan@ucsd.edu, Junghee Lee, Hyoduk Shin

We study supply chains where technology is a critical determinant of product success and is often licensed from upstream firms by downstream supply chain entities through a royalty contract. We investigate the impacts of two prevalent royalty bases, Full System Base(FSB) and Sub System Base(SSB). We derive optimal royalty approaches for different market settings. FSB, despite its similarity to revenue sharing, is not always pareto-efficient in technology supply chains.

4 - Dynamic Product Development and Optimal Launch for a Customer Network

Nur Sunar, Assistant Professor, University of North Carolina, Kenan-Flagler School of Business, Chapel Hill, NC, United States of America, Nur_Sunar@kenan-flagler.unc.edu, Sinit Vitavasiri, John Birge

Development and the launch of products with network externalities require a deep understanding of social or commercial relationships among customers. Using a continuous time Brownian model, we analyze the optimal dynamic product development and launch strategies of a firm that sells an indivisible product to a network of customers. Our analysis shows that the network structure has a drastic impact on the optimal product quality and timing of the product launch.

■ MB44

44-Room 103B, CC

Joint Session RMP/HAS: Health Care Pricing

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Margret Bjarnadottir, Assistant Professor of Management Science and Statistics, Robert H. Smith School of Business, University of Maryland, 4324 Van Munching Hall, College Park, MD, 20742, United States of America, margret@rhsmith.umd.edu

Co-Chair: Wedad Elmaghraby, Associate Professor, University of Maryland, University of Maryland, 4311 Van Munching Hall, College Park, MD, 20742, United States of America, welmaghr@rhsmith.umd.edu

1 - Drug Pricing for Pharmaceutical Manufacturers Distributing through a Common PBM

Nan Yang, Assistant Professor, University of Washington at St. Louis, St. Louis, MO, 63130, United States of America, yangn@wustl.edu, Yixuan Xiao, Panos Kouvelis

We model the competition among branded drug manufacturers on prices when contracting with a common PBM, who manages the prescription drugs of all manufacturers on behalf of their clients. We analyze the PBM's optimal formulary design problem and characterize the equilibrium pricing behavior of competing drug manufacturers. We discuss the impact of various parameters on the equilibrium outcomes for plan enrollees, PBM, and drug manufacturers.

2 - Bundle Payments vs. Fee-for-Service: Impact of Payment Scheme on Performance

Elodie Adida, University of California at Riverside, Riverside, CA, elodie.goodman@ucr.edu, Hamed Mamani, Shima Nassiri

Healthcare payments in the US have been based on a fee-for-service scheme, which provides incentives for high volume of care. The new healthcare legislation tests Bundled Payments that remove such incentives. We analyze effects of different payment schemes on the extent of patient selection and treatment intensity decisions by a risk-averse provider. We benchmark performance on the socially optimal outcome. We investigate modified payment systems that induce this social optimum.

3 - Information Elicitation and Influenza Vaccine Production

Sameer Hasija, Assistant Professor, INSEAD, 1 Ayer Rajah Avenue, Grange Heights, Singapore, Sameer.Hasija@insead.edu, Javad Nasiry, Stephen Chick

We explore the procurement of influenza vaccines by a government whose objective is to minimize the expected social costs (including vaccine, vaccine administration, and influenza treatment costs) when a for-profit vaccine supplier has production yield uncertainty, private information about its productivity (adverse selection) and potentially unverifiable production effort (moral hazard).

■ MB45

45-Room 103C, CC

Dynamic Pricing: Learning, Personalization, Equilibrium, and Consumer Benefit

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Stefanus Jasin, Stephen M. Ross School of Business, University of Michigan, Ann Arbor, MI, United States of America, sjasin@umich.edu

1 - Dynamic Pricing and Learning with Online Retail Rankings

Arnoud Den Boer, Assistant Professor, University of Twente, Gebouw Zilverling, kamer 4013, Drienerloaan 5, Enschede, 7522 NB, Netherlands, a.v.denboer@utwente.nl, Bora Keskin

In online market environments such as Amazon or Google Shopping, firms receive advertisement space if they satisfy certain conditions. It is beforehand not clear if the benefits of this increased exposure outweigh the potential costs. We investigate this question in a dynamic pricing-and-learning setting.

2 - Personalized Assortment Planning with Finite Inventory and Demand Uncertainty

David Simchi-levi, Professor, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, dslevi@mit.edu, Clark Pixton

Motivated by the trend among consumers of smartphone usage for shopping online, we develop an algorithm for personalized assortment optimization over a finite horizon with finite inventory, in the case where customer choice parameters are not known. The algorithm simultaneously balances short term revenues, marginal cost of inventory, and exploration to achieve good performance in terms of regret.

3 - Stochastic Market Equilibrium for RM

Florin Ciocan, INSEAD, Boulevard de Constance 77305, Fontainebleau, France, florin.ciocan@insead.edu, Vahab Mirrokni, Mohammadhossein Bateni, Yiwei Chen

We present a dynamic pricing scheme for a seller who is allocating a volatile stream of goods to a set of budgeted buyers. Our prices are computed as a stochastic market equilibrium. We provide performance guarantees both in terms of revenues for the seller and in terms of fairness for the buyers. We apply our scheme to online ad allocation and using a dataset from a large ad network we empirically compare the performance of our scheme with the second price ad auction which is currently run.

4 - Do Consumers Benefit from Dynamic Pricing?

Guillermo Gallego, Columbia University, 820 CEPSPR, 530 West 120th Street, MC 470, New York, NY, 10027, United States of America, gmg2@columbia.edu, Ningyuan Chen

Intuitively, the seller benefits from dynamic pricing by extracting more of the consumers' surplus. Is this right? We start by looking at simpler questions: Do consumers prefer random prices? Is the consumer surplus a decreasing convex function of price? Is the optimal price an increasing concave function of cost? If true, is dynamic pricing better than optimal fixed pricing for consumers? We show that the answer to these questions are positive most of the time, but there are some exceptions.

■ MB46

46-Room 104A, CC

The Economics and Operation of Vehicle Sharing

Sponsor: Manufacturing & Service Oper Mgmt/Service Operations

Sponsored Session

Chair: Saif Benjaafar, Professor, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, saif@umn.edu

Co-Chair: Guangwen Kong, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55414, United States of America, gkong@umn.edu

1 - Contracting with Overconfident Customers in Car Sharing

Guangwen Kong, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55414, United States of America, gkong@umn.edu, Diwakar Gupta

Although the economic and environmental benefits of car-sharing services are well documented, many potential customers are reluctant to utilize such services. This has been attributed to, in part, the lack of flexibility of short-term rental contracts. We study potential impact of customers' overconfidence when making reservations, and design the contracts that incorporate customers' bounded rationality.

2 - Inventory Rebalancing in Vehicle Sharing Networks

Saif Benjaafar, Professor, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, saif@umn.edu, Xiaobo Li, Xiang Li

We study the problem of inventory rebalancing in vehicle sharing networks. We characterize the structure of an optimal policy.

3 - Dynamic Service Management of One-way Car Sharing Systems

Ho-Yin Mak, University of Oxford, Saod Business School, Park End Street, Oxford, United Kingdom, makho06@gmail.com, Guangrui Ma

One-way car sharing services (e.g., Car2go) are gaining popularity. The key operational challenge is unbalanced flow of vehicles within the service region, as customers are allowed to return cars anywhere within the service region. We investigate dynamic service blocking, i.e., restrictions of the set of return locations, as a possible measure to counter imbalance. We formulate a model that determines the blocking policy dynamically, incorporating customer destination choice behavior.

■ MB47

47-Room 104B, CC

Environmentally Responsible Operations

Sponsor: Manufacturing & Service Oper Mgmt/Sustainable Operations

Sponsored Session

Chair: Atalay Atasü, Associate Professor, Georgia Tech, 800, West Peachtree Street, Atlanta, GA, 30318, United States of America, Atalay.Atasu@scheller.gatech.edu**1 - Extended Producer Responsibility (EPR) for Pharmaceuticals**Isil Alev, Georgia Tech, Atlanta, GA, United States of America, isilalev@gatech.edu, Atalay Atasü, Ozlem Ergun, Beril Toktay

EPR-based approaches have gained traction for managing pharmaceutical coverage. In our work, we analyze the effectiveness of these approaches, particularly Source Reduction and End-of-Pipe Control, by developing a game-theoretic model of pharmaceutical chain with a focus on factors causing overage. We uncover conditions for effective EPR implementation from the welfare perspective and obtain critical factors determining stakeholder perspectives in the pharmaceuticals context.

2 - Extended Producer Responsibility and Secondary MarketsAtalay Atasü, Associate Professor, Georgia Tech, 800, West Peachtree Street, Atlanta, GA, 30318, United States of America, Atalay.Atasu@scheller.gatech.edu, Vishal Agrawal, Isil Alev

EPR-based take-back legislation is the prevalent policy for several durable products such as electronics. However, existing research on EPR ignores durable nature of the products and secondary markets. Accordingly, we analyze EPR implementations in the presence of secondary markets and provide policy guidelines that can help improve the effectiveness of EPR.

3 - Optimal Service Infrastructure Planning for New Product Adoption under Network ExternalityYiwei Wang, UC Irvine, 4293 Pereira Drive, Irvine, United States of America, willwangyiwei@gmail.com, Luyi Gui

Introducing services that complements a new product (e.g., charging service for electric vehicles) can accelerate adoption of the new product. The success of such strategies critically depend on how service infrastructure is deployed and adjusted over the product's life-cycle. We study this issue by a product diffusion analysis and derive insights regarding the optimal deployment strategy for complementary services.

4 - Lemons, Trade-ins, and RemanufacturingXimin (natalie) Huang, Scheller College of Business, Georgia Institute of Technology, 800 West Peachtree, NW Atlanta, Georgia, Atlanta, GA, United States of America, ximin.huang@scheller.gatech.edu, Atalay Atasü, Beril Toktay

Trade-in programs have been shown to partially mitigate the lemons problem in secondary markets. In this paper, we show when and how remanufacturing traded-in products can further improve the efficiency in secondary markets.

■ MB48

48-Room 105A, CC

Operations and Finance Interface

Sponsor: Manufacturing & Service Oper Mgmt/iFORM

Sponsored Session

Chair: Fehmi Tanrisever, Bilkent University, Bilkent, Ankara, Turkey, tanrisever@bilkent.edu.tr**1 - Effects of Downstream Entry in a Supply Chain with Spot Market**Xuan Zhao, Associate Professor, Wilfrid Laurier University, 75 University Avenue West, Waterloo, ON, Waterloo, Canada, xzhao@wlu.ca, Qi Zhang, Wei Xing, Liming Liu

This paper investigates the effect of downstream entry on a two-echelon supply chain with risk-averse players in the presence of a spot market. We find that the manufacturers consider three factors in deciding contract procurement quantities: production, demand-hedging and speculation. Entry may decrease the contract input price, and thus may not always benefit the supplier and hurt the incumbent manufacturers, but it enhances the utilization of contract channel.

2 - Buyer-backed Purchase-order Financing for Suppliers Facing Yield UncertaintyArun Chockalingam, Assistant Professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, 5612AZ, Netherlands, A.Chockalingam@tue.nl, Matthew Reindorp, Richa Jain

We consider a retailer whose supplier is prone to severe yield shortfall. The threat of shortfall entails that the supplier cannot independently finance production. In a single period setting, we find that the retailer can increase profit for both parties by offering a purchase order commitment that incorporates a (partial) loan guarantee. We determine the retailer's optimal commitment and the benefits for both parties. We show how the commitment varies with the supplier's yield uncertainty.

3 - Integrated Risk Management in Commodity MarketsFehmi Tanrisever, Bilkent University, Bilkent, Ankara, Turkey, tanrisever@bilkent.edu.tr

In this paper, we examine the integrated operating and financial hedging decisions of a value maximizing firm, in the presence of capital market frictions. We show that the working capital and the hedging policies of the firm interact with each other in a multi-period dynamic inventory model. In particular, looser working capital policies lead the managers to take relatively more speculative position in the market to maximize firm value. This issue may also be mitigated by asset based financing.

4 - The Midas Touch: Operational Flexibility and Financial Hedging in the Gold Mining IndustryPanos Markou, IE Business School, Calle Maria de Molina 12 Bajo, Madrid, 28006, Spain, pmarkou.phd2016@student.ie.edu, Daniel Corsten

We examine the commodity risk management strategies of gold mining firms over 36 quarters. Miners use financial hedging and operational flexibility to mitigate exposure to volatile gold prices. We find that, in line with theory, hedging reduces firm profit variance and inventory levels. On the other hand, operational flexibility increases profit variance and inventory. However, operational flexibility becomes valuable when used in a complementary fashion with financial hedging.

■ MB49

49-Room 105B, CC

Sustainability in Supply Chains

Sponsor: Manufacturing & Service Oper Mgmt/Supply Chain

Sponsored Session

Chair: Suresh Muthulingam, Assistant Professor Of Supply Chain Management, SMEAL College of Business, The Pennsylvania State University, 460 Business Building, State College, PA, 16802, United States of America, sxm84@psu.edu**1 - An Analysis of Time-based Pricing in Electricity Supply Chains**Asligul Serasu Duran, Northwestern University, Kellogg School of Management, 2001 Sheridan Road, 5th Floor, Evanston, IL, 60208, United States of America, a-duran@kellogg.northwestern.edu, Baris Ata, Ozge Islegen

This study builds a framework for the retail electricity market to empirically evaluate the impact of time-based tariffs on the electricity supply chain. We find that optimal time-based tariffs reduce peak demand, but do not change consumers' electricity bills significantly. Time-of-use tariffs with predetermined rates can capture most of the benefits of real-time prices. The environmental impact of time-based tariffs depends on the characteristics of the electricity market under study.

2 - An Empirical Investigation of Emissions Reductions under Changing Assessments of HazardWayne Fu, Georgia Institute of Technology, 800 West Peachtree Street NW, Atlanta, GA, 30308, United States of America, Wayne.Fu@scheller.gatech.edu, Basak Kalkanci, Ravi Subramanian

Governmental organizations such as the CDC provide extensive public information on potential hazards of industrial chemicals. We investigate facility-level emissions reductions of chemicals in relation to changes in their assessments over time. We also examine the effects of important external and internal factors such as competition and operational leanness.

3 - The Role of Real-time Feedback on Conservation and Energy Efficiency Adoption: An Empirical StudyChristian Blanco, UCLA Anderson School of Management, Los Angeles, CA, United States of America, christian.noel.blanco@gmail.com, Magali Delmas

Non-linear pricing schedules may make it difficult for consumers to know the marginal price they currently pay for energy services. Our results show that consumers that receive real-time information on marginal prices decrease consumption by about 5 to 15%. We also show the relationship between information and residential energy efficiency adoption.

4 - Online Reuse Marketplaces: An Empirical Analysis

Suvrat Dhanorkar, Assistant Professor, Penn State University,
University Park, State College, PA, United States of America,
dhanorkarsuvrat@gmail.com

Online Reuse Marketplaces promote matching between producers and consumers of used products. We examine questions related to the evolution and design of one such marketplace.

■ MB50

50-Room 106A, CC

Supply Chain Risk Management Strategies

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Yiming Wang, Arizona State University, Department of Supply Chain Management, Tempe, AZ, 85287, United States of America, yimin_wang@asu.edu

1 - Payment Timing in Multiechelon Supply Chains: Cost Assessment, Incentives, and Coordination

Greg Decroix, Professor, University of Wisconsin-Madison,
975 University Avenue, Madison, WI, 53706, United States of America, gdecroix@bus.wisc.edu, Jeannette Song, Jordan Tong

Developments in information technology have led to increased variety in payment arrangements between supply chain members. In this paper we introduce a new system for capturing the financing costs resulting from a general class of such payment schemes. Under wholesale price contracts, we use this framework to demonstrate the impact of payment timing on firm incentives, and show that partially delayed payments can achieve coordination in settings where standard or fully delayed payments cannot.

2 - Global Sourcing under Yield Uncertainty

Shahryar Gheibi, Doctoral Candidate, Syracuse University, 721 University Ave., Syracuse, NY, 13244, United States of America, sgheibi@syr.edu, Burak Kazaz, Scott Webster

We study the sourcing policies of a firm operating in an agricultural environment where yield uncertainty influences the firm's crop supply. Our analysis examines the direct trade sourcing policy which is perceived as an alternative to the fair trade policy. It is often believed that hedging is not advantageous in risk-neutral settings; our work, however, shows that there are conditions when the firm benefits from utilizing futures contracts simultaneously with direct trade sourcing policies.

3 - Wine Analytics: Fine Wine Pricing and Selection under Weather and Market Uncertainty

Mert Hakan Hekimoglu, Doctoral Candidate, Syracuse University,
721 University Avenue, Syracuse, NY, 13244, United States of America, mhekimog@syr.edu, Burak Kazaz, Scott Webster

We investigate a distributor's portfolio selection problem of wine futures and bottled wine. Using Liv-ex.com data, we first empirically show how the evolution of futures prices for young wines can be predicted by changes in weather and market conditions. We then examine the distributor's investment decisions in wine futures, bottled wine, and cash position analytically using a Value-at-Risk measure.

4 - Production Decisions for New Products under Yield and Demand Learning

Candace Yano, University of California, Berkeley, IEOR Dept. and Haas School of Business, Berkeley, CA, 94720, United States of America, yano@haas.berkeley.edu, Kai-chuan Yang

Manufacturers launching new products can schedule the first production run well before product introduction, allowing them to learn about the uncertain yield. But early production would occur before an accurate demand forecast is available, thus risking overproduction. We explore how a firm facing capacity constraints should optimize these decisions when new products share capacity with existing products whose demands are uncertain but whose yields are more predictable.

■ MB51

51-Room 106B, CC

Behavior-driven Operations Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Fuqiang Zhang, Olin Business School, Washington University, St. Louis, MO, United States of America, fzhang22@wustl.edu

1 - Are Strategic Customers Bad for a Supply Chain?

Ali Parlakturk, Associate Professor, UNC Kenan-Flagler Business School, 300 Kenan Center Drive, MC #4708, Chapel Hill, NC, 27599, United States of America, Ali_Parlakturk@kenan-flagler.unc.edu, Yen-Ting Lin, Jayashankar Swaminathan

We contrast the results of forward-looking strategic customers with the myopic customers benchmark in a supply chain of a manufacturer and a retailer. The combination of Strategic customer behavior and decentralization does not necessarily result in the worst supply chain performance. In fact, when customers are sufficiently patient, a decentralized supply chain that faces strategic customers outperforms the supply chain with only one of those factors at play.

2 - Managing Social Responsibility in Multi-tier Supply Chains

Robert Swinney, Associate Professor, Duke University,
100 Fuqua Dr, Durham, NC, 27708, United States of America, robert.swinney@duke.edu, Lu Huang, Jeannette Song

We examine a three level supply chain in which a Tier 2 supplier sells to a Tier 1 supplier which sells to a downstream (Tier 0) firm, and consider whether Tier 0 should manage social responsibility in Tier 2 directly or delegate to Tier 1. We focus on the impact of external stakeholder behavior (consumers, NGOs, and governments) on the Tier 0 firm's optimal strategy, and show that increasing pressure from these stakeholders may backfire and lead to a less responsible supply chain.

3 - A Model of Rational Retrials in Queues

Shiliang Cui, Georgetown University, McDonough School of Business, Washington, DC, 20057, United States of America, shiliang.cui@georgetown.edu, Senthil Veeraraghavan, Xuanming Su

Consumers suffer dis-utility in waiting for a service. When they can self-organize the timing of their service visits, they may avoid long queues and choose to retry later. We study an observable queue in which consumers make rational join, balk and costly "retry" decisions upon their arrival. Retrial attempts could be costly due to factors such as transportation costs, retrial hassle and visit fees. We characterize the equilibrium under such retrial behavior, and study its welfare effects.

4 - CEO Overconfidence, Inventory Management, and Firm Performance

Fuqiang Zhang, Olin Business School, Washington University, St. Louis, MO, United States of America, fzhang22@wustl.edu, Tianjun Feng, Qing Zhang

Using the data of U.S. manufacturing firms during 1999-2011, we investigate the relationship between CEO overconfidence and firm inventory management. We find that firms with overconfident CEOs have lower inventory levels. In addition, we provide empirical evidence of the mediation effect of inventory level on firm financial performance.

■ MB52

52-Room 107A, CC

Best Paper Award

Sponsor: Service Science

Sponsored Session

Chair: Tor W. Andreassen, Professor, NHH Norwegian School of Economics, Helleveien 30, Bergen, Norway, tor.w.andreassen@nhh.no

1 - Design of Informatics-based Services in Manufacturing Industries: Case Studies and Discussion

Chie-Hyeon Lim, Post-doc, POSTECH, Engineering Building #4-316, Pohang, 790-784, Korea, Republic of, arachon@postech.ac.kr, Jun-yeon Heo, Min-Jun Kim, Kwang-jae Kim

A key component of servitization in manufacturing industries is informatics, which transforms product and customer data into information for customers. Informatics-based service is defined as a type of service wherein informatics is crucial to customer value creation. In this talk, we introduce two case studies on the design of informatics-based services in manufacturing industries. Various aspects of informatics-based service design in manufacturing are also discussed.

2 - An Analytical Framework for Value Co-Production in Services

Guillaume Roels, Associate Professor, UCLA, 110 Westwood Plaza, Los Angeles, CA, 90095, United States of America, guillaume.roels@anderson.ucla.edu, Uday Karmarkar

Although services are often defined as co-productive of value, the concept of value is often difficult to measure. Yet, measuring value is not necessarily a prerequisite for service process improvement. In this paper, we propose a general framework for the modeling and analysis of services with co-production. The framework identifies three major process stages: (i) the production stage, which involves co-production, (ii) the output sharing stage, and (iii) the consumption stage.

■ MB53

53-Room 107B, CC

Social Media, Sales and Pricing

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Wedad Elmaghraby, Associate Professor, University of Maryland, 4311 Van Munching Hall, College Park, MD, 20742, United States of America, welmaghr@rhsmith.umd.edu

1 - Scarcity Strategies under Quasi-Bayesian Social Learning

Nitin Bakshi, London Business School, Regent's Park, London, United Kingdom, nbakshi@london.edu, Yiangos Papanastasiou, Nicos Savva

The introduction of popular experiential products is often accompanied by temporary stock outs. This paper proposes a mechanism based on an empirically-motivated behavioural model of social learning. We show that such strategies may be beneficial for the firm and may also increase consumer surplus.

2 - Integrating Social Media Metrics

Wendy Moe, University of Maryland, 3469 Van Munching Hall, College Park, MD, United States of America, wendy_moe@rhsmith.umd.edu, David Schweidel

The primary goal of this paper is to offer a modeling approach that integrates multiple social media metrics. We do this by jointly modeling the number of mentions, the number of co-mentions and expressed sentiment across brands in a given market as a function of a latent map that represents the underlying competitive landscape in the industry. We demonstrate how a brand can use this model to establish benchmark metrics and calculate a measure of differentiation.

3 - Optimizing Donation Campaigns with Social Media

Shawn Mankad, Assistant Prof Of Business Analytics, University of Maryland, 4316 Van Munching Hall, College Park, MD, 21201, United States of America, smankad@cornell.edu, William Rand, Chen Wang

The rising popularity of social media has resulted in organizations of all types attempting to use the social streams to inform managerial decisions. However, using social media data can be challenging due to its varied and dynamic nature. In this work, we discuss how donations to a major nonprofit organization can be substantially increased by integrating Twitter usage around crisis events to determine the timing and targeting of marketing communications.

■ MB54

54-Room 108A, CC

Markov Decision Processes

Cluster: Tutorials

Invited Session

Chair: Andrew J. Schaefer, University of Pittsburgh, 3700 O'Hara Street, Benedum Hall 1048, Pittsburgh, PA, 15261-3048, United States of America, schaefer@ie.pitt.edu

1 - Tutorial: Markov Decision Processes in Healthcare

Andrew J. Schaefer, University of Pittsburgh, 3700 O'Hara Street, Benedum Hall 1048, Pittsburgh, PA, 15261-3048, United States of America, schaefer@ie.pitt.edu

The last decade has seen a large number of Markov decision processes (MDPs) applied to various healthcare settings. In this tutorial we review some of the healthcare decisions for which MDPs may be appropriate. We discuss some of the unique challenges that arise in healthcare modeling. Finally, we discuss future directions for MDPs in healthcare.

■ MB55

55-Room 108B, CC

Applications of DEA II

Cluster: Data Envelopment Analysis

Invited Session

Chair: Alan Pritchard, University of Maryland, Robert H. Smith School of Business, Van Munching Hall, College Park, MD, 20742, United States of America, apritchard@rhsmith.umd.edu

1 - Nurse Staffing Performance Evaluation: Data Envelopment Analysis vs. Expert Assessment

Fan Tseng, University of Alabama in Huntsville, Dept of Mgt, Mkt, & IS, Huntsville, AL, 35899, United States of America, tsengf@uah.edu, Karen Frith, Faye Anderson, Patricia Patrician

When using Data Envelopment Analysis (DEA) to evaluate the efficiency of nurse staffing, the results are greatly influenced by the selection of input and output metrics. To evaluate different DEA models for their usefulness, we enlisted experts in nurse administration to evaluate the performance of nursing units using data from multiple hospitals. We compare the results between experts and the models, and discuss the issues in DEA modeling for evaluating nurse staffing performance.

2 - It Productivity Paradox: A New Frameworks Integrating Configuration Theory and Dynamic DEA

Liu Jiawen, PhD, Huazhong University of Science and Technology, 1037 Luoyu Road, Wuhan, 430074, China, jiawen_liu@hust.edu.cn, Yeming Gong

While some research argues that information technology (IT) can improve organizational productivity, others maintains that the impact of IT may be negative. This paper advances a new perspective based on data envelopment analysis (DEA) to investigate the IT productivity paradox. We propose a new theoretical framework based on dynamic two-stage network DEA models, considering multiple periods, multiple inputs and multiple outputs, to study and understand IT productivity paradox.

3 - An Oligopolistic Emissions Trading System with Uncertain Demand

Alireza Tajbakhsh, PhD Candidate, DeGroote School of Business, McMaster University, 1280 Main St. W, Hamilton, ON, L8S 4L8, Canada, alirezt@mcmaster.ca, Elkafi Hassini

We propose a static Cournot oligopoly game to investigate a perfectly competitive market in which supply chains compete in a non-cooperative manner in their product markets. Partners of each supply chain engage in a cooperative triopoly game where initial permit allocations of the pollutants are given on the basis of their sustainability performance that is derived from a data envelopment analysis model.

4 - Product Variety and Productivity: Evidence from the North American Beverage Industry

Alan Pritchard, University of Maryland, Robert H. Smith School of Business, Van Munching Hall, College Park, MD, 20742, United States of America, apritchard@rhsmith.umd.edu, Martin Dresner, Xiang Wan

Using data taken directly from a major North American soft drink beverage bottler and distributor, we examine distribution center (DC) productivity. First, we employ data envelopment analysis (DEA) and a double bootstrapping procedure to estimate the relative efficiency of 108 DCs over a four year period (2008-2011). Then, we use a Tobit regression model to investigate the factors that influence DC productivity – that is, unexplained variation in efficiency, over time.

■ MB56

56-Room 109A, CC

Recent Advances in Location Analysis

Sponsor: Location Analysis

Sponsored Session

Chair: Sibel Alumur, University of Waterloo, 200 University Avenue West, Waterloo, ON, N2L 3G1, Canada, sibel.alumur@uwaterloo.ca

1 - Green Charging Station Location Problem

Okan Arslan, Bilkent University, Department of Industrial Engineering, Ankara, Turkey, okan.arslan@bilkent.edu.tr, Oya E. Karasan

We deal with 'charging station location problem' as a variant of 'flow refueling location problem' (FRLM) by additionally considering the hybrid vehicles such as PHEVs. The objective is to maximize the environmental benefits through maximizing electricity usage in transportation. To solve the problem, we propose an arc-cover model, and apply Benders decomposition. The structure of this formulation allows us to construct Pareto-optimal cuts without having to solve any linear programming problems.

2 - Regenerator Location Problem in Flexible Optical Networks

Baris Yildiz, Bilkent University, Universiteler MAH., Ankara, 06800, Turkey, baris.yildiz@bilkent.edu.tr, Oya E. Karasan

We present the regenerator location problem in flexible optical network that solves the regenerator placement, routing, bandwidth allocation and modulation selection problems jointly. We propose a novel branch and price algorithm for this challenging problem. Our results show that making routing, bandwidth allocation, modulation selection and regenerator placement decisions in a joint manner, it is possible to obtain drastic capacity enhancements with a limited regeneration capability.

3 - Risk Based Facility Location by using Fault Tree Analysis in Disaster Management

Ibrahim Akgun, Assoc. Prof., Abdullah Gül University, Department of Industrial Engineering, Kayseri, 38080, Turkey, ibrahim.akgun@agu.edu.tr

We develop an optimization model that minimizes the risk that a disaster-prone area may be exposed to because it is not supported by facilities located for prepositioning supplies. The risk is calculated as the multiplication of threat, vulnerability of the area, and consequence. The vulnerability is computed by using fault tree analysis and incorporated into the optimization model innovatively. The resulting non-linear integer program is linearized and solved as a linear integer program.

4 - Service System Design with Economies-of-scale and Congestion

Samir Elhedhli, University of Waterloo, 200 University Avenue, Waterloo, Canada, elhedhli@uwaterloo.ca

We formulate and provide solution methodologies for the service system design problem with immobile servers, stochastic demand, and capacity economies of scale. We start by reformulating the problem, and then provide solution approaches based on piecewise linearization, Second Order Cone Programming (SOCP), and Lagrangian Relaxation. Numerical results are provided

■ MB57

57-Room 109B, CC

Optimization of Power Systems Planning and Operation

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Miguel Anjos, Polytechnique Montreal, Mathematics and Industrial Engineering, Montreal, Canada, miguel-f.anjos@polymtl.ca

1 - Chance-constrained Generation Expansion Planning Incorporating Bus Sensitivities

William Rosehart, Schulich School of Engineering, University of Calgary, Calgary, AB, Canada, rosehart@ucalgary.ca, Monisha Manick, Miguel Anjos

A Generation Expansion Planning problem with load uncertainty is formulated based on joint chance-constrained programming. Sensitivities are used to allow greater emphasis to be placed on regions with high demand relative to generation, and similarly to allow for lesser emphasis on regions that are generation-rich. Numerical results are presented for IEEE test systems.

2 - Interrelationship Between Power Transmission and Storage Elements of the Power Network

Enzo Sauma, Pontificia Universidad Catolica de Chile, Santiago, Chile, esauma@ing.puc.cl, Carlos Bustos, David Pozo, Javier Contreras, Sebastian De La Torre, Jose Aguado

We study the interrelationship between the construction of new power transmission lines to integrate wind farms and the installation of new power-storage elements in the network. In particular, we analyze the effect of adding new power-storage components into the power system over the optimal transmission expansion plan. We illustrate our analysis using a stylized version of the Chilean main power system (Sistema Interconectado Central).

3 - Bilateral Contract Optimization in Power Markets

Miguel Anjos, Polytechnique Montreal, Mathematics and Industrial Engineering, Montreal, Canada, miguel-f.anjos@polymtl.ca, François Gilbert, Patrice Marcotte, Gilles Savard

We consider an energy broker linking its customers and the power grid through a two-sided portfolio of bilateral contracts. The contracts cover a number of actions taken by the customers on request within specified periods. Managing this portfolio raises a number of modelling and computational issues due to the aggregation of disparate resources. We propose an innovative algorithmic framework that models short-term decisions factoring in long-term information obtained from a separate model.

■ MB58

58-Room 110A, CC

Analytics in the Petrochemical and Petroleum Industries II

Sponsor: ENRE – Natural Resources II – Petrochemicals and Petroleum

Sponsored Session

Chair: Tejinder Singh, Sr. Research Scientist, Delaware Research and Technology Center - Houston, TX, tejinder.singh@airliquide.com

1 - A Simulation and Optimization Framework for Petroleum Refinery Operations

Ariel Uribe, Ecopetrol S.A., Km 7 Via Piedecuesta, Piedecuesta, Colombia, ariel.uribe@ecopetrol.com.co, Sandra Montagut, Omar Guerra

In this work we present a framework for the simulation and optimization of petroleum refinery operations at strategic and tactic decision levels. Concerning the adequate modeling of processing units, the developed framework allows for the integration of economic models with both linear and non-linear empirical process models based on historical data, rigorous process simulators, or pilot plant data using scale up techniques.

2 - Long-term Demand Forecasting in Industrial Gas Markets

Bin Yu, Air Liquide, 200 GBC Dr, Newark, DE, 19702, United States of America, bin.yu@airliquide.com, Adel Basli, Gildas Bonnier, Athanasios Kontopoulou, Brian Besancon

In this talk we will focus on long-term demand forecasting of liquid oxygen and liquid nitrogen in the U.S. in 5-10 years. We analyzed the predictive performance of several forecasting techniques for IP in each sector using the employment and GDP as leading and associated variables. Moreover, we developed the method of decomposing the demand from the national level to local markets and identified the sectors that drive or restrain market growth in each local market.

3 - A Multi-period MINLP Model for Long-term, Quality-sensitive Shale Gas Development

Markus G. Drouven, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, mdrouven@cmu.edu, Ignacio E. Grossmann

In this work we address the long-term shale gas development problem which involves determining the optimal development strategy for drilling and fracturing gas wells, and designing a pipeline gathering infrastructure. The problem is formulated as a large-scale nonconvex MINLP involving concave investment costs and bilinear terms in the flow balances. We present a solution strategy that relies on an MILP approximation coupled with a restricted MINLP, which yields near optimal global solutions.

■ MB59

59-Room 110B, CC

Panel Discussion: The Impact of the Value-Based Approach on the Field of Strategy

Cluster: Strategy Science

Invited Session

Chair: Nicolaj Siggelkow, University of Pennsylvania, 2000 SHDH, Philadelphia, PA, 19104, United States of America, siggelkow@wharton.upenn.edu

1 - The Impact of the Value-Based Approach on the Field of Strategy

Moderator: Michael Ryall, University of Toronto, Rotman School, Toronto, ON, Canada, m.ryall@mikeryall.com, Panelists: Peter Zemsky, Tomasz Obloj, Harborne Stuart

Value-based strategy provides an intuitive, economic theory for business strategy. An immediate benefit is that it provides a coherent alternative to ad-hoc frameworks, and, in the process, it makes explicit the fact that profits are typically part of some larger economic pie. More broadly, by providing a theory for the economic aspect of strategy, it allows strategy research to focus on some of the richer issues in strategy, including, for example, organizational design, leadership, and execution. The discussion will also consider the empirical questions that arise from the general value capture model (i.e., bi-form games applied in the context of strategy). The mathematics indicate novel issues for empirical investigation. For example, whether the distinction between “competitive” vs “persuasive” resources is meaningful (as the model suggests it should be) and, if so, in which real-world settings one type is more efficacious than the other for superior returns.

■ MB60

60-Room 111A, CC

Cases in the Undergraduate OR Curriculum

Sponsor: INFORM-ED

Sponsored Session

Chair: Michael Veatch, Gordon College, 255 Grapevine Rd, Dept. of Mathematics, Wenham, MA, 01984, United States of America, Mike.Veatch@gordon.edu

1 - Strategies for using Cases in the Undergraduate Classroom

Matthew Drake, Associate Professor Of Supply Chain Management, Duquesne University, 925 Rockwell Hall, 600 Forbes Avenue, Pittsburgh, PA, 15282, United States of America, drake987@duq.edu

Students often develop a better understanding of quantitative material by applying the analytical techniques to realistic decision scenarios. Cases provide OR/MS instructors with an effective vehicle to introduce applications of business analytics in practice. While they are common at the graduate level, cases are not used as often with undergraduates. In this session we will discuss strategies for using cases effectively with undergraduate students.

2 - On the Development of Case Studies for an Undergraduate Business Analytics Course

Eric Huggins, Professor Of Management, Fort Lewis College, 1000 Rim Drive, Durango, CO, 81301, United States of America, huggins_e@fortlewis.edu

Over the past three years I have developed half a dozen case studies for an undergraduate business analytics course. Each case study started as a big data set with a few objectives attached to it, and with the help of my students, they have evolved into current (for now), relevant (I think), interesting (I hope) OR-related case studies.

3 - Where Do I Find Classroom Cases?

James Cochran, Professor Of Applied Statistics And The Rogers-spivey Faculty Fellow, University of Alabama, P.O. Box 870226, Tuscaloosa, AL, 35487-0226, United States of America, jcochran@cba.ua.edu

Many OR/analytics instructors want to incorporate short cases into their undergraduate courses but have difficulty finding suitable, relevant, and topical cases. Where can an instructor find such cases? If s/he is willing to experiment with writing cases, s/he can find the bases of cases in the news, popular culture, and her/his own life (and perhaps publish their efforts in INFORMS Transactions Today). We will demonstrate through several examples from the speaker's experience writing cases.

4 - Teaching Undergraduate Analytics using Cases

Peter Bell, Ivey Business School at Western University, 1255 Western Road, London, ON, N6G 0N1, Canada, pbell@ivey.uwo.ca, Mehmet Begen, Fredrik Odegaard

Ivey's undergraduate analytics courses have used cases extensively for many years. This interactive presentation will discuss some of the benefits (and costs) of a case-based approach to undergraduate teaching.

■ MB61

61-Room 111B, CC

Stochastic and Robust Optimization Models in Electric Power Systems

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Andy Sun, Assistant Professor, Georgia Institute of Technology, 755 Ferst Drive, Atlanta, GA, 30332, United States of America, andy.sun@isye.gatech.edu

1 - Two-stage Distributionally Robust Unit Commitment with Generalized Linear Decision Rules

Yuan Guo, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, yuanguo@umich.edu, Ruiwei Jiang, Jianhui Wang

It is challenging to accurately estimate the joint probability distribution of the renewable energy. In this paper, based on a small amount of marginal historical data, we propose a two-stage distributionally robust unit commitment model that considers a set of plausible probability distributions. This model is less conservative than classical robust unit commitment models and more computationally tractable by using generalized linear decision rules.

2 - Stochastic Unit Commitment with Topology Control Recourse for Renewables Integration

Jiaying Shi, University of California, Berkeley, CA, United States of America, United States of America, shijy07@Berkeley.edu, Shmuel Oren

We introduce a two stage stochastic unit commitment formulation in which the second stage recourse actions include possible reconfiguration of the transmission grid through line switching. Switching action in the second stage are determined by a heuristic method. Such topology control capability can mitigate adverse variability in realized renewables output and improve unit commitment efficiency.

3 - Multistage Robust Unit Commitment with Dynamic Uncertainty Sets

Alvaro Lorca, Georgia Tech, 251 10th St. NW Apt. A622, Atlanta, GA, 30318, United States of America, alvarolorca@gatech.edu

We present a multistage robust unit commitment model with renewables and storage using a simple but effective affine policy for dispatch decisions, while considering dynamic uncertainty sets that integrate wind and solar power resources taking into account spatial and temporal correlations. Our solution algorithm contains enhancements that allow solving the resulting problem efficiently. We also present simulation experiments to evaluate the benefits of our approach.

4 - Multi-stage Stochastic Unit Commitment with SDDP

Jikai Zou, Graduate Research Assistant, Georgia Institute of Technology, 755 Ferst Dr. NW, Atlanta, GA, 30332, United States of America, jikai.zou@gatech.edu, Shabbir Ahmed, Andy Sun

Despite the great amount of research, stochastic unit commitment (UC) problems, where binary commitment decisions adapt to uncertainty with a multi-stage structure, still remain one of the most challenging stochastic programming problems. In this paper, we investigate a sampling based algorithm that combines stochastic dual dynamic programming (SDDP) and the integer L-shaped method for solving multistage stochastic UC. Numerical results and algorithmic improvement will be discussed.

■ MB62

62-Room 112A, CC

Optimization Approaches for Invasive Species and Pest Management

Sponsor: ENRE – Environment I – Environment and Sustainability
Sponsored Session

Chair: Esra Buyuktahtakin, Assistant Professor, Wichita State University, 1845 N Fairmount, Wichita, KS, 67260, Wichita, United States of America, Esra.Buyuktahtakin@wichita.edu

1 - Optimal Inspection of Imports to Prevent Invasive Pest Introduction

Robert Haight, USDA Forest Service, Northern Research Station, St. Paul, MN, United States of America, rhaight@fs.fed.us, Rebecca Epanchin-niell, Cuicui Chen

Based on our work with USDA-APHIS, we study an acceptance sampling problem that incorporates several features of quality control in public safety programs, including the simultaneous inspection of many heterogeneous lots, a budget constraint that limits inspection, inspection error, and an objective of minimizing cost to consumers. We apply our results to inspecting live plant imports to prevent invasive pest introduction.

2 - Cost-effective Planning of Invasive Species Surveillance with the Maximum Expected Coverage Concept

Denys Yemshanov, Research Scientist, Natural Resources Canada, Canadian Forest Service, Great Lakes Forestry Centre, 1219 Queen Street East, Sault Ste Marie, ON, P6A2E5, Canada, Denys.Yemshanov@NRCan-RNCan.gc.ca, Robert Haight, Frank Koch, Bo Lu, Jean Turgeon, Ronald Fournier

We present two invasion survey models based on the maximum expected coverage principle (MECP). The models maximize the expected number of invaded sources that are covered by the surveys, where a source is covered if at least one of its transmission pathways connects to a surveyed destination. We present one- and two-stage models designed to survey invasive forest pests in Canada and the U.S. Overall, the approach provides flexible solution to survey the long-distance spread of invasive pests.

3 - A Multistage Stochastic Programming Model for the Optimal Surveillance & Treatment of Invasive Species

Eyyub Kibis, Graduate Research Assistant, Wichita State University, 1845 N Fairmount, Wichita, KS, 67260, United States of America, eyyubyunus@gmail.com, Esra Buyuktahtakin, Robert Haight

In this study, we develop a multistage stochastic programming model to address the invasive species surveillance and treatment while minimizing the expected damages of invasive species. We use a discontinuous discrete decision tree and incorporate discretized surveillance decisions along with the probabilities of each scenario into the spatially-explicit model. The model allows policy makers to take the best surveillance and treatment decisions over time by exploiting various scenarios.

4 - Import Inspections: Harnessing Enforcement Leverage to Prevent Invasive Species Introductions

Rebecca Epanchin-Niell, Resources for the Future, Washington DC, United States of America, epanchin-niell@rff.org, Michael Springborn, Amanda Lindsay

Allocating scarce border inspection resources over a diverse set of imports to prevent invasive pest entry presents a substantial policy design challenge. We develop a risk-based inspection system in which sampling intensities vary across imports based on risk. We determine optimal sampling of imports to minimize invasive pest introduction accounting for strategic responses of exporters.

■ MB63

63-Room 112B, CC

Daniel H. Wagner Prize Competition II

Cluster: Daniel H. Wagner Prize Competition

Invited Session

Chair: Allen Butler, President & CEO, Daniel H. Wagner Associates, Inc. 2 Eaton Street, Hampton, VA 23669, United States of America, Allen.Butler@va.wagner.com

1 - Integrated Planning of Multi-type Locomotive Service Facilities under Location, Routing and Inventory Considerations

Kamalesh Somani, CSX Transportation, 500 Water St, Jacksonville, FL, 32202, United States of America, Kamalesh_Somani@CSX.com, Xi Chen, Yanfeng Ouyang, Siyang Xie, Zhaodong Wang, Jing Huang

Long term infrastructure planning of locomotive service facilities is vital to the efficiency of the railroad. We developed a large-scale optimization model that integrates decisions on (i) location, capability, and capacity of fixed facilities, (ii) home location and routing plan of movable facilities, and (iii) assignment of a variety of service demands. A decomposition-based solution framework was developed and shown to bring significant economic benefits in full-scale implementations.

2 - Scheduling Crash Tests at Ford Motor Company

Daniel Reich, Leadership Program, Ford Motor Company, Dearborn, MI, United States of America, dreich8@ford.com, Amy Cohn, Ellen Barnes, Yuhui Shi, Marina Epelman, Erica Klampfl

We present the problem of scheduling crash tests for new vehicle programs at Ford. We developed a completely custom-made scheduling system that transforms a labor-intensive scheduling process relying on high levels of expertise, to a more automated one that utilizes optimization and institutionalizes expert knowledge. Our system enables engineers and managers to consider multiple scheduling scenarios, using efficient interfaces to specify problem instances and efficient methods to solve them

■ MB64

64-Room 113A, CC

Joint Session DAS/ENRE: Environmental Decision Analysis: Theory and Applications

Sponsor: Decision Analysis

Sponsored Session

Chair: Melissa Kenney, Research Assistant Professor, University of Maryland, 5825 University Research Court, Suite 4001, College Park, MD, 20740, United States of America, kenney@umd.edu

1 - Decision Analysis for Sustainable Management of the Yellow River Delta

Liang Chen, Student, Johns Hopkins University, 3900 N Charles St. Apt. 1302, Baltimore, MD, 21218, United States of America, chenliang1468@gmail.com, Benjamin Hobbs, Jeff Nittrouer, Hongbo Ma, Andrew Moodie

We develop a stochastic programming model for channel management and flood control that can characterize risks and impacts of possible natural avulsions, and provides solutions for prevention and mitigation. Reflecting the physical mechanism in coastal delta, our model imbeds a 1D hydrodynamic model to simulate sediment transport, channel aggradation and flooding. Our case study is Huanghe (Yellow River) Delta, China, one of the world's most dynamic and heavily urbanized coastal landscapes.

2 - Adaptive Stormwater Management with Green Infrastructure using Two-stage Stochastic Programming

Fengwei Hung, Student, The Johns Hopkins University, 3400 N. Charles Street, Ames Hall 313, Baltimore, MD, 21218, United States of America, fwhung0807@gmail.com, Benjamin Hobbs, Arthur Mcgarity

Green Infrastructure manages stormwater with natural processes involving significant uncertainty. Thus, many cities choose to implement it adaptively to learn how it works. We define "learning" as updating of distribution parameters of the stochastic program's coefficients, representing: automatic learning, triggering learning, multi-state learning, and multi-stage learning with technology improvement. Finally, we calculate risk-return tradeoffs for a Philadelphia stormwater case study.

3 - Framing Effects Created by Ambiguity Aversion in Static Decisions

Erin Baker, University of Massachusetts, MIE Department, 220 ELAB, Amherst, MA, United States of America, edbaker@ecs.umass.edu, Eva Regnier

In climate policy-making, many respected economists recommend using ambiguity-averse decision rules. The vulnerabilities created by ambiguity aversion in dynamic decision making have been demonstrated previously. We show that even in static, one-time, decisions, ambiguity-averse decision rules make policy makers susceptible to bias created by framing effects.

4 - Using Multi-criteria Decision Analysis to Explore Management Options in the Grand Canyon

Michael C. Runge, USGS Patuxent Wildlife Research Center, 12100 Beech Forest Road, Laurel, MD, 20708, United States of America, mrunge@usgs.gov, Kendra Russell, Kirk E. Lagory

The Bureau of Reclamation and the National Park Service are developing a Long-term Experimental and Management Plan (LEMP) for managing water releases from the Glen Canyon Dam and related activities. We conducted multi-criteria decision analysis to evaluate the proposed alternatives, integrating scientific input from a dozen modeling teams, and values-focused input from a wide set of deeply-involved stakeholder groups. We used value-of-information analysis to inform experimental design.

■ MB65

65-Room 113B, CC

Risk Attitudes in Decision Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Andrea Hupman, University of Missouri-St. Louis, 1 University Blvd, St. Louis, MO, United States of America, hupman1@illinois.edu

1 - Individualized Predictions of Normative Decision Making

Andrea Hupman, University of Missouri-St. Louis,
1 University Blvd, St. Louis, MO, United States of America,
hupman1@illinois.edu, Ali Abbas

Understanding how individuals make decisions in practice and predicting behavior is important in many practical applications, giving rise to numerous descriptive models of decision making behavior. In this talk, a behavioral decision making experiment is described. The results are consistent with a bounded rationality explanation of decision making behavior in which making accurate predictions of decisions hinges on individualized information about the decision maker's risk attitude.

2 - Marriage and Managers' Attitudes to Risk

Pavel Savor, Fox School of Business, Temple University,
Philadelphia, PA, pavel.savor@temple.edu

We explore the impact of marriage on corporate CEOs and find that firms run by single CEOs exhibit higher stock return volatility, pursue more aggressive investment policies, and do not respond to changes in idiosyncratic risk. These effects are weaker for older CEOs. Our results continue to hold when we use variation in divorce laws across states to instrument for marital status, supporting the hypothesis that marriage itself drives choices rather than it just reflecting innate heterogeneity.

3 - Using Means Objectives to Present Risk Information

Candice Huynh, Cal Poly - Pomona, CA, United States of
America, candicehuynh@cpp.edu, Jay Simon

When making decisions involving alternatives with risk, individuals are not always able to express or view the possible outcomes in terms of a fundamental objective. To apply information about a means objective correctly, a decision maker must first translate it into information about a fundamental objective. This paper presents the results of a study regarding decision makers' preferences when information is presented either in terms of a means objective or a fundamental objective.

4 - Evolving Risk Perceptions of Cybersecurity Events

Heather Rosoff, Research Assistant Professor, University of
Southern California, Price School of Public Policy & CREATE,
3710 McClintock Avenue, Los Angeles, CA, 90089-2902, United
States of America, rosoff@usc.edu, Robin Dillon-Merrill

Mitigating cyber risks requires understanding how people evaluate risks in this challenging context and in particular, how they respond to repeated warnings over time. In the case of the Target credit card breach in 2013, evidence now shows that Target had failed to follow through on security alerts triggered by the hacker's activities. We speculate on why Target's security team, and why people in general, might not respond to such alarms in the cyber-security context.

■ MB66

66-Room 113C, CC

Air Traffic Management Decision Support: Learning from History

Sponsor: Aviation Applications

Sponsored Session

Chair: Yi Liu, UC Berkeley, 107 McLaughlin Hall, Berkeley, CA, 94720, United States of America, liuyi.feier@gmail.com

1 - The Identification of Similar Days in the New York Area for Air Traffic Flow Management Initiatives

Kenneth Kuhn, RAND Corporation, 1776 Main Street, Santa
Monica, CA, 90407, United States of America, kkuhn@rand.org,
Akhil Shah

Analysis of air traffic flow management initiatives can show the relative success of decisions, but must account for conditions during planning and operations. We apply cluster analysis to identify similar days, using features detailing aviation weather and air traffic around New York. An example is the degree to which jet route J75 is blocked by convective weather at 9am according to a 7am weather forecast. Some features are based on automated approaches such as Principal Component Analysis.

2 - Similar Days? A Story Based on User-defined Similarity

Yi Liu, UC Berkeley, 107 McLaughlin Hall, Berkeley, CA, 94720,
United States of America, liuyi.feier@gmail.com, Mark Hansen,
Alexey Pozdnukhov

In this work, we propose a supervised data-mining algorithm for measuring similarity between two days. First, the algorithm trains the distance matrix between hours according to user-defined similarity and dissimilarity. Then it calculates the daily distance as a weighted sum of hourly distances. The approach can be applied to measure similarity between two days post-operation or identify similar days in the past for a given day.

3 - Representative Traffic Management Initiative Decisions

Alex Estes, University of Maryland-College Park, 3117 AV
Williams, College Park, MD, 20742, United States of America,
aestes@math.umd.edu, Michael Ball, David Lovell

We provide a method for presenting data on traffic management initiatives so that it may more easily be interpreted by researchers or by TMI decision makers. This method involves solving a dominating set problem to produce a set of TMIs which are representative of the range of TMI decisions that have been taken in the past.

■ MB67

67-Room 201A, CC

The Role of Information in Transportation Models

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Dirk Mattfeld, Germany, d.mattfeld@tu-braunschweig.de

1 - Approximate Dynamic Programming for Temporal-spatial Anticipation and Routing of Service Requests

Justin Goodson, Saint Louis University, St. Louis, MO, United
States of America, goodson@slu.edu, Marlin Ulmer, Dirk Mattfeld

We consider the problem of dynamically routing a vehicle to respond to service requests arriving randomly over a given time horizon. Building on a value-function approximation (VFA) that estimates rewards-to-go via the temporal components of the state variable, we use rollout algorithms to explicitly consider spatial dimensions. Our method improves upon the VFA scheme in isolation and points to the potential benefit of using two different approximate dynamic programming techniques in tandem.

2 - A Look-ahead Solution Framework for the Dynamic Vehicle Routing Problem

Han Zou, University of Southern California, Los Angeles, CA
United States of America, hanzou@usc.edu, Maged Dessouky

The problem concerns routing a fleet of capacitated vehicles in real time to fulfill orders placed by a known set of customers. Some of the orders are known a priori, while the rest are placed in real time. We develop a look-ahead solution framework that periodically re-optimizes current vehicle routes by using both realized and forecasted information. With fine-tuned parameter settings, our approach has the potential to outperform both a priori routing and total dynamic dispatching schemes.

3 - Optimal Information Collection in the Vehicle Allocation Problem in Mega-Cities

Yixiao Huang, Tsinghua University, China,
huangyx12@mails.tsinghua.edu.cn, Warren Powell, Ilya Ryzhov,
Lei Zhao

In mega-cities, urban freight delivery companies serve customers spread in a large area. These companies typically divide the city into several regions and allocate the delivery vehicles to serve these regions. The precise cost evaluation of a vehicle allocation decision can be very expensive, due to the volume and uncertainty of the delivery demand. We study on, given a fixed information collection budget, how to collect the cost evaluation information (possibly through real-life practice) to gain the best knowledge to allocate the vehicles optimally.

4 - Data-Driven Vehicle Routing with Profits

Dauwe Vercamer, Ghent University, Ghent, Belgium,
Dauwe.Vercamer@ugent.be, Dirk Van Den Poel,
Michel Gendreau, Philippe Baecke

In sales teams, making optimal visits is crucial. Customer Profitability models help in identifying top customers, but do not consider the associated visit costs. Vehicle Routing models make efficient schedules, but use naive estimates rather than good forecasts. Our prescriptive analytics approach uses auxiliary data and statistical learning to approximate full-information vehicle routes. The results show this approach improves customer selection in vehicle routes and maximizes profitability.

5 - Data Mining for Problem-Specific State Space Design in Routing Applications

Dirk Mattfeld, Technische Universität Braunschweig,
Braunschweig, 38106, Germany, d.mattfeld@tu-braunschweig.de,
Ninja Soeffker, Marlin Ulmer

We consider a dynamic routing problem, where a vehicle serves customer requests arriving stochastically over time. Due to a time limit, not every request can be served. Rejections are possible to maximize the overall number of served requests. For anticipation of future requests, we apply value function approximation (VFA). For improvement of the approximation process, we combine VFA with data mining operations to derive a problem specific VFA-state space based on the observed problem states.

■ MB68

68-Room 201B, CC

Green Vehicle Routing

Sponsor: Transportation, Science and Logistics

Sponsored Session

Chair: Mesut Yavuz, Associate Professor, University of Alabama, Alston Hall Box 870226, Tuscaloosa, AL, 35487, United States of America, myavuz@cba.ua.edu

1 - Pathways to Green Logistics: Past, Present and Future of the Green Vehicle Routing Problem (GVRP)

Sevgi Erdogan, Faculty Research Associate, University of Maryland-NCSG, 1112 J Preinkert Field House, College Park, MD, 20742, United States of America, serdogan@umd.edu

This talk will give a brief background to the GVRP and a review of the variants and extensions to the problem as well as techniques to their modeling and solution. A close analysis of the state of literature will be given. Pathways for future research will be discussed.

2 - The Electric Fleet Size and Mix Vehicle Routing Problem with Time Windows and Recharging Stations

Richard Hartl, Professor, University of Vienna, Oskar-Morgenstern-Platz 1, Vienna, Austria, richard.hartl@univie.ac.at,
Gerhard Hierman, Jakob Puchinger, Stefan Ropke

When routing electrical vehicles, limited battery capacity makes detours to recharging stations necessary. We introduce the E-FSMVRPTW to model decisions regarding the fleet composition and the actual routing including the choice of recharging times and locations. We propose a branch-and-price method as well as an ALNS with an embedded local search and labelling procedure. The effectiveness of the proposed approach is shown on a newly created set of benchmark instances and existing benchmarks.

3 - An Iterated Beam Search Algorithm for the Green Vehicle Routing Problem in Service Fleets

Mesut Yavuz, Associate Professor, University of Alabama, Alston Hall Box 870226, Tuscaloosa, AL, 35487, United States of America, myavuz@cba.ua.edu

We present a novel Iterated Beam Search (IBS) solution to the Green Vehicle Routing Problem (GVRP) in Service Fleets. The problem allows internal and external refueling and aims to minimize the total travel distance of a homogeneous fleet. Two mathematical formulations (vehicle flows and set partitioning) are built and a lower bound is obtained for each. Two heuristics (savings and insertion) are adopted for upper bounding. We also present preliminary results of a computational experiment.

4 - Fleet Sizing and Scheduling for Mixed Fleets with Alternative Fuel Vehicles

Ismail Capar, Texas A&M University, College Station, TX, United States of America, capar@tamu.edu

We present a mixed-integer formulation for a new type of fleet sizing and scheduling problem. The formulation consider special need for refueling of alternative fuel vehicles due to their limited range and/or limited refueling infrastructure, such as availability of charging stations for electric vehicles. We provide results of numerical analysis together with managerial insights.

■ MB69

69-Room 201C, CC

Facility Logistics IV

Sponsor: TSL/Facility Logistics

Sponsored Session

Chair: Debjit Roy, Associate Professor, Indian Institute of Management Ahmedabad, Vastrapur, Ahmedabad, 380015, India, debjit@iimahd.ernet.in

1 - Robust Supply Chain Design and Operation under Uncertainty

Deniz Tursun, Postdoctoral Research Associate, University of Illinois Urbana Champaign, 3308 Sharp Drive, Champaign, IL, 61822, United States of America, utursu2@illinois.edu

Robust supply chain design and operation under uncertainty problems lead to confluence of integer and continuous variables, which call for Mixed-Integer Nonlinear Programming (MINLP) algorithms. We consider a comprehensive random projection algorithm for a subclass of MINLP's, where the objective and constraints are defined by convex functions and integrality restrictions are imposed on a subset of the decision variables.

2 - Batching Decisions in Stock-to-Picker Order Picking

Debjit Roy, Associate Professor, Indian Institute of Management Ahmedabad, Vastrapur, Ahmedabad, 380015, India, debjit@iimahd.ernet.in, Vibhuti Dhingra, Jennifer Pazour

We develop new analytical models to analyze performance of static vs. dynamic batching policies in stock-to-picker order pick systems. In particular, we analyze the effect of batch size, variability in item inter-arrival times, and item commonality on order pick performance.

3 - Branch-and-Price for the Capacitated Mobile Facility Location Problem

S. Raghavan, Professor, Smith School of Business & Institute for Systems Research, University of Maryland, College Park, MD, 20742, United States of America, raghavan@umd.edu, Mustafa Sahin, Sibel Salman

The Capacitated Mobile Facility Location Problem (CMFLP) is a combinatorial optimization problem with applications in supply chain operations and distribution of medical services. We propose two Mixed Integer Programming formulations for the CMFLP and discuss a branch-and-price algorithm for a set partitioning formulation, where the linear programming relaxation is solved with a column generation procedure. We demonstrate the quality of the algorithm on instances adapted from the literature.

4 - Store Fulfillment for Online Orders: A Planning Model in a Collaborative Store Environment

Ming Ni, SUNY Buffalo, 326 Bell Hall, University at Buffalo, Amherst, NY, 14260, United States of America, mingni@buffalo.edu, Arun Hampapur, Qing He, Xuan Liu

This study on online order fulfillment aims to identify the seasonal planning dimensions from local retailing outlets perspective. It develops optimization models and heuristic algorithms which solve order assignment and fleet sizing problems to construct the supply chain plan. The numerical examples are derived from same day delivery from a real-world retailer store network.

■ MB70

70-Room 202A, CC

Joint Session RAS/TSL/AAS: Real-Time Decision Support Practice

Sponsor: Railway Applications

Sponsored Session

Chair: Ravindra Ahuja, President, Optym, 7600 NW 5th Place, Gainesville, FL, 32607, United States of America, ravindra.ahuja@optym.com

1 - Simulation-guided Optimization Algorithms for Real-time Train Scheduling

Pedram Sahba, Senior Systems Engineer, Optym, 7600 NW 5th Place, Gainesville, FL, 32607, United States of America, pedram.sahba@optym.com, Ravindra Ahuja, Abbas Bozorgirad

In this presentation, we will describe several algorithms for real-time train scheduling (also known as meet-pass planning) using simulation, mixed integer programming and network optimization techniques including their computational results. These algorithms are in production at a railroad in Australia and we will give a demonstration of the system using these algorithms. We will also share our lessons about how these algorithms evolved, what worked, and what did not work.

2 - Real-time Airline Schedule Recovery

Dejun Hang, Jeppesen, Englewood, CO,
United States of America, Darren.Hang@jeppesen.com

In airline daily operations, the schedule is often disrupted by events unforeseen at the planning stage. Recovering the disrupted schedule as fast as possible with good quality is critical to protect revenue. We present how Jeppesen's Fleet Management System approaches this problem. We will discuss the underlying models and algorithms used to solve the aircraft and crew schedule recovery problems, and also some of the critical support processes.

■ MB71

71-Room 202B, CC

Mobility Choices in Urban Transportation

Sponsor: TSL/Urban Transportation

Sponsored Session

Chair: Hai Jiang, Tsinghua University, Dept of Industrial Engineering, Beijing, China, haijiang@tsinghua.edu.cn

1 - Determinants of Private Vehicle use Intensity: Evidence from Disaggregate Household Data in China

Hai Jiang, Tsinghua University, Dept of Industrial Engineering, Beijing, China, haijiang@tsinghua.edu.cn, Zhao Zhang

The level of congestion is primarily determined by the number of vehicles owned by the residents and their use intensity (that is, annual vehicle miles driven). Existing literature typically conduct the analysis using aggregated macroeconomic variables. In this talk, we use disaggregate household data to identify determinants of private vehicle use intensity in China. We find that gasoline price plays little role in use intensity, which is consistent with results from existing literature using macroeconomic data. We also find that the socioeconomic characteristics of the household has considerable effect in vehicle use intensity.

2 - A Comparison of Mixed Logit and Latent Class Methods for Mode Choice Analysis

Yuntao Guo, Purdue University, Lyles School of Civil Engineering, West Lafayette, IN, 47907-2051, United States of America, guo187@purdue.edu, Jian Wang, Srinivas Peeta

This study aims to investigate the differences between the mixed logit and the latent class methods in terms of model fit, model insights, predicted travel mode choice, and spatial transferability using a large sample of revealed preference travel mode choice data. The model can help planners to develop effective strategies to foster more sustainable transportation mode choice behaviors by reducing automobile dependency and encouraging the usage of alternative modes of travel.

3 - Traffic Equilibrium and Pricing with Information in a Correlated Network

Song Gao, Associate Professor, University of Massachusetts Amherst, Department of Civil and Env. Engineering, 214C Marston Hall 130 Nat. Resources Rd, Amherst, MA, 01003, United States of America, sgao@engin.umass.edu, Andre de Palma

We study the impacts of correlation and information penetration rate in a network with correlated, random link capacities, in terms of the types of equilibrium solution (corner vs interior for informed and uninformed respectively), the user cost for informed and uninformed, the social cost, and the optimal price for system optimum.

■ MB72

72-Room 203A, CC

Journal of Quality Technology (JQT) Invited Session

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Fugee Tsung, Prof., HKUST, Clear Water Bay, Kowloon, Hong Kong - PRC, season@ust.hk

1 - An Introduction to Statistical Issues and Methods in Metrology

Joanne Wendelberger, Los Alamos National Laboratory, Statistical Sciences Group, MS F600, Los Alamos, NM, 87545, United States of America, joanne@lanl.gov, Michael Hamada, Max Morris, Stephen Vardeman, J. Marcus Jobe, Tom Burr, Huaqing Wu, Leslie Moore

Statistical science and metrology provide valuable concepts and approaches for assessing the quality of measured data. Measurement quality impacts the knowledge that can be gained by collecting and analyzing data using statistical methods, and appropriate data collection and analysis quantifies the quality of measurements. An overview of statistical issues and methods in metrology is presented that includes both frequentist and Bayesian methodologies.

2 - From Profile to Surface Monitoring: SPC for Cylindrical Surfaces via Gaussian Processes

Bianca Colosimo, Professor, Politecnico MILANO, via La Masa, 1, Milano, 20156, Italy, biancamaria.colosimo@polimi.it, Massimo Pacella

Quality of machined products is often related to the final shapes of the manufactured surfaces. This paper presents a novel method for surface monitoring, which combines Gaussian processes to model the manufactured shape and multivariate control charting for monitoring the deviations of the actual surface from the in-control pattern. Regardless of the specific case study, the proposed approach is general and can be extended to deal with different kinds of surfaces or profiles.

3 - Multimode Geometric Profile Monitoring with Temporally Correlated Image Data

Abhishek Shrivastava, Assistant Professor, FAMU-FSU College of Engineering, Dept of Industrial & Manufacturing Eng, Tallahassee, FL, 32310, United States of America, ashrivastava@fsu.edu, Park Chiwoo

We propose a new method for monitoring changes in geometrical profiles of objects in a dynamic process; changes in profiles occur in various modes. This work is motivated by the need for monitoring changes in geometrical shape and sizes of nanoparticles during self-assembly process. The proposed multimode geometric profile monitoring method addresses three specific issues - profiling of functional data, monitoring of multimode processes, and monitoring of time-correlated processes.

4 - Statistical Surface Monitoring by Spatial-Structure Modeling

Kaibo Wang, Associate Professor, Tsinghua University, Department of Industrial Engineering, Beijing, China, kbwang@tsinghua.edu.cn, Fugee Tsung, Andi Wang

We propose a new chart based on the Gaussian-Kriging model to monitor a two-dimensional (2-D) surface. A parametric model that considers three components of the surface, the global trend, the spatial correlations, and independent errors, is first constructed; then we monitor the process by detecting changes in the estimated parameters. This method is utilized to monitor a wafer-manufacturing process and its performance is compared with that of an existing method through simulation.

■ MB73

73-Room 203B, CC

Game-theoretical Models in Maintenance and Reliability

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Maryam Hamidi, PhD Candidate, University of Arizona, 1127 E. James E. Rogers Way, Room 111, P.O. Box 210020, Tucson, AZ, 85721, United States of America, mhamidi@email.arizona.edu

1 - A Cooperative Game of Spare-Parts Systems

Ulas Ozen, Ozyegin University, Ozyegin University Cekmekoy Campus, Istanbul, Turkey, ulas.ozen@ozyegin.edu.tr

We consider a group of firms that keep spare-parts inventory to maintain their equipments. The firms can cooperate by pooling their spare-parts inventory and reduce costs. One important question is how the benefit of such cooperation should be shared between the participating firms. The firms' spare-parts investment problem is modeled as a queueing model and we study the associated cooperative game. We show that the resulting game has a non-empty core. Several extensions are studied further.

2 - Non-cooperative Game Theory Analysis in Supply Chain Internal Financing

Wanying Shi, Western New England University, 1215 Wilbraham Street, Springfield, MA, 01119, United States of America, wanying.shi@wne.edu, Julie Drzymalski

This paper evaluates the effect of wholesale price discount contract on coordinating non-cooperative supply chain financing between a liquid supplier and a capital constrained retailer at a risk-free rate. Optimal policies for retailer and supplier are found. Profits and efficiencies of retailer, supplier and supply chain are compared in both the retailer- and supplier-led Stackelberg games. Results show that internal financing will increase overall profits.

3 - A Competitive Dynamics Approach to Supply Chain Management: Competitive Action and Performance

Xinyi Ren, PhD Student, University of Maryland, 3330 Van Munching Hall, College Park, MD, 20742, United States of America, xinyi.ren@rhsmith.umd.edu, Christian Hofer, Curtis Grimm, David Cantor

This study investigates how the actions of supplier and manufacturer (focal firm) dyads impact focal firm's performance. Grounded in competitive dynamics and the relational view, theory will be developed regarding actions and performance. A panel dataset will be built combining data from FACTSET, Compustat and LexisNexis. This paper will contribute to both the competitive dynamics literature and relational view by studying competitive actions in a supply chain context.

■ MB74

74-Room 204A, CC

Sustainable Operations in the Manufacturing Industry

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Wilkistar Otieno, Assistant Professor, University of Wisconsin-Milwaukee, 3200 N Cramer St, Milwaukee, WI, 53209, United States of America, otieno@uwm.edu

1 - Inventory Optimization in a Three Echelon Closed Loop Supply Chain with Stochastic Quality in Return

Sajjad Farahani, PhD Student, University of Wisconsin-Milwaukee, 4046 N Wilson Dr Apt2, Milwaukee, WI, 53211, United States of America, farahani@uwm.edu, Farshid Zandi, Wilkistar Otieno

We considered three echelon closed loop supply chain in which returned product arrive to the re-manufacturing system with different quality level inspect to estimate needed time to re-manufacture as a new product. We proposed an analytical queuing models with the time value of money consideration to optimize inventory level of two warehouses and the admission decision, which decides on the acceptance of returned products based on quality and processing time.

2 - A Simulation Based Model for Performance Evaluation of Control Drive Remanufacture

Thomas Omwando, Graduate Student, University of Wisconsin-Milwaukee, 3200 N Cramer St. EMS 503, Milwaukee, WI, 53211, United States of America, tomwando@uwm.edu, Wilkistar Otieno

Process complexities and uncertainties in product remanufacture affect system performance. In this study a discrete event simulation approach is employed to model process performance with the objective of improving system performance. A case study of two product families in control drive remanufacture is used to illustrate the applicability of the model. A sensitivity analysis is carried out to assess the effect of changes in various decision variables on the overall system performance.

3 - Warranty Analysis of Remanufactured Electrical Products

Yuxi Liu, Graduate Student, University of Wisconsin-Milwaukee, 3438 N Oakland Ave #302, Milwaukee, WI, 53211, United States of America, yuxiliu@uwm.edu, Wilkistar Otieno

This study considers a remanufactured electrical product under warranty. Warranty is key ensuring a good manufacturer-consumer relationship. Manufacturers hope to minimize warranty costs while consumers believe warranty promises product quality. This paper presents an optimal warranty period from the perspective of a manufacturer to maximize the total expected profits, while sustained consumer relation. We use data from a local company with a global supply chain to provide a numerical example.

■ MB75

75-Room 204B, CC

Managing Search and Problem Solving in Innovation Settings

Cluster: New Product Development

Invited Session

Chair: Sezer Ülkü Associate Professor, Georgetown University McDonough School of Business, 545 Hariri Building, 37 & O Streets, Washington, DC, 20057, United States of America, su8@georgetown.edu

1 - When to Leave the Building? Search and Pivoting in a Lean Startup

Onesun Steve Yoo, University College London, Gower Street, London, WC1E 6BT, United Kingdom, o.yoo@ucl.ac.uk, Kenan Arifoglu, Tingliang Huang

An early stage entrepreneurial firm with a new product concept must maximize the chance of successful product launch. To avoid developing an unwanted product, practitioners suggest a lean approach to development, i.e., a firm should iteratively launch an unfinished product to learn what the consumers want and to alter the final product goal whenever necessary. We formalize this approach via the Bayesian learning framework, and investigate the optimal development strategy.

2 - How (and When) to Encourage Cooperation Across Projects

Fabian Sting, Erasmus University Rotterdam, Rotterdam School of Management, 3000 DR Rotterdam, Netherlands fsting@rsm.nl, Pascale Crama, Yaozhong Wu

Inspired by an innovative practice, we model a Project Management system that incorporates and shapes cooperative problem solving. Help is at the core of this system, in which project managers may ask for and provide help. We find that companies should take a nuanced approach when designing help exchange and time-based incentives.

3 - Search under Constraints - An Experimental Study

Sezer Ülkü, Associate Professor, Georgetown University McDonough School of Business, 545 Hariri Building, 37 & O Streets, Washington, DC, 20057, United States of America, su8@georgetown.edu

In contexts of innovation, slack resources are required due to the many unknowns. At the same time, according to some, "necessity is the mother of invention", and resource constraints might improve innovative performance. Through a series of experiments, we examine how constraints influence search strategies, and the ultimate performance.

■ MB76

76-Room 204C, CC

Simulation Optimization and Input Uncertainty

Sponsor: Simulation

Sponsored Session

Chair: Enlu Zhou, Assistant Professor, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, United States of America, enlu.zhou@isye.gatech.edu

1 - Insights on Ranking and Selection when there is Input Uncertainty

Barry Nelson, Walter P. Murphy Professor, Northwestern University, Dept. of IEMS, 2145 Sheridan Road, C210, Evanston, IL, 60208, United States of America, nelsonb@northwestern.edu, Eunhye Song

We examine the impact of input uncertainty (inaccuracies in the stochastic input models that have been estimated from real-world data) on the simplest form of simulation optimization: ranking and selection among a finite number of alternatives. We show that the conclusions from the optimization must be altered, establish the limits of what can be attained by increased simulation effort alone, and suggest alternative ways to attack the problem that lead to interpretable conclusions.

2 - Distributionally Robust Stochastic Optimization using Divergences- A Data Driven Strategy

Anand Vidyashankar, Associate Professor, George Mason University, Department of Statistics, Volgeneau School of Engineering, Fairfax, VA, 22030, United States of America, avidyash@gmu.edu, Jie Xu

We propose a new paradigm for data-driven distributionally robust stochastic optimization (DRSO). This paradigm integrates existing approaches to decision making under uncertainty with robust and efficient statistical procedures. Specifically, it extends the scope of DRSO by centering the ambiguity sets on density estimates neighborhoods in the space of probability densities. The proposed approaches are transparent, theoretically justified, and accessible to researchers and decision makers.

3 - Some Statistical Perspectives on Optimization under Parameter Uncertainty

Henry Lam, Assistant Professor, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, khlam@umich.edu, Jeff Hong

We consider approaches to improve the quality of solutions for optimizations under parameter uncertainty, in the case of limited data. We analyze two computationally tractable methods: bootstrap aggregation, or bagging, and Bayes estimator in the decision-theoretic framework. Both are simulation-based schemes that aim to improve the distributional behavior of the optimality gap by reducing its frequency of hitting large values.

4 - Simulation Optimization When Facing Input Uncertainty

Enlu Zhou, Assistant Professor, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, United States of America, enlu.zhou@isye.gatech.edu, Xie Wei

This talk makes an attempt at the question of what is a good formulation for simulation optimization when there is input uncertainty. We propose a risk formulation of simulation optimization that tries to balance the trade-off between optimizing under the estimated input model and hedging against the risk brought by input uncertainty.

■ MB77

77-Room 300, CC

Supply Chain Management VI

Contributed Session

Chair: Bisheng Du, Assistant Professor, Ningbo University, 818 Fenghua Road, Ningbo, China, dubisheng@nbu.edu.cn

1 - Supplier Development Investments under Competition

Tarun Jain, IIM Bangalore, FPM Office, IIM Bangalore, Banerghatta R, Bangalore, India, tarun.jain@iimb.ernet.in, Jishnu Hazra

We model a case, where a buyer is evaluating a new supplier. The buyer allocates some capacity to the incumbent supplier and makes supplier development investments in the entrant supplier. Both incumbent and entrant supplier also exerts improvement investments. We find the optimal investments strategy of these players and the optimal capacity allocation strategy of the buyer.

2 - Analysis and Design of Retail Backrooms and its Impact on Supply Chain

Lita Das, Student, MIT, 77 Massachusetts Avenue, E40-286, Cambridge, MA, 02139, United States of America, litadas@mit.edu, Edgar Blanco

Backroom space management and supply chain operations are closely linked. We propose a model to optimally manage backroom space and demonstrate the impact on retail supply chain planning and design.

3 - An Evaluation of the Progressive Formulation (PF) through the Modeling of the PCSA

Daniel Mota, Researcher, MIT, Rua Jose de Magalhaes 373, Vila Clementino, Sao Paulo, SP, 04026, Brazil, danmota@mit.edu, Roberto Perez-franco

Progressive Formulation (PF), an ad-hoc approach recently proposed for formulating a supply chain strategy, has shown potential in applied projects but has never been objectively evaluated. This paper attempts a first evaluation of the merits of the PF approach, by modeling PF as a greedy algorithm and comparing its results against an optimal solution for the same data set. Results are compared in terms of the quality of the solution generated and the amount of information needed to achieve it.

4 - Capacity Planning over a Finite Time Horizon with Dual Contracts: An Optimization Approach

Ramya Ravi, Student, Indian Institute of Technology, Madras, Chennai, 600036, India, ramya.tcemdu@gmail.com, Haritha Thirumalai, Rajendran Chandrasekharan, Vivekanandan Srinivasan

We consider a supply chain with multiple products manufactured using processes outsourced to suppliers by the manufacturer. Capacity planning contracts (i.e., fixed charge and option, with setup/order costs) are considered. We present an algorithm to determine the capacity investments, considering the total supply chain profit over a finite time horizon.

5 - Optimal Fulfillment Decisions in a Capacitated Online Retailing System with Different Leadtimes

Bisheng Du, Assistant Professor, Ningbo University, 818 Fenghua Road, Ningbo, China, dubisheng@nbu.edu.cn

Online retailers offer more options, like flexible delivery, pricing, etc. We consider an inventory system where customers may have different lead-times under the retailer's capacity. The retailer has a primary warehouse and many regional warehouses. The regional warehouses fulfill the customers' orders by on-hand inventory, or the primary warehouse will fulfill orders with longer time. Our intention is to analyze the performance of the capacitated retailing system under the multistage setting.

■ MB78

78-Room 301, CC

Shipping and Transportation for Supply Chains

Contributed Session

Chair: Sherif Masoud, Operations Research Analyst, RockTenn, 3950 Shackleford Rd., Duluth, United States of America, smasoudphd@gmail.com

1 - Port Logistics and the Voice of the Customer

Richard Monroe, Visiting Assoc Prof, Longwood Univ, College of Business and Econ, 201 High Street, Farmville, VA, 23120, United States of America, rickmon53@gmail.com

Customers are key stakeholders for logistics services through the various modes which include seaports, trucking, rail and inland ports. Primary customers such as manufacturers and retailers are highly dependent on the smooth flow of freight through the logistics system. Customer expectations for logistics services have received limited attention in previous research. This paper will utilize a combination of approaches to explore the voice of the customer in the port logistics setting.

2 - A New Formulation for the Cyclic Inventory Routing Problem and the Solution Method

Zhe Liang, Professor, Tongji University, No. 1239, Siping Road, Shanghai, 200092, China, liangzhe@tongji.edu.cn, W. Art Chaovalitwongse

We study a cyclic inventory routing problem (IRP). The traditional exact methods for IRP use an arc-based model, in which a variable represents a possible vehicle flow between a pair of customers. We develop a Dantzig-Wolfe reformulation for the arc-based model. To solve the problem efficiently, we develop a set of valid inequalities and a column generation algorithm. Computational results show that the new model can obtain near optimal solutions to very large test cases in a reasonable time.

3 - Robust Supply Chain System under Yield Uncertainty

Samir Alsobhi, PhD Candidate, Wichita State University, 11328 E Pine Meadow Ct, Wichita, KS, 67206, United States of America, samiralsobhi@gmail.com, Krishna Krishnan

Products are often damaged in transit. These damages are stochastic in nature. To minimize the impact of damage, the selection of routes should consider not only the expected damage but also the variability of damage. In this research, the first model is of the supply chain network in order to minimize total cost, which consists of product cost and transportation cost while considering multiple routes and products. In the second model, the concept of robust design has been applied to minimize damage.

4 - A Floating Price Contract for the Ocean Freight Industry

Ruina Yang, Xi'an Jiaotong University, No. 28 West Xianning Road, Xi'an, China, rnyang@mail.xjtu.edu.cn

We propose a floating price policy to address the shipper default issue. Specifically, the shipper has to make a tradeoff between not fulfilling all committed capacity to secure a lower spot price in the low season and purchasing the capacity at a higher floated price in the high season. The results reveal that the non-capacity commitment contract serves both parties' best interests under a tight-capacity market, while the floating price contract is the most effective in an over-capacity market.

5 - Minimizing Automotive Supply Chain Costs under Mixed Transportation Modes

Sherif Masoud, Operations Research Analyst, RockTenn,
3950 Shackleford Rd., Duluth, MN, United States of America,
smasoudphd@gmail.com, Scott Mason

We present an industry-motivated integrated production and transportation problem focused on short-term automotive supply chain planning. We consider multiple, heterogeneous modes of transportation that offer a cost vs. delivery time option to the manufacturer. Computational results demonstrate the efficiency of a proposed metaheuristic-based solution approach, given the problem's NP-hard computational complexity.

■ MB79

79-Room 302, CC

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - AMPL - Developing Optimization Applications Quickly and Reliably with Algebraic Modeling

Robert Fourer, President, AMPL Optimization Inc., 2521 Asbury Ave, Evanston, IL, 60201, United States of America,
4er@ampl.com

Can you negotiate the complexities of the optimization modeling lifecycle, and deliver a working application before the problem owner loses interest? Algebraic languages were invented to streamline the key steps of model formulation, testing, and revision. Today they are supported by powerful facilities for embedding models into larger systems and deploying them to users. This presentation introduces algebraic modeling for optimization through examples using classic and recently introduced features of the AMPL language and system.

2 - Gurobi Optimization, Inc. – Modeling with the Gurobi Python Interface

Renan Garcia, Optimization Support Engineer, GAMS Development Corp

Are you looking for an environment that combines the expressiveness of a modeling language with the power and flexibility of a programming language? The Gurobi Python interface allows you to build concise and efficient optimization models using high-level modeling constructs. Moreover, Python itself has a vast ecosystem of packages designed to increase your productivity, such as a notebook-style interface (iPython Notebook), data access capabilities and web development tools. This tutorial will provide an overview of these features, including detailed examples that show how to use the Python interface to build models that can be turned into full optimization applications.

Monday, 12:30pm - 2:30pm

Exhibit Hall A

Monday Poster Session

Contributed Session

Chair: Wenjing Shen, Drexel University, Philadelphia, PA,
United States of America, ws84@drexel.edu

Co-Chair: Allen Holder, Rose-Hulman Mathematics, Terre Haute, IN,
United States of America, holder@rose-hulman.edu

Co-Chair: Min Wang, Drexel University, 3141 Chestnut Street,
Philadelphia, PA, United States of America, mw638@drexel.edu

1 - Big Data

Marwah Halwani, University of North Texas, 2812 Loon Lake Road, Denton, TX, 76210, United States of America,
marwahhalwani@my.unt.edu, Victor Prybutok, Adam Corwin,
Daniel Peak

The Big Data Model developed to provide a foundation for the proper use of Big Data and Data Visualization in Social Media environments that will drive positive bottom-line results. This research addresses how can Big Data represented with Data Visualization in a Social Media environment contribute to better decisions

2 - Brightness-location Congruency Effects on Consumer Behavior in Retail Context

Tsutomu Sunaga, Professor, Kwansei Gakuin University, 1-1-155, Uegahara, Nishinomiya, Hyogo, 662-8501, Japan,
sunaga@kwansei.ac.jp, Jaewoo Park

The study investigates the effects of the crossmodal correspondence between colour and visual heaviness on consumer purchase behavior. The results of the experiments demonstrate that brightness-location congruence, specifically products with bright (dark) colour at the higher (lower) shelf positions, increases shoppers' perceptual fluency and promotes their purchase behaviour.

3 - A Kalman Filter Algorithm for Artillery Firing Shift

Michael Bendersky, Ben Gurion University of the Negev,
Beersheba, Israel, michael.bendersky@gmail.com, Israel David

We propose an innovative algorithm for artillery firing shift using the Kalman Filter approach. Firing shift implies an immediate artillery engagement of a target ("fire for effect") without a prior fire adjustment (by a forward observer). The capability of firing shift provides undeniable operational advantages. Implementing the Kalman Filter allows sequential fire adjustment relying on multiple auxiliary targets.

4 - Demand Forecasting and Area Marketing for Gas Appliances

Kosuke Shaku, Tokyogas, 1-5-20, Kaigan, Minato-ku, Tokyo,
Japan, shaku@tokyo-gas.co.jp

Tokyo gas has been utilizing O.R. to a lot of fields such as marketing, emergency response, and so on. Demand Forecasting of gas appliances has been a big problem for gas appliances sales. We managed to establish the method of quantitatively rational demand forecast by utilizing the CRM data of appliances stocks, survival analysis, and transience of appliances types in replacement. The result of this work has been adopted to many Tokyo gas measures such as sales goal setting and area marketing.

5 - Who to Call Predictive Modeling of Potential Customers Based on Customer Behavior Data

Lin Shi, Kihhihi Network Information Systems Technology, China,
shilin@baixing.com

A telemarketing campaign is operated in a classified advertisements website Baixing.com. A model is needed to predict the possibility of customers order and then those with highest possibility can be selected. The paper designed and implemented a practical decision support system which could generate and distribute customer lists to sales representative. The poster introduces the object, business background, specific aims, modeling procedures, modeling data, final result and the conclusions of the work. Four techniques have been used to compare the performance. Random forest gives the best result. The final dynamic model integrates customers online behavior data, which is also called click-stream data as indicators of willingness to pay. The result from field study inspired that in the future work, we may push dynamic modeling for more robust and precise prediction.

6 - The Opportunity Cost of Federal Subsidies for Electricity Generation in the U.S.

James Gibson, USMC, 2414 Turtle Bay Dr, New Bern, NC, 28562,
United States of America, gibson.james.r@gmail.com

This study is the first investigation of the opportunity cost associated with electric utility sector federal subsidies using the mean-variance portfolio theory. The application of portfolio theory provides for an examination of how policy decisions influence electricity generation costs. The results indicate federal subsidies have an uncertain effect on electricity generation costs and the associated tax burden becomes an opportunity cost assumed by society and individual taxpayers.

7 - The Effect of Shape and Semantic Novelty in Product Design Usage

Harris Kyriakou, Stevens Institute of Technology, 1 Castle Point on Hudson, Hoboken, NJ, 07087, United States of America,
ckyriako@stevens.edu

Our study examines 35,727 product designs submitted to the largest 3D printing online community from January 2009 to June 2013, showing how (i) shape novelty, (ii) semantic novelty and (iii) their interaction affect product design usage. We develop both a shape-based and a text-based measure of novelty by identifying designs that are dissimilar to any preexisting design.

8 - Who Wants My Product? Affinity-based Marketing

Leyla Zhuhadar, Assistant Professor, Western Kentucky University, 1906 College Heights Blvd, Grise Hall, Bowling Green, KY, 42101, United States of America, leyla.zhuhadar@wku.edu

In this research, we have developed a marketing application for data mining with the goal of publicizing a new product to those customers with a high affinity for it. We assembled suitable data to test and evaluate different mining algorithms on it. We have used the buyers of our product of interest as "model customers" for finding similar customers among the non-buyers. Finally, we deployed our final model to our customer base.

9 - Robust Security-constraint Unit Commitment with Dynamic Rating

Anna Danandeh, University of South Florida, Tampa, FL, 33613,
United States of America, annadanandeh@mail.usf.edu, Bo Zeng,
Brian Buckley

A challenge in UC is the impact of uncertain factors such as ambient temperature on generation and transmission capacities. Since system capacity is mostly determined statically, weather changes can cause outages and/or congestions. We developed a 2 stage robust security-constraint UC formulation which dynamically rates the assets and hedges against possible efficiency drops. Leveraging the correlation between weather and load, it yields a less conservative decision and a faster computation.

10 - Advanced Decision-making Procedures in Massive Failure Data Classification

Keivan Sadeghzadeh, Northeastern University,
27 Payne Rd, Newton, MA, 02461, United States of America,
k.sadeghzadeh@neu.edu

In many professional areas, management decision-making process is based on the type and size of data where data classification is a necessary procedure. Massive amount of data in high-dimensions are increasingly accessible from various sources and it has become more difficult to process the streaming data in traditional application approaches. This poster presents advanced procedures to analyze high-dimensional failure data in order to facilitate decision-making through data classification.

11 - Exploring Residents Attitude Towards Solar Photovoltaic System Adoption in China

Yaqin Sun, Drexel University, 38 Clarence Avenue, Bridgewater, PA, United States of America, ys23@drexel.edu, Xiangrong Liu

The research aimed to identify the drivers and dynamics that most encourage Chinese customers to install solar PV systems (SPS) in their residential buildings. A survey was designed and conducted among Chinese residents. The first hand data indicated the importance of increasing awareness of SPS among potential consumers. This research also assessed the impacts of gender on their knowledge of, concerns, and attitudes towards PV adoption. However, no significant difference among gender was found.

12 - Design of Financial Incentive Programs to Promote Net Zero Energy Buildings

Alireza Ghalebani, University of South Florida, Tampa, FL, United States of America, alireza@mail.usf.edu, Tapas Das

Promoting net zero energy buildings (NZE) is among key carbon emissions reduction approaches in the U.S. and in the EU countries. We present a mixed integer programming (MIP) model to aid determining the minimum thresholds of financial incentives that would spur growth in NZEBs. Several combinations of production tax credit and loan interest rates have been investigated for different commercial buildings in Tampa, FL. The results indicate the threshold values of the incentive program parameters.

13 - Multi-objective Scenario Discovery for Climate Change Adaptation

Julie Shortridge, PhD Student, Johns Hopkins University, 3400 N. Charles St., Ames Hall 317, Baltimore, MD, 21218, United States of America, julieshortridge@gmail.com, Seth Guikema

New methods for decision support under non-probabilistic uncertainty are becoming increasingly popular in the climate change adaptation field. Scenario discovery, as part of the robust decision making framework, uses machine learning to identify multivariate scenarios where a plan or system will perform poorly. In this work, we evaluate different methods for incorporating multiple criteria into the scenario discovery process to assess whether the method used impacts the scenarios identified.

14 - The Unit Commitment Model for Power Interruption Contracts

Lakshmi Palaparambil Dinesh, PhD Candidate, University of Cincinnati, 221 Piedmont Avenue Apt. 21, Cincinnati, OH, 45219, United States of America, lakshmi603@gmail.com, Jeffrey Camm

The term unit commitment implies which power generation units should be turned on or off in a power plant. When the demand for power is high, power could either be bought from the spot market or the customers could be interrupted using a contract. The problem deals with choosing the right set of customers for interruption using a technique called conjoint optimization and hence reducing the overall costs for the supplier.

15 - Virtual Metrology for Copper Clad Laminate Manufacturing

Misuk Kim, Seoul National University, 39-339, Gwanak-ro, Gwanak-gu, Seoul, Korea, Republic of, misuke88@naver.com

Virtual metrology predicts wafer quality properties based on sensor values of the equipment in semiconductor manufacturing. It reduces the cost associated with physical metrology as well as identifies important equipment sensor values. We applied it to copper clad laminate for printed circuit board with data from a Korean manufacturer. We not only obtained prediction models with a high accuracy, but also found a number of important, yet previously unknown to engineers, equipment sensors.

16 - Goodness of Fittest for Multinomial Model with Clustered Data

Zhiheng Xie, PhD Candidate, University of Kentucky, Lexington, KY, 40503, United States of America, zhiheng.xie@uky.edu

Discrete-time Markov chains have been used to analyze the transition of subjects from intact cognition to dementia with transient states, and death as competing risk. We proposed a modified chi-square test statistic which can deal with the clustering effects for the multinomial assumption. We showed our new statistic has a better type I error control when clustering effects presents. We apply the test to the data from the Nun Study, a cohort of 461 participants.

17 - Discrete Event Dynamic Simulation for Modeling a Real Job Shop System

Golshan Madraki, Ohio University, 15 Station St, Apt. F, Athens, OH, 45701, United States of America, gm705913@ohio.edu

A new approach for simulating a job shop system is introduced. The interarrival time of jobs, processing time of machines, time between failures, repair time have general distribution. Previous models consider these parameters deterministic or exponentially distributed. We facilitate estimation of maximum production rate where Buffers capacity, Number of machines in each shop, Number of Lift-truck are efficient

18 - Optimization of Food Production (Ready-To-Eat Meat Sticks)

Rebecca Brusky, Data Science Student, University of Nebraska Omaha, 3602 Lincoln Blvd, Omaha, NE, 68131, United States of America, rbrusky@unomaha.edu, Betty Love

In the production of ready-to-eat meat sticks, the bottlenecks (dependencies) need to be minimized and number of sticks produced needs to be maximized. Dependent components include equipment flow constraints, smoke room duration and cleaning downtime. The largest downtime factor is the required four-hour cleaning when switching to a non-compatible flavor. This poster documents how a six-flavor production line governed by a set of flavor ordering rules and production demands can be optimized.

19 - Rethinking Principal Component Analysis in EEG Classification

Xiaoxia Li, North Dakota State University, 124 East Bison Court, Fargo, ND, 58108-6050, United States of America, xiaoxia.li@ndsu.edu

Principal Component Analysis (PCA) is considered to be a powerful tool in dimension reduction. However, it is worth thinking of the suitability of application for EEG signal data. Two EEG datasets collected from alcoholic and control groups were used to test the prediction accuracy before and after PCA transformation with SVM and KNN methods. Based on the classification results, we found that PCA is not valid in EEG signal processing. We also concern that other factors might be confounding.

20 - Strategic Exclusive Supply Contract for Carbon Fiber Reinforced Plastic in the Aviation Industry

Kenju Akai, The University of Tokyo, 7-3-1 Hongo, Bunkyo-Ku, Tokyo, Japan, akai@css.t.u-tokyo.ac.jp, Kazuma Sakamoto, Nariaki Nishino, Kazuro Kageyama

We investigate the rationality of an exclusive supply contract for Carbon Fiber Reinforced Plastic (CFRP) between Boeing and a Japanese CFRP supplier, Toray. We build a mathematical model of the market for CFRP comprising Toray and the oligopolistic market for aircraft, assuming Airbus, as Boeing's rival. The subgame perfect Nash equilibria show that both Boeing and Toray obtain the higher profits rather than that in the Cournot Competition.

21 - Hand Motion Identification from Electroencephalography Recordings using Recurrent Neural Network

Jinwon An, SNU, 1 Gwanak-ro, Gwanak-gu, Seoul 151-742, Seoul, Korea, Republic of, jinwon@dm.snu.ac.kr, Sungzoon Cho

Neurological disabled patients can be aided by brain-computer interface (BCI) prosthetic devices. Grasp and lift tasks are basic actions that needs to be implemented in those devices. In this study, grasp and lift tasks were analyzed by using electroencephalography (EEG) recordings. Various recurrent neural network models were used. It shows that EEG can identify hand motions such as reaching, grasping, loading and retracting with high accuracy.

22 - On Optimization of Carbon Capture, Utilization, and Storage Supply Chains under Uncertainty

Mahnaz Asghari, Virginia Tech, 1406 University City Blvd., Blacksburg, VA, 24060, United States of America, mahnaz@vt.edu, Hamed Shakouri Ganjavi

Carbon capture, utilization, and storage (CCUS) is a crucial technology to mitigate climate change. Due to the high costs of the technology, a great deal of attention has been focused on how the captured CO₂ can be optimally utilized or stored. We study optimizing CCUS supply chains under uncertain environment. In this poster, we present an algorithm to generate a candidate network for CO₂ transportation and a model for optimizing the utilization and storage of the captured CO₂ in CCUS systems.

23 - On Two-row Chvatal Gomory Cuts

Babak Badri Koohi, Doctoral Student, Virginia Tech, 1406 University City Blvd., Blacksburg, VA, 24060, United States of America, babakbk@vt.edu, Diego Moran

Chvatal-Gomory (CG) cuts are a very important class of cutting planes for solving mixed-integer programs. CG cuts for a polyhedron P are obtained by computing integer hulls of its 1-row relaxations. We study 2-row CG cuts, a generalization of CG cuts that are obtained by computing integer hulls of 2-row relaxations of P. In this poster, we present some basic properties of 2-row CG cuts and discuss their relation to other well-known classes of cuts such as split cuts and (crooked) cross cuts.

24 - Stable Strategic Marriages

James Bailey, Graduate Student, Georgia Institute of Technology, 116 Ponce De Leon Ave NE, Atlanta, GA, 30308, United States of America, james.bailey@gatech.edu, Craig Tovey

The effect of lying on the stability of marriages is a long standing open problem. When men and women behave strategically, an ideal decision mechanism selects a marriage that is (1) stable, and (2) egalitarian, with respect to sincere preferences. We provide a positive result to (1) and a negative result to (2) under two natural conditions. We strengthen current results about the Gale-Shapley algorithm, showing that the woman-optimal marriage is the only obtainable one when men propose.

25 - Decision Analytics for Managing Invasive Wild Pigs

Matthew Brondum, U.S. Army Corps of Engineers, 3909 Halls Ferry Rd., Vicksburg, MS, 39180, United States of America, matthew.c.brondum@usace.army.mil, Igor Linkov, Zach Collier, Buddy Goatcher

Wild pigs pose significant environmental, economic, and social risks to the United States and around the world. A number of wild pig eradication and control measures exist, but many eradication campaigns are ultimately unsuccessful due to a variety of complexities across multiple domains. We are developing a decision analytic tool which will assist affected landowners in deciding which eradication technique best suits their site-specific interests.

26 - The Regional Logistics Hubs Location Problem Based on the Topsis and Genetic Algorithm: A Case of Sichuan

Si Chen, Southwest Jiaotong University, #1 Jingqu Road, Emei, China, chensi@swjtu.edu.cn, Qian Guo, Mi Gan

The regional logistics demands, which are the key factors for logistics hubs location problem, are changing with the developing regional economic and the structure of industry. Then we aim to modeling this problem with an integrated approach of multi-criteria decision making and integer programming model. And the real data case of Sichuan is employed to verify the feasibility of proposed models and approach. Moreover, the numerical results are corresponding to the actual logistics situation.

27 - Promotional Mix and Pricing Strategy with Risk-averse Buyers in the Age of Social Media

Wei-yu Kevin Chiang, City University of Hong Kong, P7614, Academic 1, Hong Kong, Hong Kong - PRC, wchiang@cityu.edu.hk, Qiao Wang, Lu Qiang

How should a firm minimize the wastage on marketing expenditure with an efficient promotional mix? The firm has two promotional strategies, hype advertising campaign (HAC), which refers to a basic publicity that makes consumers aware of the product's existence, and referral reward program (RRP), which refers to an incentive-based program that offers rewards to the existing buyers for bringing in new buyers. We study the firm's optimal promotional mix and pricing strategy with risk-averse buyers.

28 - A Game Theoretic Analysis of Electricity Time-of-use (TOU) Tariff for Residential Customers

Dong Gu Choi, Senior Researcher, Korea Institute of Energy Research, 152 Gajeong-ro, Yuseong-gu, Daejeon, 34129, Korea, Republic of, doonggus@gmail.com, Valerie Thomas

We properly formulate a game-theoretic model for analyzing not only the optimal behaviors of both an electric utility and residential customers but also their monetary gains or losses under a TOU tariff. With two heterogeneous customer types in terms of consumption pattern, we identify that a win-win situation is not possible. Also, we emphasize our analytic results by describing a numerical example, and we discuss the implications of our results for electric utilities and regulatory agencies.

29 - Why Classical Hybrids are so Risky for Entrepreneurs, and What to do About it

Gaston De Los Reyes, Assistant Professor, George Washington University School of Business, 2201 G St. NW, Funger 615, Washington, DC, 20008, United States of America, gdlr@gwu.edu

Williamson (1991) insufficiently characterized the institutions of hybrid governance, emphasizing forms that feature neoclassical devices to co-govern past contract close. Entrepreneurs, however, frequently resort to hybrids of classical form, lacking terms to protect from 'lawful' opportunism in case of disruption. I explicate the implications, drawing upon my dissertation study of contract law. I discuss a novel institutional solution and managerial strategies for the status quo.

30 - An Integrated Make-pack-route Problem of Fresh Agri-food Online Retailing in China

Mu Du, Institute of Systems Engineering, Dalian University of Technology, No.2 Linggong Road, Dalian, China, dumu.dlut@gmail.com, Xiangpei Hu, Nan Kong

Fresh agri-food sold by farm-to-home online retail is produced through a make-pack-route process at farm's distribution centers. Due to the large variety of produce and high cost of intermediate storage, an integrated decision model is employed to coordinate these different operations. We introduce a make-pack-route model that minimizes the total cost and propose an effective heuristic method. We report a case study based on real-world business practice in China.

31 - Decision Analytic Modeling of the Five Competitive Forces in the Residential Solar Industry

Karim Farhat, PhD Candidate, Management Science and Engineering, Stanford University, 475 Via Ortega, Huang Engineering Center 245A, Stanford, CA, 94305, United States of America, kfarhat@stanford.edu

Using a first-of-kind quantitative decision-analytic model of Michael Porter's five competitive forces, we investigate an international solar firm's plan to enter and properly position in the US residential solar PV industry. Applying a Bayesian probabilistic approach, the model assesses the uncertain profitability of the overall competitive market, and it provides several insights on the firm's go-to-market strategy, including: regional focus, vertical integration, and customer finance.

32 - Portfolio Analysis for Army Corps of Engineers Business Line Integration

Cate Fox-lent, US Army Corps of Engineers, 333 Massachusetts Ave 7, Arlington, MA, 02474, United States of America, catherine.fox-lent@usace.army.mil, Matthew Bates, Christy Foran

Portfolio analysis is used to demonstrate opportunities to leverage synergies across business lines. Coastal systems can benefit from reduced cost, reduced environmental impact, or increased project performance when planning for Navigation, Environmental Restoration, and Coastal Storm Risk Management projects is intentionally integrated. Long-term monitoring to improve quantification of project interactions can lead to improved utility of this type of analysis.

33 - Incorporating Passenger Recovery Decisions During Airline Operations Recovery

Dinakar Gade, Senior Operations Research, Sabre, 3150 Sabre Drive, Southlake, TX, 76092, United States of America, dinakar.gade@sabre.com, Sureshan Karichery, Shahram Shahinpour

Airlines are faced with several types of disruptions that impede regular operations. The Sabre AirCentre Recovery Manager (Ops) helps airlines quickly recover both the schedule and aircraft rotations from disruptions. We introduce a new feature of Recovery Manager called the Passenger Flow Module (PFM) that incorporates passenger re-accommodation decisions during schedule recovery. The solutions generated reduce the impact to passenger flows in the network and reduce passenger inconvenience.

34 - The Impact of Roadway Traffic Flow in Regional Network Design Problem

Mi Gan, Dr, Southwest Jiaotong University, 111 N 2nd Bound Erhuang Road, Chengdu, SC, 610031, China, migang@swjtu.cn, Si Chen

In order to solving the problem that the existed logistics network design models(LND) are lack of consider on roadway traffic flow. The uncover degree function of logistics facility nodes based on impedance function was constructed. Then, integrated logistics network design models and corresponding algorithms were proposed with the basis of uncover degree function. The comparison of general LND models and models we developed by real case reveals the impact of roadway traffic flow on LND.

35 - Evaluating Zoning Strategies for Demand Responsive Transit Systems

Eric Gonzales, University of Massachusetts, Amherst, Department of Civil & Environmental Eng., 130 Natural Resources Road, Amherst, MA, 01003, United States of America, gonzales@umass.edu, Mahour Rahimi

DRT systems often divide their service area into smaller regions in order to simplify operations. However, this management strategy can create inefficiencies. This paper develops an analytical formulation to explain the relation between agency cost and zoning strategies. The two main objectives are to understand when a service area needs to be divided into smaller regions to reduce the total costs of a DRT system and how the split should be done in order to be the most cost effective.

36 - Supply Enhancement in Capital-constraint Assembly System: Financing Suppliers or Dual Sourcing?

Chaocheng Gu, PhD Candidate, Huazhong University of Science and Technology, 1037 Luoyu Rd., 326 School of Management, Wuhan, HB, 430074, China, chaocheng@hust.edu.cn, Shiming Deng

We study two mechanisms for supply reliability enhancement in capital constraint assembly system. Financial mechanism. Three financial strategies are examined; that is, bank finance, buyer finance and a combined peer finance. The manufacturer can also avail of a more expensive backup sourcing. When bank finance and buyer

finance both present, the manufacturer always prefer buyer finance. The optimal mechanism switches back and forth as the equilibrium order quantity increases.

37 - Rating Aggregation in Multi-dimensional Rating Systems: How do Reviewers Form Overall Ratings?

Dominik Gutt, PhD Candidate, University of Paderborn, Warburger Str. 100, Paderborn, 33098, Germany, dominik.gutt@wiwi.uni-paderborn.de, Dennis Kundisch

A recent strain of literature on online product reviews has focused in particular on multi-dimensional product reviews. Multi-dimensional product reviews usually allow the reviewer to rate a product first, based on one overall rating, and second, based on a set of several sub-dimensions. Mostly, overall ratings do not equal e.g. the calculated mean of the sub-dimensions. Our research will shed light on the question, which heuristics reviewers use to form an overall rating.

38 - Cyclic Timetabling and Platforming of Mixed Train Types on a Bidirectional Railway Line

Mojtaba Heydar, University of Newcastle, University Drive, Callaghan, Australia, mojtaba.heydar@newcastle.edu.au

We present a mixed integer program for cyclic train timetabling and platforming problem. It is assumed that there are different types of trains moving on a single, bidirectional railway line. Two objectives: timetable cycle length and total journey time of all train types are considered. Constraints include infrastructure characteristics, safety regulations, and operational rules. Heuristics and exact methods are combined with math model to solve large problem instances are solved and discussed.

39 - The Impact of Platform Update Interval on Platform Diffusion in a Cooperative Mobile Ecosystem

Yoo S. Hong, Professor, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul, 08826, Korea, Republic of, yhong@snu.ac.kr, Gyesik Oh

Periodic platform upgrading is one of the effective strategies for potential participants as well as existing stakeholders. However, the diffusion of an updated platform is ineffective in a cooperative mobile ecosystem where a manufacturer modifies a platform released as open-source software on its smartphones. This paper models the effectiveness of platform diffusion with respect to the platform update interval in consideration of the manufacturer's decision mechanism.

40 - Operational Health Information Exchange Platform

Kang-yu Hsu, PhD Student, Purdue University, 610 Purdue Mall, West Lafayette, IN, 47907, United States of America, hsu66@purdue.edu, Poching Delaurentis, Yuehwen Yih, Rich Zink

Health Information Exchange (HIE) has been focusing on utilizing patient electronic health records to improve service quality and patient safety. The exploitation of HIE, however, can go beyond patient records. This study aims to build an infusion drug limit library database and embedded analytical tools as a pilot for the operational HIE platform that may house and utilize other types of data with similar usage and functionality.

41 - Design and Pricing of Crop Insurance Based on NDVI

Jing Huang, Hohai University, No.8 Focheng Road, Nanjing, China, huangjingshow@hotmail.com, Anna Shi, Huimin Wang, Jinping Tong

The crop index-insurance is a possible approach to solve the dilemmas in traditional crop insurance. In this study, the crop insurance contract is designed based on remote sensed Normalized Difference Vegetation Index (NDVI). Then the crop yield estimation models in different expectations is proposed. Lastly, the pure rate of premium is presented under different triggers using nonparametric kernel density model. The paddy rice in three cities in Yunnan Province, China are chosen as an example.

42 - An Infinite Time Horizon Portfolio Optimization Model with Delays

Azmat Hussain, PhD Student, North Carolina State University, Raleigh, NC, 27606, United States of America, ahussai@ncsu.edu

We consider a portfolio optimization problem over an infinite time horizon. The problem is formulated as a stochastic control problem and the state is governed by a stochastic process with delay. The goal is to choose investment and consumption controls such that the total expected discounted utility is maximized. Under some conditions, the corresponding HJB equations for exponential, log and HARA utility functions are solved and verification results and the optimal control are also established.

43 - Optimization of the Order-up-to and Reorder Levels for Each Item in the Forward Area of Warehouse

Takashi Irohara, Professor, Sophia University, 7-1 Kioi-cho, Chiyodaku, Tokyo, 1028554, Japan, irohara@sophia.ac.jp

We propose an optimization procedure to solve a forward reserve allocation problem and determine the order-up-to and reorder levels for each item in the forward area. In the target warehouse or distribution center, the forward area stores items in a unit of piece for efficient order picking and the reserve area stores items in a unit of case. There is a tradeoff between replenishment frequency and inventory space in the forward area. We show the effectiveness of the proposed method.

44 - Net Energy Analysis of Wind/Solar Generation and Electric Vehicles: Are They as Green as They Seem?

Tongdan Jin, Texas State University, 601 University Drive, San Marcos, TX, United States of America, tj17@txstate.edu, Joseph Duke

Wind and solar energy are widely hailed as "free" and "clean" energy. Similarly, electric vehicles (EV) that run on batteries are considered to be much greener than their gasoline counterparts. But is it possible that the environmental benefits from new energy and transport technologies may be exaggerated? The goal of this research is to perform an analysis of the lifecycle CO₂ emissions, from wind turbines, solar photovoltaic panels, and EV, to weigh together the cost and benefits.

45 - Design and Modelling of Crowdsourced Enabled Relay System for Urban Parcel Delivery

Nabin Kaffle, Research Assistant, UIC, 842 W Taylor St, Chicago, IL, 60616, United States of America, nkaffle3@uic.edu, Bo Zou, Jane Lin

We propose a new relay-based intermodal system for urban parcel delivery enabled by crowdsourcing technology. A mathematical model is formulated which (i) identifies relay locations and their visiting order by the delivery truck; and (ii) uses local green modes in place of the delivery truck for last-leg pickup/delivery from the chosen relay points, where crowdsources are selected through auction. We develop a heuristic algorithm to solve the model.

46 - Automatic Sentiment Words Extraction from Online Reviews for Product Comparison

Eunji Kim, Data Mining Lab., 39-339, Seoul Natl' Univ., Gwanak-ro, Gwanak-gu, Seoul, Korea, Republic of, eunjikim@dm.snu.ac.kr, Sungzoon Cho

Online customer reviews are potentially a great source for improving the quality of products or services. However, it is technically tough to automate it because the review data is vast and unstructured. We propose a text mining approach that can handle a context dependent sentiment of a word in reviews. A word is associated with different sentiment values for different product categories. This enables us to extract pros and cons of a product when compared to similar products.

47 - A Cooperative Game Theory Approach to Highway Cost Allocation

Saurav Kumar Dubey, PhD Student Department of Industrial and Systems Engineering, University of Tennessee at Knoxville, 1615 Laurel Avenue, Box-203, Knoxville, TN, 37916, United States of America, skumardu@vols.utk.edu, Alberto Garcia-Diaz

Traditional methods of allocating highway cost among vehicle classes include proportional and incremental procedures. Two non-traditional game-theoretic concepts of Least Core and Discrete Aumann-Shapley Value will be shown to be effective in integrating Traffic Capacity and Pavement Thickness requirements. The Nucleolus solution concept will be implemented to strengthen the core stability of Highway Cost Allocation game and reinforce the principles of fairness and rationality.

48 - Incorporating the Impact of Product Reviews on Future Propensity to Purchase

Matthew Lanham, Doctoral Candidate, Virginia Tech, Dept. of BIT (0235), Blacksburg, VA, 24061, United States of America, lanham@vt.edu, Ralph Badinelli

This study investigates the potential impact that publically accessible product reviews might have on future sales and propensity to purchase for a national retailer and provides a means to incorporate this knowledge posteriori to already derived demand forecasts. The study is motivated by the emergence of Big Data Analytics (BDA) in the retail industry to improve consumer experience, products, and services.

49 - Active Fund Performance: A Full-distributional Analysis

Yongjae Lee, Korea Advanced Institution of Science and Technology, 291 Daehak-ro, Yuseong-gu, Daejeon, 34141, Korea, Republic of, yongjae.lee@kaist.ac.kr, William T. Ziemba, Woo Chang Kim

Performance evaluation of active funds has been eagerly studied by many scholars in finance. They have compared the performance distribution of active funds to relevant benchmarks. Most of these studies were naïve comparisons of a full distribution to a small number of points that do not reveal distributional characteristics. Therefore, we analyze the Sharpe ratio distributions of active funds in comparison with analytically derived Sharpe ratio distributions of all feasible portfolios.

50 - Behavioral Ordering Decision under Downward Substitution

Yan Li, Dr., China University of Mining and Technology, Ding 11, Xueyuan Road, Beijing, China, liyan@cumtb.edu.cn, Bojiao Mu

Downward substitution is one common strategy for selling multi-class products. The previous research assumes perfect rationality. This paper relaxes the assumption and utilizes the MNL model to depict the ordering behaviors for substitutable products. We compare the ordering quantity considering substitution with that without substitution. The substitution effect shows non-monotonicity regarding the extent of rationality and is superior to the one predicted by rationality.

51 - Optimal Capital Structure and Credit Spread under Partial Information

Bo Liu, UESTC, No.4, Section 2, North Jianshe Rd., Chengdu, China, liub@uestc.edu.cn

The paper first incorporates partial information friction to extend the classic optimal capital structure model. We derive closed-form results for the value of risky debt, credit spread, default threshold, and for optimal capital structure. We find that under partial information, dynamic learning significantly increases the optimal coupon level and firm's leverage, and improves the tax advantage to debt.

52 - Optimal Production and Inventory Policy in Solar Photovoltaic Supply Chain

Xiangrong Liu, Bridgewater State University, 95 Grove Street, Bridgewater, PA, United States of America, Xiangrong.Liu@bridgew.edu, Chuanghui Xiong

The development and utilization of solar photovoltaic (PV) energy has progressed at a very fast pace. With decreasing price of PV module and uncertain government incentives, this research models the production and inventory strategies in the setting of a PV supply chain with a PV manufacturer, an installer and an end customer. Based on the manufacturer's and installer's optimal decision, this study discusses how to improve supply chain performance through parameters setting in contract design.

53 - Optimal Stopping Game with Investment Spillover Effect

Akira Maeda, Professor, The University of Tokyo, 3-8-1 Komaba, Meguro, Tokyo, 153-8902, Japan, maeda@global.c.u-tokyo.ac.jp, Motoh Tsujimura, Ryuta Takashima

The purpose of this study is to analyze the game over optimal choice of firm's investment time, focusing on the case that there is positive externality in the effect of investment. We consider a situation where firms can increase their subsequent revenue stream by making an irreversible investment, and the investment has a spillover effect to other firms. This setup describes gaming over optimal stopping problems. We examine the property of the subgame perfect Nash equilibrium.

54 - Recent Trends in Blood Banking Systems: A Supply Chain Perspective

Amir Masoumi, Assistant Professor Of Management, Manhattan College, 4513 Manhattan College Parkway, DLS 504, Riverdale, NY, 10471, United States of America, amir.masoumi@manhattan.edu

Blood service operations are a key component of the healthcare system all over the world. In the US prior to 2008, there were several reported cases of blood shortages; however, the scenario has significantly changed thereafter. The total number of whole blood and red blood cells collected annually decreased from 17.3 to 15.7 million units during the 2008-2011 period. We investigate the recent trends in supply and demand management of blood banking systems from a logistics perspective.

55 - Optimal Sizing of a Price-maker Energy Storage Facility Considering Uncertainty

Ehsan Nasrolahpour, University of Calgary, 2500 University Dr. NW, Calgary, AB, Canada, enasrola@ucalgary.ca

This paper proposes a strategic investment model for a price-maker energy storage facility considering market uncertainties. The proposed model is a stochastic bi-level optimization problem where planning and operation decisions of the energy storage facility are made in the upper level, and market clearing is modeled in the lower level under different operating conditions. The bi-level optimization problem is recast as an Mathematical Program with Equilibrium Constraints (MPEC).

56 - Army Materiel Systems Analysis Activity (AMSAA)

Joseph Olah, AMSAA, 392 Hopkins Road, APG, MD, United States of America, joseph.m.olah.civ@mail.mil, Tiffany Gutowski

AMSAA is the Army's independent source of data, modeling & simulation, and materiel lifecycle & logistics systems analysis to support the Army's Equipping, Sustaining and Warfighting decisions. AMSAA's Core Competencies are Independent Materiel Performance and Effectiveness Analysis, Independent Logistics Analysis, Field Data Collection and Analysis, Program Management of DoD's JTCG-ME Program, Strategic/Corporate Level Decision Analysis, and Certified System Level Performance Data.

57 - Reinforcement Learning Algorithm for Blood Glucose Control in Diabetic Patients

Mahsa Oroojeni Mohammad Ja, Northeastern University, 334 Snell Engineering, Boston, MA, United States of America, oroojeni.m@husky.neu.edu

In this paper a reinforcement learning algorithm is proposed for regulating the blood glucose level of Type I diabetic patients. In the proposed reinforcement learning algorithm body weight and A1C level define the state of a diabetic patient. For the agent, insulin dose levels constitute the actions. As a result of a patient's treatment, after each time step t , the patient receives a numerical reward depending on the response of the patient's health condition.

58 - Modeling the Stockist

Omkar Palsule Desai, Associate Professor, Indian Institute of Management Indore, Prabandh Shikhar, Rau Pithampur Road, Indore, MA, 453556, India, omkardpd@iimahd.ernet.in, Ananth Iyer

We focus on the problem of distribution to the millions of small shops that constitute the retail sector in India, as well as many other developing countries. We model the role of a stockist - a supply chain entity whose role is to facilitate distribution. We use a principal agent model structure, with a complements or substitutes relationship between manufacturer assistance and retailer impact, to understand the optimal contract structure, i.e., level of assistance and associated retail margin.

59 - Automatic Design of Methods for Combinatorial Optimization Problems

Lucas Parada, General Manager, Universidad de Concepcion, Avenida Inglesa 134 / 504, Concepcion, 4040409, Chile, lucasparada20@gmail.com

Designing an method to solve an optimization problem is a complex intellectual task. However, to design an algorithm is also an optimization problem. To solve this second level problem we combine and evolve elementary algorithmic components through genetic programming. The produced algorithms show promising features such as low solution errors and small computational times for several classical optimization problems.

60 - Bayesian Adjusted Uplift Modeling for Direct Mail Campaign

Yidong Peng, Conclusive Analytics, 13620 Reese Boulevard E. Suite 300, Huntersville, NC, 28078, United States of America, yidong.peng@ndsu.edu

The study compares the performance of traditional respond model, uplift model and our proposed Bayesian adjusted uplift model on selecting customers for direct mail campaign. The proposed model applies customers' responses to historical campaign to generate the posterior uplift estimates based on result of uplift model. A case study is conducted to verify that the proposed model provides higher sales lift by using the real monthly directly campaign data from a top auto-parts retail company.

61 - How to Make Big Blue (IBM) Business Segments Fast and Responsive

Alan Picacchio, Senior Technical Staff Member / Lead Request For Service Business Analyst In Rfs, IBM, 2455 South Road, Poughkeepsie, NY, 12590, United States of America, alanpic@us.ibm.com, Jose Cano, Skip Jahn

This poster will describe how a big company like IBM can be nimble and fast and responsive. Over the past 3 years - in the growth segment (hundreds of millions of dollars yearly) of IBM's Global Technology Services unit, an impactful set of analytics and actions have been deployed to dramatically improve business revenue by tens of millions of dollars, via a 65% improvement in cycle time.

62 - Continuum Approximation Modeling of Freight Distribution Systems

Mahour Rahimi, University of Massachusetts, Amherst, 139 Marston Hall, 130 Natural Resources Rd., Amherst, MA, 01003, United States of America, mrahimi@umass.edu, Eric Gonzales

This study presents a continuous approximation model for truck deliveries which relate the operating parameters to the characteristics of the service and network, service area, and demand rate. The objective of this study is to minimize the total cost of distributing multicommodity freight from an origin to randomly distributed points, with or without transshipments, and within a limited amount of time. Two different distribution methods are considered: peddling, and peddling with transshipment.

63 - Modeling Relation Between Natural Problems and Formal Structures: A Health Systems Application

Edmond Ramly, University of Wisconsin-Madison, 20 Sherman Terrace, Unit 6, Madison, WI, 53704, United States of America, edmond.ramly@gmail.com

We formulate a class of cyber-social systems where formal (mathematical) and natural (problem structuring) operations research are complementary and insufficient separately. We adapt the Hertz-Rosen Modeling Relation from systems biology as a unifying framework relating natural and formal systems with encoding and decoding operations. We present a category-theoretic axiomatization and a demonstration of complementarity in a health IT evaluation case.

64 - Analytic Network Process: Assisting Computers to Think Like Humans?

Elena Rokou, Chief Research Officer, Creative Decisions Foundation, Ellsworth Ave, Pittsburgh, PA, United States of America, erokou@gmail.com

Whatever your stance is on Artificial intelligence, it is generally admitted that it has not yet enabled computers to make satisfactory decisions. Methods like Neural Networks, can train computers to make decisions for simpler types of tasks, but the ANP can factor in morality, ethics and broader considerations associated with complex decisions. We want computers to think more like humans, thoughtful and compassionate in their choices, and ANP enables this type of higher-level decision-making.

65 - An Energy-aware Multiobjective Scheduling Optimization Framework for Sustainable Manufacturing

Saeed Rubaiee, Wichita State University, 2119 Malcolm Street, Wichita, KS, 67208, United States of America, ssal21@gmail.com, Mehmet Bayram Yildirim

The goal of this paper is to minimize the total tardiness and total energy cost under time-of-use electricity tariffs, where energy prices vary hourly, on a non-preemptive single-machine. The problem is modeled using a mixed-integer multiobjective mathematical programming model to obtain an approximate Pareto front. Results show that the proposed multiobjective NSGA-II genetic algorithm finds a good approximate Pareto front with better diverse solutions and shorter computational CPU times.

66 - Early Warning Methods and Predictive Models for Hospital Risk and Readmissions

Jakka Sairamesh, CEO And President, CapsicoHealth, Inc, 2225 E Bayshore Rd STE 200, Palo Alto, CA, 94303, United States of America, ramesh@capsicohealth.com, Ruichen Rong

This poster and research abstracts presents the effectiveness of methods for improving patient quality outcomes (e.g. reducing 30-day readmissions) based on clinical and cost based factors. We will present early-warning methods to predict patients at risk of 30-day readmissions based on past admissions, ER visit rates, mortality rates, and charges. The dominant factors includes clinical risk, costs, emergency room visits and mortality rates. The prediction showed nearly 88 percent accuracy.

67 - Software License Optimization Model for Software Asset Management

Seungbae Sim, Korea Institute for Defense Analyses, 37 Hoegi-ro, Seoul, Korea, Republic of, sbsim@kida.re.kr, Cheonsoo Yoo

Information System can be generally comprised of hardware and software. As software has been getting more important than hardware, most organizations must reduce increasing software costs and control software assets. Especially, commercial software can be licensed to end-users. We propose the mathematical model considering the complexity of software license types. Also, the case example is presented for validating the proposed optimization model.

68 - Optimization Problems Arising in Stability Analysis of Discrete Time Recurrent Neural Networks

Jayant Singh, Dept. of Mathematics, North Dakota State University, 1210 Albrecht Boulevard Minard 408, Fargo, ND, 58102, United States of America, Jayant.Singh@ndsu.edu

We consider the method of Reduction of Dissipativity Domain to prove global Lyapunov stability of Discrete Time Recurrent Neural Networks. It involves a multi-step procedure with maximization of special nonconvex functions over polytopes on every step. We derive conditions which guarantee an existence of at most one point of local maximum for such functions over every hyperplane. This nontrivial result is valid for wide range of neuron transfer functions.

69 - Modular Function Deployment Adapted to the Project Typology in the Development of Modular Products

Monique Sonogo, Universidade Federal do Rio Grande do Sul, Av. Osvaldo Aranha 99 - PPGEP 5Jandar, 90035-190, Porto Alegre, Brazil, hgmonique@gmail.com, Angela Danilevicz, Márcia Echeveste

Modular Function Deployment (MFD) is one of the best-known methods for modularization in New Product Development. However, this method is not tailored to different project typologies. We propose an adaptation for the MFD method for different levels of complexity and novelty of each project. This adaptation provides companies with the possibility of choosing the setting of stages and tools that best fit their specific projects by customizing the application of the MFD.

70 - Enriching Competitiveness and Connectivity with HLED-inspired Air Service Agreement

Andrew Stapleton, Professor Of Supply Chain Management, University of Wisconsin La Crosse, 1725 State Street, La Crosse, WI 54650, La Crosse, WI, 54650, United States of America, Astapleton@uwlax.edu

U.S. cargo and passenger airlines will have a greater opportunity to compete for a larger share of freight trade and traffic between the U.S. and Mexico when the new Air Services Agreement (ASA) takes effect January 2016. It is a key element

of the US-Mexico High Level Economic Dialogue (HLED), that aims to promote competitiveness and connectivity, foster economic growth, productivity and innovation, and partner for regional and global leadership.

71 - The Value of Flexibility in Dynamic Ride-sharing

Mitja Stiglic, University of Ljubljana, Kardeljeva Ploščad 17, Ljubljana, 1000, Slovenia, mitja.stiglic@ef.uni-lj.si, Mirko Gradisar, Niels Agatz, Martin Savelsbergh

We consider a dynamic ride-sharing system that allows people with similar itineraries and time schedules to share rides. Participants are willing to somewhat adapt their trip plans in order to be matched. We study how participants' flexibility in departure times and the willingness of drivers to perform detours influence the matching rate and the sustainability of the system. We conduct an extensive computational study to quantify the impact on system performance in a variety of settings.

72 - Managing a Bike-sharing System using Wireless Mobility Data

Rahul Swamy, University at Buffalo, 49 Englewood (Lower), Buffalo, NY, 14214, United States of America, rahulswa@buffalo.edu, Jose Walteros

This research aims to provide a mathematical framework for operating a campus bike-sharing system. We use wireless network (WiFi) usage logs to generate a detailed estimation of the inter-building demand across campus. We propose solving a sequence of MILPs to determine: 1) the optimal location of bike stations, 2) the number of bikes to be added to or removed from each station every hour to satisfy the demand-supply needs, and 3) the redistribution logistics, while minimizing overall costs.

73 - Configurations of Distribution Strategies

Jing Tang, Em-lyon Business School, 23 Avenue Guy de Collongueresear, Ecully, France, TJ11.Jessie@gmail.com, Yeming Gong

Based on 124 quantitative samples with both first-hand and second hand data, as well as 56 qualitative samples, this paper examines the strategic fit of distribution strategies from the perspective of configuration theory. We find that the fit between operational decisions including infrastructural and structural decisions, and operational competencies including cost and flexibility, has an important effect on business performance.

74 - Teaching Machine Learning Methods Based on Systematic Approach Derived from Potential Theory

Nadia Udler, Fordham University, 113 West 60 St, New York, NY, United States of America, nadiakap@optonline.net

Many real word problems can be reduced to black box optimization. One of the challenges in the design of black box optimization software is identifying a minimal set of modules for building hybrids for real word applications. Existing software provides such building blocks but they are heuristic thus difficult to teach. We discuss black box optimization library based on systematic approach derived from potential theory. It can be used as educational tool to teach machine learning techniques.

75 - Optimizing Player Lineups in Daily Fantasy Sports

Nicholas Valentour, Graduate Student, University of Nebraska Omaha, Department of Mathematics, Omaha, NE, United States of America, nvalentour@gmail.com, Betty Love

The growing market of online fantasy sports has increased demand for providers of daily player projections and optimal fantasy lineups. Fantasy lineup optimization is a variant of the multiple choice knapsack problem. We develop an integer linear programming algorithm to identify optimal daily lineups. Further, we combine the algorithm with forecasting to examine the overall fantasy performance on historical basketball data.

76 - Design and Operation of a Last Mile Transportation System

Hai Wang, MIT ORC, 2D 550 Memorial Drive, Cambridge, MA, 02139, United States of America, haiwang@smu.edu.sg

The Last Mile Problem refers to the provision of travel service from the nearest public transportation node to a home or office. Last Mile Transportation Systems (LMTS) are critical extensions to traditional public transit systems. We study the design and operation of a LMTS from three perspectives: (1) performance evaluation from a queueing perspective; (2) system operation from an optimization perspective; and (3) demand estimation from an inference perspective.

77 - Competition Strategies of Platform-based Retailing

Man Wang, Guanghua School of Management, Peking University, No.5 Yiheyuan Road Haidian District, Beijing, China, dream26@pku.edu.cn, Lihua Chen

While collaborating with third-party sellers via opening infrastructure online, platform-based retailers and third-party sellers run into a head-to-head price competition. We show that when the inventory of the platform-based retailer is sufficient, higher service quality can bring larger competitive profits. However, it may not always be optimal for a platform-based retailer to improve its service quality. The platform-based retailer may be worse off when the inventory is shortage.

78 - Using Past Scores and Regularization to Create a Winning NFL Betting Model

Eric Webb, Graduate Student, Indiana University, 1309 E. 10th Street, Bloomington, IN, 47405, United States of America, ermwebb@indiana.edu, Wayne Winston

Is the National Football League betting market efficient? We have devised a profitable betting model that would win 52.9% of the 7,554 bets against the spread it would have made over 33 seasons. Scores from previous weeks are used to estimate the point value of each team's offense and defense. These values predict next week's scores, and a bet is placed against the advertised spread. The sum of squares of offensive/defensive point values are constrained to be less than a regularization constant.

79 - Self-organized Deliberative Agent and its Application in Medical Claim Editing

Jack Xue, Exec. Application Architect, National Government Services, Anthem, 8115 Knue St., Indianapolis, IN, 46250, United States of America, xinjian.xue@anthem.com

In this system each agent self-adjusts its organization per environments before execution and optimizes itself both in structure and in execution steps to meet Service Level Agreement. The scheduling algorithm is formatted as an LP or MILP then generalized to stochastic with uncertainty in phase transitions. The efficacy is demonstrated in a medical claim editing system that identifies irregularities in million claims with calculations of terabyte current and historical data, in near real-time.

80 - Behavioral Analysis of Participants in Community Outreach Intervention Projects

Haoxiang Yang, Northwestern University, 2145 Sheridan Road, Room C151, Evanston, IL, 60208, United States of America, haoxiangyang2019@u.northwestern.edu, David Morton, Alexander Gutfraind

The Community Outreach Intervention Projects (COIP) serves the Chicago metropolitan area, providing support for drug users to help prevent infectious diseases. Using about 10 years of data, we study the behavior of participants in COIP's syringe exchange program, focusing on the temporal process governing their visits to storefronts and demographics. With a better understanding of the participants' behavior, we aim to help develop an improved marketing plan for COIP.

81 - A Schatten-p Norm Perturbation Inequality and its Application in Low Rank Matrix Recovery

Man Chung Yue, The Chinese University of Hong Kong, RM 2511, Man Tai House, Tsz Man Est., Tsz Wan Shan, KLN, Hong Kong, Hong Kong - PRC, mcyue@se.cuhk.edu.hk, Anthony Man-cho So

Low-rank matrix recovery, with its applications in finance, network localization, etc, has recently attracted intense research and can be formulated as a rank minimization. Because of the NP-hardness, a common heuristic is to use the Schatten-p norm minimization as a surrogate. However, the equivalence property of this remains elusive and hinges on a conjectured matrix inequality. We prove this conjecture and derive sufficient conditions for low-rank matrix recovery using Schatten-p heuristics.

82 - Demand Prediction and Two-stage Inventory Policy for an Online Flash Sale Retailer

Mengzhenyu Zhang, University of Michigan, Stephen M. Ross School of Business, 701 Tappan Ave, Ann Arbor, MI, 48109, United States of America, zhenyuzh@umich.edu

We show the work cooperated with an online flash sale retailer in China. With millions history sales records, we use machine learning techniques to predict demand and propose a two stage inventory policy, which requires to response quickly to early-hour real sales and restock inventory thereafter. A model is built to explain positive and negative effects of our policy. Experimenting on real data, we help this firm increase profit by approximately 18% and reduce remaining inventory by over 50%.

83 - Heuristics for Bicycle Sharing System Repositioning Problem

Mary Kurz, Clemson University, 110 Freeman Hall, Clemson, SC, 29634, United States of America, mkurz@clemson.edu, Ling Zu

This paper studies the static bicycle repositioning problem with real NYC Citi system data. It selects a subset of stations to visit, sequences them, and determines the pick-up/drop off quantities in each visited station. The study incorporates real problem characteristics by minimizing total penalties of lacking/ overflowing bicycles and routing cost. A Variable Neighborhood Search heuristic is introduced to solve the described problem.

84 - Ranking Universities: Practices, Problems and Way Forward

Muhammad Mukhtar, Professor, American University of Ras Al Khaimah, (AURAK), Ras Al Khaimah 10021, United Arab Emirates, mukhtar.muhammad@gmail.com, Sarah Mukhtar, Zahida Parveen, Brian Wigdahl

We report here a comparison of various global ranking systems of universities and their impacts in the society. Five global ranking systems parameters evaluations revealed that Times Higher Education Ranking System is more appropriate when compared with other ranking systems. Our analyses revealed that discipline wise ranking by various global rankers are creating dilemmas for the parents and public to decide about their children education. We propose normalization of ranking systems.

Monday, 1:30pm - 3:00pm**■ MC01**

01-Room 301, Marriott

Military O.R. and Applications V

Sponsor: Military Applications

Sponsored Session

Chair: Michael Hirsch, ISEA TEK, 620 N. Wymore Rd., Ste. 260, Maitland, FL, 32751, United States of America, mhirsch@iseatek.com

1 - Predicting the Use of Violence using Machine Learning Methods

Erkam Guresen, KHO, Dikmen, Ankara, Turkey, erkamguresen@gmail.com, Salih Tutun, Gulgun Kayakutlu

Use of Violence by Ethno-Political Organizations is threatening not only individually countries but also all humanity. As a consequence governments are obliged to take measures in their budget for this threat. Obviously it does not mean that whole of security budgets consist of spending for Use of Violence, however it has important effects on them. For all these reasons, the aim of this study is to examine the predetermine models for use of violence.

2 - Unmanned Aerial Vehicle Routing in the Presence of Threats

Kamil Alotaibi, Taibah University, College of Engineering, P.O. Box 344, Almadinah Almunawwarah, PC41411, Saudi Arabia, kamilalotaibi@hotmail.com, Jay Rosenberger, Siriwat Visoldilokpun, Stephen Mattingly

We study the routing of Unmanned Aerial Vehicles (UAVs) in the presence of enemy threats. We formulate a mixed integer linear program that maximizes the total number of visited targets for multiple UAVs while maintaining both the route travel time and the total threat level to predetermined constant parameters. Several waypoint generation methods are proposed. Branch and price is used to solve the problem. A computational study is done and results for different scenarios are presented.

3 - Variants of the Target Visitation Problem

Michael Hirsch, ISEA TEK, 620 N. Wymore Rd., Ste. 260, Maitland, FL, 32751, United States of America, mhirsch@iseatek.com

In this research, we consider the target visitation problem, and discuss some variants. Mathematical formulations are derived, heuristics are developed, and results are presented.

■ MC02

02-Room 302, Marriott

Logistics and Transportation Security

Cluster: Homeland Security

Invited Session

Chair: Gary Gaukler, Drucker School of Management, Claremont Graduate University, Claremont, CA, 91711, United States of America, Gary.Gaukler@cgu.edu

1 - Cyber Vulnerability Models

Murat Karatas, The University of Texas at Austin, 1 University Station Austin TX 78712, United States of America, mkaratas@utexas.edu, Nedialko Dimitrov

Infrastructures, such as university nuclear reactors, are controlled through cyber-physical systems. Assessing the vulnerability of these system is key in directing defensive investment. We present an MDP to compute an optimal attack policy. The MDP has an exponential number of states, and is based on tracking the set of available attacks for each link in the network. Surprisingly, we show it is possible to compute values for each MDP state, and optimal attack policies, using s-t reliability.

2 - Stochastic Network Interdiction with Risk Preference

Jing Zhang, University at Buffalo, SUNY, 338 Bell Hall, Buffalo, NY, 14221, United States of America, jzhang42@buffalo.edu, Jun Zhuang, Brandon Behlendorf

This paper studies the stochastic network interdiction problem, where the defender maximizes the length of the shortest path between a source and a destination by allocating sensors to the arcs with a limited budget. There is a detecting probability of the sensor, and the defender is unaware of the type of the attacker (strategic, or non-strategic). We develop game-theoretic models, solution methods, and illustrate the models using a portion of the Arizona-Mexico border transportation network.

3 - Keeping Pace with Criminals: Designing Patrol Allocation Against Adaptive Opportunistic Criminals

Milind Tambe, USC, 941 Bloom Walk, Los Angeles, CA, United States of America, tambe@usc.edu, Arunesh Sinha, Chao Zhang

A distinctive feature of urban crimes is that criminals react opportunistically to patrol officers' assignments. Opportunistic criminals are less strategic in planning attacks and flexible in executing them. Our goal is to recommend optimal police patrolling strategy against such opportunistic criminals. Our key contribution is to learn the criminal model from real-world crime and patrol data by representing the criminal behavior as parameters of a Dynamic Bayesian Network.

4 - Improving Logistics Security by using Distributed Container Inspection History Data

Gary Gaukler, Drucker School of Management, Claremont Graduate University, Claremont, CA, 91711, United States of America, Gary.Gaukler@cgu.edu

We present a two-stage interdiction model for smuggled nuclear materials in which prior container inspection data from an upstream inspection stage is used as a low-cost way of increasing overall interdiction performance. We provide insights into how a decision maker at a downstream inspection stage should optimally use detection data from the upstream stage to improve the overall detection capability.

MC03

03-Room 303, Marriott

Innovative Scheduling Applications

Cluster: Scheduling and Project Management

Invited Session

Chair: Tolga Aydinliyim, Baruch College, One Bernard Baruch Way, Dept of Management Box B9-240, New York, NY, United States of America, Tolga.Aydinliyim@baruch.cuny.edu

1 - Throughput Optimization in Single and Dual-gripper Robotic Cells

Manoj Vanajakumari, Texas A&M University, 3367 TAMU, College Station, TX, 77845, United States of America, manojuv@tamu.edu, Chelliah Sriskandarajah, Sushil Gupta

In view of maximizing throughput, practitioners use a class of cycles known as 1-unit cycles in which the cell returns to the same state after the production of each unit. The complexity of throughput optimization in the class of 1-unit cycles in single and dual-gripper robotic cells is the main focus of this paper. We provide some insights for throughput optimization using two-unit cycles.

2 - A Decision Support System for Appointment System Templates with Operational Performance Targets

William Millhiser, Associate Professor, Baruch College, One Bernard Baruch Way, Box B9-240, New York, NY, 10011, United States of America, William.Millhiser@baruch.cuny.edu, Emre Veral

We present a web-based scheduling system for outpatient services that meets user-defined operational targets to achieve managed/fair waiting times, dependable session end times, and minimal unintended idle time for providers. Using historical service times and an underlying model based on prior research, we demonstrate that appointments that meet these operational targets can be scheduled in a real-time environment, while the software provides dynamic assistance in selecting appointment slots.

3 - Improving Blood Products Supply through Donation Tailoring

Ali Ekici, Assistant Professor, Ozyegin University, Industrial Engineering, Nisantepe Mah., Orman Sok, Cekmekoy, Istanbul, 34794, Turkey, ali.ekici@ozyegin.edu.tr, Elvin Coban, Okan Orsan Ozener

Multicomponent apheresis (MCA) allows the donation of more than one component and/or more than one transfusable unit of each component. It provides several opportunities including (i) increasing the donor utilization, and (ii) tailoring the donations based on demand. In this study, we develop mathematical models to develop donation schedules for repeat donors while considering factors such as blood products demand, shelf-life of the blood products, donation costs, and deferral times.

4 - Optimal Schedule of Elective Surgery Operations Subject to Disruptions by Emergencies

Xiaoqiang Cai, The Chinese University of Hong Kong, Shatin, Hong Kong, Hong Kong - PRC, xqcai@se.cuhk.edu.hk, Xianyi Wu, Xian Zhou

Elective surgery operations are to be scheduled at an operating theater, which can accommodate one operation at a time. Emergency cases may arrive randomly, which have higher priority. Any operation, no matter it is normal or emergent, has to be processed until it is completed. Optimal dynamic policies are derived.

5 - Optimal Movement and Transshipment of Rail Freight Shipments

Chinmoy Mohapatra, PhD Candidate, University of Texas at Austin, 3500 Greystone Drive, Apt. 126, Austin, TX, 78731, United States of America, chinmoym@utexas.edu, Anant Balakrishnan

We study the problem of assigning shipments to scheduled transport services that share common capacitated resources. At each node, shipments using same outbound service are assigned in a first-in first-out order. We develop modeling and algorithmic enhancements to effectively solve this large-scale optimization problem, and present computational results for real-life instances.

MC04

04-Room 304, Marriott

Joint Session JFIG/MIF: Panel Discussion on Tenure and Promotion

Sponsor: Junior Faculty Interest Group

Sponsored Session

Chair: Shengfan Zhang, Assistant Professor, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, United States of America, shengfan@uark.edu

Co-Chair: Lauren Davis, North Carolina A&T State University, 1601 E. Market St., Greensboro, NC, United States of America, lbdavis@ncat.edu

1 - Department Chair Panel

Moderator: Shengfan Zhang, Assistant Professor, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, United States of America, shengfan@uark.edu, Panelists: Mark Daskin, Scott Grasman, Ann Maruchek, Alice Smith

A session with IE and business department chairs on issues related to junior faculty.

MC05

05-Room 305, Marriott

Predictive Models of Human Behavior in Social Media

Cluster: Social Media Analytics

Invited Session

Chair: Tauhid Zaman, MIT Sloan School of Management, 50 Memorial Drive, Cambridge, MA, 02139, United States of America, zlisto@mit.edu

1 - Adaptive Searches in Twitter

Chris Marks, MIT, 50 Memorial Drive, Cambridge, MA, 02139, United States of America, cemarks@mit.edu

We present a methodology for adaptively collecting data from the Twitter microblogging application. Based on an initial search query or filter, our method uses network structure and count data from the returned results to update the search query so that additional relevant results are returned. Measures of result relevance will also be presented and discussed.

2 - Graph Control over Social Media: The Follow-back Problem

Krishnan Rajagopalan, Graduate Student, MIT, 50 Memorial Drive, Cambridge, MA, 02139, United States of America, krishraj@mit.edu, Tauhid Zaman

We create a new influence maximization problem on social media where an agent seeks to form a connection with a specific user, the target, in an online social network. We model the problem as an MDP. We use transition probabilities, learned from analysis of Twitter data and find a policy that gives the agent the optimal sequence of interactions with the target's friends to maximize the probability the target will form a connection with the agent. We identify heuristics for certain topologies.

3 - Influence Maximization Revisited

Paramveer Dhillon, MIT Sloan School of Management,
77 Massachusetts Avenue, Cambridge, MA, 02139,
United States of America, dhillion@mit.edu, Sinan Aral

Most research on influence maximization has focused on a single task: to devise algorithms with better approximation guarantees for the NP-Hard discrete optimization problem. The influence models over which the optimization operates, however, remain simplistic and disconnected from empirical evidence on influence in real networks. We propose extensions to existing models of influence propagation that incorporate the most recent empirical evidence and study the implications of these extensions.

4 - Is Exercise Contagious? Evidence from a Global Natural Experiment

Christos Nicolaides, Postdoctoral Fellow, MIT Sloan School of
Management, 100 Main St, E62-489, Cambridge, MA, 02142,
United States of America, chrisnic@mit.edu, Sinan Aral

Health-related behaviors, such as fitness habits, cluster amongst connected peers in social networks. Clustering of behaviors is in part attributable to causal social influence but can also arise through alternate means like homophily of preferences. Using fined grain individual running data from Nike+ we devise a natural experiment to quantify social contagion, identify influential members and groups and determine under which conditions influence is the dominant factor in behavior clustering.

MC06

06-Room 306, Marriott

INFORMS Section on Finance Student Paper Competition

Sponsor: Financial Services

Sponsored Session

Chair: Jim Bander, Toyota Financial, Chandler, AZ,
United States of America, jim.bander@gmail.com

1 - Revisiting Eisenberg - Noe: A Dual Perspective

Deung-geon Ahn, KAIST, #2111, E2-2, 291 Daehak-ro, Yuseong-gu,
Daejeon, Korea, deungeon.ahn@kaist.ac.kr,
Kyoung-kuk Kim

In this paper, we consider the Eisenberg-Noe framework for systemic risk with random shocks. Using duality, we characterize the amount of shock amplification due to the network structure and find the region for the shock vector that makes a specific bank default. These results enable us to improve some of the existing results of the network effect on systemic risk. More importantly, we propose efficient simulation schemes for the systemic risk measurement based on the characterization.

2 - A Partitioning Algorithm for MDPs and its Application to Limit Order Books with Stochastic Market Depth

Ningyuan Chen, Columbia University, S. W. Mudd 321, 500 W
120th Street, New York, NY, 10027, United States of America,
nc2462@columbia.edu

Linear-quadratic control plays a central role in control theory, but its analytical solution, the so-called linear-quadratic regulator, fails in the presence of constraints. We consider a class of Markov decision processes (MDPs), with linear inequality constraints, non-convex quadratic cost, and linear state dynamics, governed by a Markov chain. By the proposed partitioning algorithm, we find the explicit solution to this class of MDPs: The value function and the optimal policy have analytical quadratic and linear forms, respectively, subject to a linear partition of the state space. The algorithm is applied to two applications. In the main application, we present a model for limit order books with stochastic market depth to study the optimal order execution problem. As a feature of our model, stochastic market depth is consistent with empirical studies and necessary to accommodate various order activities, such as limit order submission at and outside the best quotes and order cancellation, which may account for a large proportion of limit order activities. As a result, the optimal order execution policy is also stochastic and adapted to the random changes of market depth.

3 - An Optimization View of Financial Systemic Risk Modeling: The Network Effect and the Market Liquidity Effect

Xin Liu, Doctoral Student, The Chinese University of Hong Kong,
609, William Mong Engineering Building, Hong Kong,
Hong Kong - PRC, liuxin@se.cuhk.edu.hk

Abstract not available at this time.

4 - Accounting for Estimation Risk when Pricing under Adverse Selection

Richard Neuberg, Columbia University, 1255 Amsterdam Avenue,
Dept of Statistics, 10th Floor, New York, NY, 10027,
United States of America, rn2325@columbia.edu

Financial product prices often depend on unknown parameters. Their estimation introduces the risk that a better informed counterparty may strategically pick mispriced products. We discuss how overall estimation risk can be minimized by selecting a probability model of appropriate complexity. Such a model has small bias, which allows measuring product-specific estimation risk. We illustrate how to determine a premium for estimation risk, using a simple example from pricing regime credit scoring.

5 - Combined Estimation-Optimization (CEO) Approach for High Dimensional Portfolio Selection

Chi Seng Pun, PhD Candidate, The Chinese University of Hong
Kong, Department of Statistics, Lady Shaw Building, Shatin, N.T.,
Hong Kong - PRC, cspun@link.cuhk.edu.hk

We propose a combined estimation-optimization (CEO) approach that directly estimates the optimal trading strategy (optimal control), instead of separating the estimation and optimization procedures. This paper investigates a constrained ℓ_1 -minimization for estimating the optimal control and applies it to the mean-variance portfolio (MVP) problems under static and dynamic settings when the number of assets (p) is larger than the number of observation times (n). We prove that the classical sample-based MVP strategy makes the probability that the optimal portfolio will outperform the bank account tend to 50% for $p \gg n$ and a large n . The CEO approach, however, converges to the true optimal solution. In addition, the CEO scheme automatically filters out unfavorable stocks based on historical data, and works for dynamic portfolio problems and non-Gaussian distributions. Simulations validate the theory and the behavior of the proposed approach. Empirical studies show that the CEO-based portfolios outperform the equally-weighted portfolio, the MVP with shrinkage estimators and other competitive approaches.

MC07

07-Room 307, Marriott

Modeling and Quantification of Risk

Cluster: Risk Management

Invited Session

Chair: Patrick Cheridito, Princeton University, ORFE, Princeton, NJ,
United States of America, dito@princeton.edu

1 - Assessing Financial Model Risk

Pauline Barrieu, Professor, London School of Economics,
Statistics Department, Houghton Street, London, WC2A2AE,
United Kingdom, P.M.Barrieu@lse.ac.uk, Giacomo Scandolo

Model risk has a huge impact on any risk measurement procedure and its quantification is therefore a crucial step. In this paper, we introduce three quantitative measures of model risk when choosing a particular reference model within a given class: the absolute measure of model risk, the relative measure of model risk and the local measure of model risk. Each of the measures has a specific purpose and so allows for flexibility.

2 - Multivariate Shortfall Risk and Monetary Risk Allocation

Samuel Drapeau, Shanghai Jiao Tong University, 211 West
Huaihai Road, Shanghai, 200030, China,
samuel.drapeau@gmail.com, Stephane Crepey, Yannick Armenti,
Antonios Papapantoleon

We present a measure designed to address the global and intrinsic risk of interconnected system (banks, CCP...). The goal is twofold: first, provide the total amount of liquidity to be reserved to overcome financial stress situations. Second, address its allocation to each member in function of the systemic risk they put on the system. Finally, we present how these high dimensional computations can be solved in an efficient manner using Fourier methods.

3 - Variable Annuities with Guaranteed Withdrawal Benefits

Patrick Cheridito, Princeton University, ORFE, Princeton, NJ,
United States of America, dito@princeton.edu

Variable annuities with withdrawal benefits have become popular over the last couple of years. Their cost to the issuer not only depends on market conditions but also on policyholder behavior. In this talk we discuss a contract whose withdrawal guarantees are based on the running maximum of the account value. The optimal withdrawal strategy is derived, and the cost of the contract to the issuer is determined.

■ MC08

08-Room 308, Marriott

Empirical Perspectives on Business Model Innovation

Cluster: Business Model Innovation

Invited Session

Chair: Karan Girotra, Associate Professor, INSEAD, Boulevard de Constance, Fontainebleau, 77300, France, Karan.girotra@insead.edu

1 - Channel Integration, Sales Dispersion, and Inventory Management

Ioannis Stamatopoulos, Doctoral Candidate, Northwestern University, Kellogg School of Management, 2001 Sheridan, Evanston, IL, 60208, United States of America, i-stamatopoulos@kellogg.northwestern.edu,
Antonio Moreno-Garcia, Santiago Gallino

Channel integration initiatives are a rapidly increasing trend in retail, creating uncharted areas in marketing, logistics and inventory management. Using data from a leading retailer, we analyze the effects of implementing of a "ship-to-store" functionality, which improves access to SKUs not available in brick-and-mortar stores, to sales dispersion and inventories.

2 - Bike-share Systems: Accessibility and Availability

Ashish Kabra, INSEAD, Boulevard de Constance, Fontainebleau, France, ashish.kabra@insead.edu, Elena Belavina, Karan Girotra

This paper estimates the effects on ridership of station accessibility and of bike-availability. Our analysis is based on a structural demand model that considers the choices of spatially distributed commuters, and it is estimated using high-frequency system-use data from the bike-share system in Paris. To make the method computationally tractable, we develop a novel transformation of our estimation problem: from the time domain to the "station stockout state" domain.

3 - The Role of Surge Pricing: Managing Capacity and Competition in a Peer-to-peer Service Network

Kaitlin Daniels, The Wharton School, 3730 Walnut Street, Suite 500, Philadelphia, PA, United States of America, kaitd@wharton.upenn.edu, Gerard Cachon, Ruben Lobel

We study the incentive design problem of a platform that coordinates a network of service providers who encounter nontrivial, stochastic opportunity cost when they offer their services for hire through the service network. In particular, we examine the role of demand-contingent pricing in determining short and long term service capacity and measure the efficacy of a heuristic in approximating the optimal incentive scheme.

■ MC09

09-Room 309, Marriott

Collaborative Innovation

Sponsor: Technology, Innovation Management & Entrepreneurship

Sponsored Session

Chair: Fabian Sting, Erasmus University Rotterdam, Rotterdam School of Management, 3000 DR Rotterdam, Netherlands, fsting@rsm.nl

1 - The Effect of Environmental Changes on Employee Idea Value

Philipp Cornelius, University College London, UCL School of Management, Gower Street, London, WC1E 6BT, United Kingdom, philipp.cornelius.12@ucl.ac.uk, Bilal Gokpinar, Fabian Sting

Employee ideas are a valuable starting point to improve operational efficiency. Manufacturing organizations therefore systematically tap into employee knowledge and creativity. In this paper we empirically investigate how changes in task nature and manufacturing environment affect the value created by employee ideas for the organization.

2 - Managing New Product Development Knowledge Between Competing Firms

Gulru Ozkan-Seely, Georgia Institute of Technology, 800 W Peachtree St. NW, Atlanta, GA, United States of America, gulru.ozkan@scheller.gatech.edu, Cheryl Gaimon, Sriram Venkataraman

We introduce a two period stochastic game on KM for NPD of two competing firms. First, leader sets price for knowledge transfer (patents); follower decides how much knowledge to acquire. Next, firms pursue knowledge development (problem solving). Finally, both firms release new products. Insights include impact of uncertain market forces.

3 - The Impact of Hospital Information Technology Adoption Process on Quality of Care

Luv Sharma, PhD Student, The Ohio State University, 650 Fisher, Columbus, OH, 43210, United States of America, sharma.154@osu.edu, Aravind Chandrasekaran

This paper looks at the process of adoption of Health Information Technologies (HIT) for 979 hospitals to identify an ideal implementation strategy. We define process of adoption in terms of the sequence and intensity of adoption of HITs. Results demonstrate an ideal sequence whose benefits depend on the intensity of adoption.

4 - How Communication and Incentives Transform a Strategic Plan into Action

Jeremy Hutchison-Krupat, Darden UVA, Darden, VA, KrupatJ@darden.virginia.edu

A senior manager primarily uses two levers to influence a direct report's actions: financial incentives and communication. Financial incentives are explicit and unambiguous but lack flexibility; communication is flexible but may be ambiguous. We study a principal who decides whether to add a new initiative with an uncertain value to the organization's portfolio. We compare results between settings of incentives alone, non-strategic communication, and strategic communication.

■ MC10

10-Room 310, Marriott

Social Media and E-Commerce

Sponsor: E-Business

Sponsored Session

Chair: Yan Huang, Assistant Professor, Stephen M. Ross School of Business, University of Michigan, 701 Tappan St. R5322, Ann Arbor, MI, 48109, United States of America, yphuang@umich.edu

1 - Building Reputation through Charitable Giving in Online Social Networking Environment

Xue Tan, University of Washington, 4747 30th Ave NE J171, Seattle, WA, 98105, United States of America, xuetan@uw.edu, Yingda Lu, Yong Tan

When online social network introduces charity service, fundraising can be more efficient. Unlike in traditional channels, users of online social platform can take the role of solicitor. This paper empirically examines the motivation of charitable giving through a leading micro-blogging platform where charity service is embedded. We employ a quasi-natural experimental setting resulting from platform design change, and identify different factors in individual donation decisions.

2 - An Empirical Study of Customer Strategic Switching Behavior in Multi-channel E-commerce System

Shahryar Doosti, PhD Student, University of Washington, Foster School of Business, University of Washington, Seattle, WA, 98195, United States of America, shahryar@uw.edu, Xi Chen, Yong Tan

This work uses a dataset from a leading e-retailer which offers multi-channels, such as TV shopping, websites, smart-phone applications, microblog-channel store, and call center, to examine how customers strategically select various methods to purchase. We also analyze how customers learn from their experience to gain knowledge about products and channel efficiency. We further run policy simulations to make suggestions for the retailer to improve its operational efficiency.

3 - Impact of Firm Social Media Engagement on Sales Revenue: Evidence from Taobao

Fei Wan, Peking University, Beijing, China, wanfei0304@pku.edu.cn, Yong Tan, Fei Ren

In this paper, we study the impact of marketer generated content on sales revenue. We collect data from taobao.com and its microblogging platform WeiTao. Using Propensity Score Matching and Difference-in-Differences, we find that MGC significantly promotes sales. Firms selling low-involvement products benefit more from MGC efforts, compared to those selling high-involvement products. Our findings suggest that MGC plays an important role in firm marketing activities.

■ MC11

11-Franklin 1, Marriott

Symmetry and Extended Formulations in Integer Programming

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Sebastian Pokutta, Georgia Tech, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, sebastian.pokutta@isye.gatech.edu

Co-Chair: Daniel Zink, Georgia Tech, 755 Ferst Drive, NW, Atlanta GA 30332, United States of America, zink.dani@gmail.com

1 - Strong Mixed-integer Formulations for the Floor Layout Problem

Joey Huchette, MIT, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA, 02139, United States of America, huchette@mit.edu, Juan Pablo Vielma, Santanu Dey

The floor layout problem (FLP) asks a designer to position a collection of rectangular boxes on a fixed floor in such a way that minimizes total communication costs between the components. This work presents a framework for generating mixed-integer formulations for the FLP by “encoding” a union of polyhedra in a higher dimensional space. We present theoretical and computational evidence for the strength of the resulting formulations and valid inequalities.

2 - Detecting Almost Symmetries of Graphs

Bernard Knueven, University of Tennessee, 851 Neyland Dr, Knoxville, TN, 37996, United States of America, bknueven@vols.utk.edu, Sebastian Pokutta, Ben Knueven

We present a branching framework to solve the following problem. Given a graph G and an integer k , find the symmetries on subgraphs of G formed by removing no more than k edges. We call such symmetries “ k -almost symmetries” of G . We specialize the framework and present and implement a branch-and-bound algorithm to find the best such subgraph for a given k . Computational results are reported, showing that for some popular graphs, few edges need be removed to induce additional symmetry.

3 - LP and SDP Inapproximability of Combinatorial Problems

Daniel Zink, Georgia Tech, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, zink.dani@gmail.com, Sebastian Pokutta, Gábor Braun

Motivated by [arXiv:1309.0563], we provide a framework for studying the size of LP formulations as well as SDP formulations of combinatorial optimization problems without encoding them first as linear programs. As a result we define a consistent reduction mechanism that degrades approximation factors in a controlled fashion. As a consequence we establish strong linear programming inapproximability (for LPs with a polynomial number of constraints) for several problems that are not 0/1-CSPs.

4 - Maximizing a Class of Utility Functions Over the Vertices of a Polyhedron

Andres Gomez, PhD Student, University of California at Berkeley, 4141 Etcheverry Hall, University of California Berkeley, Berkeley, CA, 94720-1777, United States of America, a.gomez@berkeley.edu, Alper Atamturk

Given a polyhedron, a concave univariate function g , and two vectors c and d , we consider the optimization problem of finding a vertex that maximizes the function $c'x + g(d'x)$, which is NP-hard. We propose a 1/2-approximation algorithm. Improved approximation ratio of 4/5 is given for specific cases in project scheduling and reinforcement learning. Computational experiments indicate that the suggested approach finds solutions within 1% of the optimal solution for most of the instances quickly.

■ MC12

12-Franklin 2, Marriott

Global Optimization: Algorithms and Applications

Sponsor: Optimization/Mixed Integer Nonlinear Optimization and Global Optimization

Sponsored Session

Chair: John Chinneck, Professor, Carleton University, Systems and Computer Engineering, 1125 Colonel By Drive, Ottawa, ON, K1S5B6, Canada, chinneck@sce.carleton.ca

1 - CCGO: A Fast Heuristic Global Optimizer

John Chinneck, Professor, Carleton University, Systems and Computer Engineering, 1125 Colonel By Drive, Ottawa, ON, K1S5B6, Canada, chinneck@sce.carleton.ca, Mubashsharul Shafique

Our CCGO multistart heuristic trades off some accuracy to gain speed. It generally finds good quality solutions quickly. The main steps are a latin hypercube scatter of initial points, rapid movement towards feasibility via Constraint Consensus, clustering, simple point improvement, and local solver launch. Much of the work is done concurrently. Our results are very promising in comparison to several existing global optimizers, especially for larger nonconvex models.

2 - A Mixed Integer Nonlinear Program for Remote Hybrid Energy System Design and Dispatch

Michael Scioletti, Colorado School of Mines, 1500 Illinois Street, Golden, CO 80401, United States of America, msciolet@mymail.mines.edu, Alexandra Newman

Our remote hybrid energy system design and dispatch problem is a non-convex, mixed-integer nonlinear program that determines the optimal mix of technologies (generators, batteries, and solar panels) and their dispatch to minimize system costs. Constraints meet load and satisfy operational rules. Most notably, we model the batteries in some detail. Linearization techniques yield near-optimal solutions to instances containing real data over a yearly horizon at hourly fidelity in a matter of hours.

3 - Which Programming Language should you choose for your Optimization Project?

Bjarni Kristjansson, President, Maximal Software Inc., 2111 Wilson Boulevard, Suite 700, Arlington VA 22201, United States of America, bjarni@maximalsoftware.com

When working on real-world optimization projects which are intended to be deployed for end-users, it is often not enough to use just a modeling language with a state-of-the-art solver. To implement user-interfaces, data preparation, and integrating the optimization solution into an easy-to-use application, you will typically have to use also a programming language. In this presentation, we will compare the pros and cons between popular programming languages, such as C/C++, CSharp, Visual Basic, Java, and Python.

■ MC13

13-Franklin 3, Marriott

Robustness in Optimization, Complementarity, and Queueing systems

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Uday Shanbhag, The Pennsylvania State University, 310 Leonhard Building, University Park, PA, 16801, United States of America, udaybag@engr.psu.edu

1 - On Robust Solutions to Uncertain Linear Complementarity Problems and Their Variants

Yue Xie, Research Assistant, PSU IE, 351 Leonhard Building, University Park, PA, 16802, United States of America, xieyue1990@gmail.com, Uday Shanbhag

Complementarity problems have been well studied in modeling optimization and equilibrium problems. Yet, less progress has been seen in the uncertain context. We present an avenue for obtaining robust solutions to uncertain linear complementarity problems in a distribution-free environment by solving a low-dimensional program. Particularly, robust solutions to uncertain non-monotone LCPs are provided by customizing an existing scheme. Preliminary numerics suggest that such avenues hold promise.

2 - Percentile Optimization in Multi-class Queueing Systems with Parameter Ambiguity

Austin Bren, PhD Student, Arizona State University, 1537 East Palmdale Drive, Tempe, AZ, 85282, United States of America, hasbren@gmail.com, Soroush Saghafian

In a multi-class queueing system that experiences system ambiguity through unknown service rate parameters, we incorporate robustness in control policies by applying a novel percentile optimization technique that allows for the expression of a controller's optimism level and utilizes incoming data to learn the true system parameters. We identify structural results of the optimal policy and use our technique in a hospital emergency department application using data from Mayo clinic.

3 - A Convexity Result for Nonlinear Gaussian Chance Constraints

Miles Lubin, MIT, 77 Massachusetts Avenue, E40-149, Cambridge, MA, 02139, United States of America, miles.lubin@gmail.com, Juan Pablo Vielma, Daniel Bienstock

We present an extension of the well-known convexity result for linear chance constraints under Gaussian uncertainty. We derive an exact convex reformulation for certain nonlinear chance constraints, together with a tractable SOCP formulation with provable approximation guarantees. We apply these results to tackle a more challenging chance constraint which arises from nonlinear power flow equations.

■ MC14

14-Franklin 4, Marriott

Optimization Award Session

Sponsor: Optimization

Sponsored Session

Chair: Suvrajeet Sen, Professor, University of Southern California, University Park Campus, Los Angeles, CA, 90089, United States of America, s.sen@usc.edu

1 - Optimization Society Awards

The Optimization Society sponsors four awards annually. They are a) the Khachiyan Prize for lifetime contributions in optimization, b) the Farkas Prize for exceptional mid-career accomplishments, c) the Young Optimization Researcher award, and finally, d) the student paper prize competition. The award winners will present brief overviews of their contributions in this session. The speakers will be Dr. J-B Lasserre (Khachiyan Prize), Professor Robert Weismantel (Farkas Prize), Fatma Kilinc-Karzan, Javad Lavaei, and Somayeh Sojoudi (all for the Young Optimization Researcher award), and Paul Grigas for the best student paper. These awards are highly competitive and coveted, and this session is dedicated to congratulating the winners, and their lasting contributions to optimization.

■ MC15

15-Franklin 5, Marriott

Theory and Applications of Convex Optimization

Sponsor: Optimization/Nonlinear Programming

Sponsored Session

Chair: Amir Ali Ahmadi, Princeton University, Department of ORFE, Sherrerd Hall, Charlton Street, Princeton, NJ, 08544, United States of America, a_a_a@princeton.edu

1 - Finding Stable Periodic Solutions to the N-body Problem via Robust Optimization

Robert Vanderbei, Princeton University, ORFE, Sherrerd Hall, Princeton, NJ, 08544, United States of America, rvd@princeton.edu

It is rather easy to use nonconvex nonlinear optimization techniques to find periodic solutions to the n-body problem in celestial mechanics. But, the vast majority of the solutions found are dynamically unstable. In this talk, I will discuss how one can adapt ideas from robust optimization to coerce the optimization toward local solutions that are in fact stable. Some preliminary results will be shown.

2 - Efficiency of Supply Function Equilibrium in Networked Markets

Ermin Wei, Assistant Professor, Northwestern University, 2145 Sheridan Rd, Tech L310, Evanston, IL, 60208, United States of America, ermin.wei@northwestern.edu, Chaitanya Bandi, Yuanzhang Xiao

We study the efficiency loss of the supply function equilibrium (SFE). Specifically, we consider a market where the demand is inelastic, the suppliers submit their supply functions, and a uniform price is set to clear the market. Literature is limited to the markets with no network structure, and suggest that SFE is asymptotically efficient. Motivated by power grid, we study how network topology affects the efficiency of SFE. We identify the structure where the intuition from literature holds.

3 - DC Decomposition of Nonconvex Polynomials with Algebraic Techniques

Georgina Hall, Princeton University, ORFE Department, Sherrerd Hall, Charlton Street, Princeton, NJ, 08540, United States of America, gh4@princeton.edu, Amir Ali Ahmadi

The concave-convex procedure is a majorization-minimization algorithm for difference of convex (DC) optimization, where the constraints and the objective are given as the difference of two convex functions. In this talk, we focus on polynomial optimization: we introduce LP, SOCP, and SDP based algorithms for finding optimal DC decompositions by appealing to the algebraic concepts of "DSOS-Convex, SDSOS-Convex, and SOS-Convex" polynomials.

■ MC16

16-Franklin 6, Marriott

Advances in Infinite-Dimensional Linear Programming

Sponsor: Optimization/Linear and Conic Optimization

Sponsored Session

Chair: Marina Epelman, University of Michigan, Industrial and Operations Engineering, 1205 Beal Ave, Ann Arbor, MI, 48109, United States of America, mepelman@umich.edu

1 - Analysis of Algorithms for Non-stationary Markov Decision Processes

Ilbin Lee, Postdoctoral Researcher, Georgia Tech, 755 Ferst Dr., NW, Atlanta, GA, 30332, United States of America, ilbinlee@umich.edu, Marina Epelman, H. Edwin Romeijn, Robert L. Smith

We consider infinite-horizon discounted Markov decision processes (MDPs) with finite state space and non-stationary problem data. Existing solution methods for such MDPs are receding horizon approach and simplex algorithm. For each method, we establish an upper bound on number of iterations to find a near-optimal solution and compare the theoretical guarantees. We also provide experimental results comparing their empirical performances.

2 - Policy Iteration for Robust Nonstationary Markov Decision Processes

Archis Ghatge, University of Washington, Industrial & Systems Engineering, Box 352650, Seattle, WA, United States of America, archis@uw.edu, Saumya Sinha

In this talk, we will present an implementable policy iteration algorithm for solving robust nonstationary Markov decision processes. Its convergence analysis will be discussed.

3 - Dual Pricing in Semi-infinite Linear Programming

Christopher Ryan, University of Chicago, Booth School of Business, Chicago, IL, United States of America, chris.ryan@chicagobooth.edu, Kipp Martin, Amitabh Basu

LPs satisfy strong duality (SD) and the dual pricing (DP) property, which means that given a small perturbation of the right-hand side, there exists a dual solution that computes the exact change in optimal value. SD and DP fail in general for semi-infinite LPs. For a restricted constraint space SD and DP hold. We give conditions for when DP holds in general. Dual solutions may exist that guarantee DP but have awkward structure. "Nice" solutions can be seen as integrals that price constraints.

4 - The Slater Conundrum: Duality and Pricing in Infinite Dimensional Optimization

Matthew Stern, University of Chicago - Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, stern@chicagobooth.edu, Kipp Martin, Christopher Ryan

For a general class of infinite dimensional vector spaces, we show that the existence of interior points required by common constraint qualifications for zero duality gap (such as Slater's condition) implies the existence of singular dual solutions that are difficult to find and interpret. We then provide sufficient conditions that guarantee the existence an optimal dual solution that is not singular.

■ MC17

17-Franklin 7, Marriott

Network Flows and Combinatorial Optimization

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Baski Balasundaram, Associate Professor, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74078, United States of America, baski@okstate.edu

1 - A Branch Decomposition Algorithm for Better P-median Solutions

Caleb Fast, Rice University, 6100 Main St., Houston, TX, 77005, United States of America, ccf5@rice.edu, Ilyia Hicks

This talk presents a branch decomposition algorithm for improving approximate solutions to the p-Median problem. Since the p-Median problem is NP-hard, heuristics are commonly used to generate approximate solutions. We use a branch decomposition algorithm on the support graph generated from multiple heuristic runs to find an approximate solution of higher quality than that provided by the heuristic. We report numerical results for some common heuristics.

2 - Generalizations of the Dominating Set Problem on Social Networks

Raghu Raghavan, University of Maryland, Institute for Systems Research, A. V. Williams Building, College Park, MD, 20742, United States of America, raghavan@rhsmith.umd.edu, Rui Zhang

The positive influence dominating set problem is a generalization of the dominating set problem that arises on social networks. First, we show that it can be solved in linear time on trees. Next, we provide a tight and compact extended formulation, and derive a complete description of its polytope on trees. The formulation is also valid on general graphs, thus providing a new and stronger one. Facet defining conditions for the new inequalities are provided. A computational study is conducted.

3 - Flow Networks with Interdependent Commodities

Kelly Sullivan, Assistant Professor, University of Arkansas, Fayetteville, AR, 72701, ksullivan@uark.edu, Sarah Nurre, Matthew Robbins, Brian Lunday

We model an extension of the minimum cost flow problem to a multi-layered network in which each layer is associated with a commodity that flows through the network. Nodes in this network must consume certain commodities before they are able to transport other commodities. We discuss model properties, solution approaches, and application of the model to characterize vulnerabilities in interdependent systems where disruptions may propagate across layers.

MC18

18-Franklin 8, Marriott

Optimization Metaheuristics

Contributed Session

Chair: Celso Ribeiro, Universidade Federal Fluminense, Institute of Computing, Niterói, Brazil, celso@ic.uff.br

1 - Healing the Achilles' Heel: Finding and Preserving Feasibility in Evolutionary Algorithms

Stephen Henry, Senior Member Technical Staff, Sandia National Labs, 7304 Laster Ave NE, Albuquerque, NM, 87109, United States of America, smhenry@sandia.gov

Evolutionary algorithms can be powerful tools for optimizing discrete, multidimensional, nonlinear design problems. Finding or maintaining solution feasibility, however, is often an "Achilles' heel" of these approaches - confounding genetic operators and stifling optimization progress. In this presentation, we give an overview of Sandia's WSTAT genetic algorithm system design tool, the gene healing approaches that have been implemented, and the resulting improvements in algorithm performance.

2 - Heuristics for the Generalized Median Graph Problem

Leonardo Musmanno, Universidade Federal Fluminense, Institute of Computing, Niteroi, Brazil, lmusmanno@ic.uff.br, Celso Ribeiro

The graph edit distance is often used to measure the similarity between two graphs. The generalized median graph of S is any graph that minimizes the sum of the distances to all graphs in S . We propose two new heuristics for solving the generalized median graph problem: a greedy adaptive algorithm and a GRASP heuristic. Numerical results indicate that both heuristics can be used to obtain good approximate solutions for the generalized median graph problem.

3 - A Memetic Algorithm to Minimize Latency in Location-Routing Problems

Mohammad Moshref-Javadi, School of Industrial Engineering, Purdue University, 315 N. Grant St., West Lafayette, IN, 47907, United States of America, moshref@purdue.edu, Seokcheon Lee

Latency-Location Routing Problem determines the locations of depots and the routes of the vehicles aiming at minimizing waiting time of the customers. In this paper, we formulate the problem mathematically and propose an efficient Memetic Algorithm and compare it with a Granular Variable Neighborhood Search on different problems. The Latency-LRP has important applications in customer-oriented supply chain and disaster relief logistic.

4 - Hybridizing Meta-raps with Machine Learning

Fatemah Al-Duoli, Old Dominion University, Dep. of Eng.Mngt. and Systems Eng., 5115 Hampton Blvd., Norfolk, VA, 23529, United States of America, fateamah.aldouli@gmail.com, Ghaith Rabadi

The performance of Meta-heuristics for Randomized Priority Search (Meta-RaPS) is improved by integrating a learning phase to its original construction and improvement phases. Information collected during the original Meta-RaPS phases is used by machine learning algorithms in the new learning phase. The proposed approach will be demonstrated using instances for the Capacitated Vehicle Routing Problem (CVRP).

5 - Extending Time-to-target Plots to Test Sets with Multiple Problem Instances

Celso Ribeiro, Universidade Federal Fluminense, Institute of Computing, Niterói, Brazil, celso@ic.uff.br, Alberto Reyes

Time-to-target plots (tttplots) or runtime distributions are a useful tool to characterize, evaluate, and compare the behavior of randomized algorithms. However, they are limited to the evaluation of one single problem instance at-a-time. In this work, we propose their extension to address sets of test problems with multiple instances. Numerical results for different problems illustrate the applicability and usefulness of the newly proposed m-tttplots tool.

MC19

19-Franklin 9, Marriott

Tools for Optimization Modeling

Sponsor: Computing Society

Sponsored Session

Chair: Robert Fourer, President, AMPL Optimization Inc., 2521 Asbury Ave, Evanston, IL, 60201, United States of America, 4er@ampl.com

1 - The Surprising Difficulties of Supporting Quadratic Optimization in Algebraic Modeling Languages

Robert Fourer, President, AMPL Optimization Inc., 2521 Asbury Ave, Evanston, IL, 60201, United States of America, 4er@ampl.com

Algebraic modeling languages can readily convey quadratic functions to general nonlinear solvers, but support for recent quadratic extensions to mixed-integer linear solvers has proven much more challenging. The difficulty is due in part to the limited range of representations that solvers recognize and in part to the variety of transformations that must be considered. This presentation surveys the principal issues, and their implications for anyone building large-scale convex quadratic models.

2 - Modeling by Learning: The Problem Definition Repair Process

Choat Inthawongse, Lehigh University/Ramkhamhaeng University, 200 W Packer Ave., Bethlehem, PA, 18015, United States of America, choat@lehigh.edu, George R. Wilson

This research puts forward a framework for restructuring the problem and decision analysis template, representing an important extension to the cognitive computing systems, powered by IBM Watson. We develop an optimization model representation for model redefinition as a steppingstone toward creation of a decision support system motivated by cognitive computing. Broadening from the former models representation by Geoffrion as a semantic instrument for solution-method association state.

MC20

20-Franklin 10, Marriott

Modeling and Optimization of Big Data Systems

Cluster: Cloud Computing

Invited Session

Chair: Li Zhang, IBM T. J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, zhangli@us.ibm.com

1 - Stage Aware Performance Modeling for Dag-based Analytic Platforms

Min Li, Dr., IBM Research, United States of America, minli@us.ibm.com, Li Zhang, Yangdong Wang

In this presentation, we introduce a stage aware performance modeling tool for DAG based analytic platforms. The main idea of stage aware performance modeling is to divide the job execution flow into stages and derive the job execution time based on the DAG of the workflow to cope with the variances such as different program and job parameter configuration of the data analytic frameworks.

2 - The Power of Slightly More than One Sample in Randomized Load Balancing

Xiaohan Kang, Associate Professor, Arizona State University, GWC 436, Tempe, AZ, 85287, United States of America, leiying07@gmail.com, R. Srikant, Lei Ying

In this paper, we show that the number of sampled queues in randomized load balancing can be dramatically reduced by using the fact that tasks arrive in batches (called jobs). In particular, we sample a subset of the queues such that the size of the subset is slightly larger than the batch size, and equalize the load among the sampled servers. We show that our algorithm maintains the same asymptotic performance as the power-of-two-choices algorithm while using only half the number of samples.

3 - Towards Multi-resource Fairness in Big Data Systems

Zhenhua Liu, Assistant Professor, Stony Brook University,
Stony Brook, NY, 11794, United States of America,
zhenhua.liu@stonybrook.edu

Big data systems nowadays involve multiple resources such as CPU, memory, network during multiple stages. On the other hand, these systems are usually shared among multiple tenants with different demand characteristics. How to optimally align these two complexities while maintaining fairness among tenants has significant theoretical challenges, while generates great practical value. In this talk, I will briefly introduce our recent progress along this.

MC21

21-Franklin 11, Marriott

Pierskalla Award Finalists

Sponsor: Health Applications

Sponsored Session

Chair: Mohsen Bayati, Assistant Professor, Stanford Graduate School of Business, 655 Knight Way, Stanford, CA, United States of America, bayati@stanford.edu

Co-Chair: Soo-Haeng Cho, Associate Professor, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, soohaeng@andrew.cmu.edu

1 - Pierskalla Award Finalists

Mohsen Bayati, Assistant Professor, Stanford Graduate School of Business, 655 Knight Way, Stanford, CA, United States of America, bayati@stanford.edu, Soo-Haeng Cho, Joel Goh

The Health Applications Society of INFORMS sponsors an annual competition for the Pierskalla Award, which recognizes research excellence in the field of health care management science. The award is named after Dr. William Pierskalla to recognize his contribution and dedication to improving health services delivery through operations research. The Pierskalla award information can be found on the website at: <https://www.informs.org/Community/HAS/Pierskalla-Award>

MC22

22-Franklin 12, Marriott

Message Passing for Inference

Sponsor: Applied Probability

Sponsored Session

Chair: Jinwoo Shin, Korea Advanced Institute of Science and Technology, 291 Daehak-ro, Yuseong-gu, Daejeon, Korea, Republic of, jinwoos@kaist.ac.kr

1 - How Hard is Inference for Structured Prediction?

David Sontag, Assistant Professor, NYU, 715 Broadway, 12th Floor, Room 1204, New York, NY, 10003, United States of America, dsontag@cs.nyu.edu

Structured prediction tasks in machine learning involve the simultaneous prediction of multiple labels. This is typically done by maximizing a score function on the space of labels, which decomposes as a sum of pairwise terms, each depending on two specific labels. Although marginal and MAP inference for these models are NP-hard in the worst-case, approximate inference algorithms are often remarkably successful. In this talk, we develop a theoretical framework to explain why.

2 - Tractable Graphical Modeling and the Bethe Approximation

Tony Jebara, Professor, Columbia University, 500 West 120 St., Room 450, Mail Code 0401, New York, NY, 10027, United States of America, jebara@cs.columbia.edu

We consider three NP-hard graphical modeling problems. For maximum a posteriori inference, we identify the limits of tractability via perfect graph theory. For marginal inference, we provide efficient solutions using Bethe free energy approximations and discretization. For learning, we combine Bethe with a Frank-Wolfe algorithm to avoid intractable partition functions. Applications include link prediction, social influence estimation, computer vision, financial networks and power networks.

3 - Lifts of Graphs and Approximate Inference

Nicholas Ruozi, Assistant Professor, UT Dallas, 2601 N. Floyd Rd. MS EC31, Richardson, TX, 75080, United States of America, nicholas.ruozzi@utdallas.edu

The approximate maximum a posteriori inference problem (MAP) for graphical models over finite state spaces is an NP-hard problem in general. As a result, approximate MAP inference techniques based on convex relaxations are often employed in practice. These convex relaxations are relatively well-understood in the discrete case but many open questions remain in the continuous setting. I will

discuss how to extend many of the discrete results to the continuous setting using lifts of graphs.

4 - Factor Graphs, Kramers-Wannier Duality, and the Sum-product Algorithm

Ali Al-Bashabsheh, Postdoc, The Chinese University of Hong Kong, Hong Kong, Hong Kong - PRC, entropyali@gmail.com, Pascal O. Vontobel

A key object associated with a graphical model is its partition function. Although the partition function is often intractable, it can be estimated (e.g., via the sum-product algorithm) or analyzed (e.g., via factor graph transforms). An example of the latter, and also the main focus of this talk, is the analysis of 2D-Ising models via Kramers—Wannier duality. At various places we will point out connections to optimization problems.

MC23

23-Franklin 13, Marriott

Optimal Control of Stochastic Systems

Sponsor: Applied Probability

Sponsored Session

Chair: Jiheng Zhang, HKUST, Clear Water Bay, Hong Kong, Hong Kong - PRC, j.zhang@ust.hk

1 - Distributionally Robust Inventory Control when Demand is a Martingale

Linwei Xin, Assistant Professor, University of Illinois at Urbana-Champaign, 104 S. Mathews Ave., Urbana, IL, 61801, United States of America, lxin@illinois.edu, David Goldberg

Independence of random demands across different periods is typically assumed in multi-period inventory models. In this talk, we consider a distributionally robust model in which the sequence of demands must take the form of a martingale with given mean and support. We explicitly compute the optimal policy and value, and shed light on the interplay between the optimal policy and worst-case martingale. We also compare to the analogous setting in which demand is independent across periods.

2 - Join the Shortest Queue with Customer Abandonment

Ping Cao, University of Science and Technology of China, Room 707A, School of Management, Hefei, China, pcao@ustc.edu.cn, Junfei Huang

We consider an overloaded queueing system with many servers and customer abandonment under the join-the-shortest-queue policy. Diffusion approximations for system performances are established. The approximation expressions depend on the traffic intensity: in some cases a one-dimensional Ornstein-Uhlenbeck process is enough while in other cases a two-dimensional process is necessary. We also compare the results with that of the one-global-queue system.

3 - Asymptotic Optimal Control of Perishable Inventory

Jiheng Zhang, HKUST, Clear Water Bay, Hong Kong, Hong Kong - PRC, j.zhang@ust.hk, Rachel Zhang, Hailun Zhang

We study joint replenishment and clearance of perishable products when the demand rate is large. We propose two policies based on fluid and diffusion approximations, respectively. The fluid based policy can achieve asymptotic optimality with the gap explicitly computed. The diffusion based policy can significantly improve the gap when the initial inventory is small. When the initial inventory is large, we prove that depletion-once is enough to achieve asymptotic optimality.

MC24

24-Room 401, Marriott

Network Modeling and Analysis

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Junming Yin, University of Arizona, Department of MIS, Tucson, AZ, 85721, United States of America, junmingy@email.arizona.edu

1 - Analysis of Network Experiments with Nonnegative Treatment Effects

David Choi, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, United States of America, davidch@andrew.cmu.edu

Randomized experiments in network settings are potentially useful for understanding the effects of peer influence and other social mechanisms. However, the analysis of experiments is an open problem when the individuals in the experiment are assumed to be able to influence each other's decisions. We propose a new method that requires much weaker assumptions than existing methods, which often impose stylized models of individual behavior that may not be valid in practice.

2 - How Our Networks Shape Our Privacy

Yotam Shmargad, University of Arizona, 1515 E. First St., Tucson, United States of America, yotam@email.arizona.edu

In this study, I relate characteristics of people's networks to the level of privacy they experience in their social environments. I analyze over half a million users with nearly 40 million connections on a social network site, and show that characteristics of users' networks can be used to predict various behaviors on the site – including decisions to share and consume information. In particular, users with networks containing several distinct social groups are more active on the site.

3 - Inter-firm Managerial Social Ties, IT Supplier Selection and IT Standardization

Oliver Yao, George N. Beckwith, Professor, Lehigh University, 621 Taylor Street, Bethlehem, PA, 18015, United States of America, yuy3@lehigh.edu, Ling Xue, Ke Yang

We empirically test links between inter-firm managerial social ties (IMST) and IT supplier selection and IT standardization. We find that: (1) A firm is more likely to use an IT vendor if the firm has more IMST with the IT vendor. (2) A firm with more IMST with its potential IT vendors uses more IT vendors. (3) More IT vendors is associated with lower IT standardization for the firm, and such relationship is strengthened when the firm has a greater number of IMST with its IT vendors.

4 - Latent Space Inference of Internet-Scale Networks

Junming Yin, University of Arizona, Department of MIS, Tucson, AZ, 85721, United States of America, junmingy@email.arizona.edu, Qirong Ho, Eric Xing

The rise of internet-scale networks with hundreds of millions to billions of nodes, presents new scientific opportunities, such as overlapping community detection to discover the structure of the internet. However, many existing models are difficult or impossible to deploy at these massive scales. We propose a scalable approach for overlapping community detection in internet-scale networks, and we demonstrate our method on real networks with up to 100 million nodes and 1000 communities.

■ MC25

25-Room 402, Marriott

Data-Driven Research on Economics of Digitization

Sponsor: Information Systems

Sponsored Session

Chair: Hossein Ghasemkhani, Assistant Professor, Purdue University, 425 W. State Street, West Lafayette, IN, 47907, United States of America, hossein@purdue.edu

1 - Predicting Buying Opportunity in Retail Market with Machine Learning

Warut Khern-Am-Nuai, Purdue University, 403 W. State Street, West Lafayette, IN, 47907, United States of America, wkhernam@purdue.edu, Karthik Kannan, Hossein Ghasemkhani

Previous literature has shown that many machine learning techniques are effective in predicting stock price. However, it is not clear if those practices can be applied to a non-financial context or not. This paper employs three machine learning algorithms: ANNs, SVMs, and MARS to predict buying opportunities of products in a retail market. The preliminary results suggest that machine learning could be one potential avenue to help managers in optimizing buying decisions.

2 - Dynamic Estimation of Peer Effects and Product Engagement

Daniel Rock, Doctoral Candidate, MIT Sloan School of Management, 30 Memorial Drive, Office 341, Cambridge, MA, 02142, United States of America, drock@mit.edu, Sinan Aral, Sean Taylor

After product adoption, consumers make decisions about continued use. These choices can be influenced by peer decisions in networks, but identifying causal peer influence effects is challenging. Using engagement data for Yahoo Go, a mobile application, we apply a dynamic version of the Bramoullé et al. (Journal of Econometrics 2009) identification strategy to estimate usage peer effects. We compare the performance of a variety of prediction models for the instrumental variables "first stage".

3 - Information Technology and the Rise of the Power Law Economy

Guillaume Saint-jacques, PhD Candidate, MIT Sloan School of Management, 100 Main St, E62-459, Cambridge, MA, 02142, United States of America, gsaintja@mit.edu, Erik Brynjolfsson

We show that the dramatically increasing share of income going to top earners can be explained by the rise of the "power law economy" and argue this reflects increased digitization and networks. Specifically, tax data (1960-2008) show that more individual incomes are drawn from a power law, as opposed to the long-established log-normal distribution. We present a simple theoretical model to argue that the increased role of power laws is consistent with the growth of information technology.

4 - The Value of Live Chat in Online Purchase

Xue Tan, University of Washington, Seattle, WA, United States of America, Youwei Wang, Yong Tan

In today's competitive online marketplace, adopting a live chat tool is widely considered by merchants as a way to conduct one-to-one selling like in physical store. By allowing customer representatives to talk to potential buyers, e-tailer can answer consumers' questions and decrease the level of information asymmetry. This paper empirically examine the role of live chat in terms of purchase conversion.

■ MC26

26-Room 403, Marriott

Academic Job Search Panel

Cluster: INFORMS Career Center

Invited Session

Chair: Beril Toktay, Georgia Tech, Atlanta, GA, United States of America, beril.toktay@scheller.gatech.edu

1 - Academic Job Search Panel

Moderator: Beril Toktay, beril.toktay@scheller.gatech.edu, Panelists: Kris Johnson Ferreira, H. Edwin Romeijn, Wedad Elmaghraby, Gad Allon

The panel will discuss the academic interview process and do's and don'ts associated with the job search. In addition to comments by current and former search chairs, time will be provided for questions and answers.

■ MC27

27-Room 404, Marriott

Multi-objective Design Problems

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Diclehan Tezcaner Ozturk, Dr., TED University, Industrial Engineering, Ankara, Turkey, diclehan.ozturk@tedu.edu.tr

1 - A Control Chart Recommendation System

Sidika Tunc, Research Assistant, Middle East Technical University, Cankaya, Ankara, Turkey, tsidika@metu.edu.tr, Gulser Koksak

An approach is developed to recommend the most appropriate control chart to a novice decision maker in statistical process control. The chart selection problem is formulated as an MCDM problem. Overall desirability of each chart is determined. Expert knowledge is utilized. The system is tested and calibrated by statistical experiments.

2 - Estimating Non-additive Value Functions with Active Learning in the Ordinal Classification Setting

Levent Eriskin, Middle East Technical University, Industrial Engineering Department, Ankara, Turkey, levent.eriskin@gmail.com, Gulser Koksak

Preference modeling is used to represent Decision Maker's subjective preference structure. Preference structure having some kind of interaction among criteria is hard to model. In this study, we present results of analyses conducted for estimating non-additive value functions having interaction structure by utilizing active learning techniques in the ordinal classification setting.

3 - Interactive Mean-variance-covariance Optimization for Two Responses

Melis Ozates, Research Assistant, Middle East Technical University, Universiteler Neighborhood, Dumlupinar Avenue No.1, Ankara, 06800, Turkey, mozates@metu.edu.tr, Gulser Koksak, Murat Koksak

We develop an interactive approach for the two-response product and process design optimization problem, explicitly considering decision maker preferences and allowing for correlated responses. We use several performance measures to represent the objectives that facilitate effective communication with the decision maker.

4 - Bi-objective Route Planning for Unmanned Air Vehicles in Continuous Space

Diclehan Tezcaner Ozturk, Dr., TED University, Industrial Engineering, Ankara, Turkey, diclehan.ozturk@tedu.edu.tr, Murat Koksalan

We consider the route planning problem of a single unmanned air vehicle visiting multiple targets in continuous space under two objectives: minimization of total distance traveled and minimization of total radar detection threat. We develop solution approaches to generate the nondominated frontier of this problem. We also develop an interactive algorithm that asks for comparison between solutions and progressively reduces the search area around the decision maker's most preferred solutions.

■ MC28

28-Room 405, Marriott

Auctions and Trading Agents

Cluster: Auctions

Invited Session

Chair: Wolf Ketter, Professor, Rotterdam School of Management, Burgemeester Oudlaan 50, Rotterdam, 3062 PA, Netherlands, WKetter@rsm.nl

1 - Understanding, Replicating, and Leveraging Dynamics of Bidder Behavior in Combinatorial Auctions

Ali Mahdavi, Carlson School of Management, 321 19th Ave S, #3-365, Minneapolis, MN, 55455, United States of America, mahd0008@umn.edu

We use an agent-based modeling approach to simulate human bidder behaviors observed in continuous combinatorial auctions. After validating our bidding agents, we leverage them to simulate a wide variety of competition types (i.e., compositions of bidder behavior) and demonstrate how different competition types affect auction outcomes, such as revenue and allocative efficiency.

2 - An Experimental Agent-based Approach for Intelligent Decision Making on Electricity Future Markets

Derck Koolen, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, 3062 PA, Netherlands, koolen@rsm.nl, Wolf Ketter, Liangfei Qiu, Ronald Huisman

We study the determinants of forward prices and hedging decisions on electricity future markets in an experimental agent-based setting. Faced with imperfect storability and depending on price expectations, the agent supports producers using different technologies with varying risks from fuel trading, emission prices and weather conditions. Presenting different information treatments, the decision making of wholesale market participants is assessed.

3 - Moral Hazard in Auctions: A Principal-agent Model of Bidding Firms

Martin Bichler, Professor, TU München, Boltzmannstr. 3 Germany, bichler@in.tum.de, Per Paulsen, Salman Fadaei

We model auctions where the bidders are firms consisting of a principal and an agent. The agent wants to win the package with the highest expected value. Bayesian Nash equilibrium strategies in sealed-bid auctions illustrate possibilities for profitable manipulation of agents. For small markets we prove a non-truthful ex-post Nash equilibrium. Sometimes it is impossible for the principal to set allowances such that the agent bids truthful. In larger markets, there are multiple equilibria.

4 - An Auction Mechanism for Scheduling Electric Vehicle Charging

Konstantina Valogianni, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, Netherlands, kvalogianni@rsm.nl, Wolfgang Ketter, Soumya Sen, Alok Gupta, Eric Van Heck

We present an auction-based framework for scheduling electric vehicle charging. We account for individual arrival and departure preferences and aim to service as many customers as possible without suffering major delays regarding their departure time. We show how the payments need to be allocated to minimize the system's delay cost. We examine the effect of the presented mechanism to smart grid's stability and reliability.

5 - Dynamic Decision-making in Sequential B2b Auctions

Yixin Lu, Assistant Professor, VU University Amsterdam, Netherlands, y2lu@vu.nl, Eric Van Heck, Alok Gupta, Wolfgang Ketter

We develop a dynamic structural model of competitive bidding in sequential B2B auctions. Given that bidders often have multiple purchase opportunities in these auctions, we formulate the optimal bidding problem as a partially observable Markov decision process. We apply the model to a unique dataset from the world's largest flower wholesale market.

■ MC29

29-Room 406, Marriott

Joint Session Analytics/CPMS: Panel Session: Extending the Reach of Certification: The New Associate Certified Analytics Professional

Sponsor: Analytics

Sponsored Session

Chair: Polly Mitchell-Guthrie, Sr. Mgr., Advanced Analytics Customer Liaison Group, SAS Institute, SAS Campus Dr., Cary, NC, 27513, United States of America, Polly.Mitchell-Guthrie@sas.com

1 - Extending the Reach of Certification: The New Associate Certified Analytics Professional

Moderator: Polly Mitchell-Guthrie, Sr. Mgr., Advanced Analytics Customer Liaison Group, SAS Institute, SAS Campus Dr., Cary, NC, 27513, United States of America, Polly.Mitchell-Guthrie@sas.com, Panelists: Louise Wehrle, Esma Gel, Randy Bartlett

The Certified Analytics Professional (CAP®) Program will soon be within reach of more people with the launch this fall of the Associate Certified Analytics Professional. This new certification will retain the rigor of the current CAP and will allow candidates to pass the certification exam without the required work experience if those candidates have an MS in a related field. To earn the CAP, experience is still required. We expect this new offering to be particularly attractive to graduates of the many MS in Analytics degree programs where demand has been high. This panel will include the Chair of the Analytics Certification Board; the Certification Program Manager; a member of the Analytics Certification Board who is also the INFORMS VP of Sections and Societies; and a noted author, speaker, analytics professional as well as CAP. The panel will discuss the overall CAP program, the new offering, and where the program is headed.

■ MC30

30-Room 407, Marriott

Practice Presentations by INFORMS Roundtable Companies II

Sponsor: INFORMS Practice

Sponsored Session

Chair: Stefan Karisch, Digital Aviation Optimization & Value Strategy, Boeing Commercial Aviation Services, 55 Inverness Drive East, Englewood, CO, 80112, United States of America, stefan.karisch@jeppesen.com

1 - A Consultancy's Perspective on the Evolution of and Future Opportunity for Operations Research

Nick Nahas, Booz Allen Hamilton, 8283 Greensboro Drive, McLean, VA, 22102, United States of America, nahas_nicholas@bah.com, Cenk Tunasar

Big Data is popular and computation is fast and distributed, yet has the practice truly taken advantage of this in the same way as the Data Scientist? And what can the practice do, to use Big Data to enhance management decision making? And what innovations will this lead to? Booz Allen will explore these questions from our perspective as a global management and technology consulting firm with a diverse set of experiences solving today's greatest challenges in the public and private sector.

2 - Change Management for Analytics Projects

Irv Lustig, Optimization Principal, Princeton Consultants, 2 Research Way, Princeton, NJ, 08540, United States of America, irv@princeton.com, Zahir Balaporia, John Milne, Karl Kempf, Rahul Saxena

To gain the acceptance of analytics used for decision support, analytics professionals should use organizational change management principles. This paper provides advice to these professionals on these principles as they work with key users to gain acceptance of analytics. These ideas are drawn from the collective observations and insights of practitioners with decades of experience in the development and deployment of analytic methods for improved decision making.

3 - Engineering Technician Location Analytics

Dwayne Otis, Air Products and Chemicals, 7201 Hamilton Boulevard, Allentown, PA, 18195, United States of America, otisdk@airproducts.com

In this talk we present a model whose objective is to determine, within a given physical region, the near-optimal required number of technicians and their assigned home base locations in order to satisfy defined customer service levels. Ideally, the workload for each technician would be balanced and the total cost to meet the desired service level is minimized. Furthermore, we examine additional areas where this general technique could be applied.

MC31

31-Room 408, Marriott

Data Mining in Healthcare

Sponsor: Data Mining

Sponsored Session

Chair: Ramin Moghaddass, Assistant Professor, University of Miami, 1251 Memorial Dr, Coral Gables, FL, 33146, United States of America, ramin@miami.edu

1 - Influential Neighbor Analysis with a Hierarchical Bayesian Model

Ramin Moghaddass, Assistant Professor, University of Miami, 1251 Memorial Dr, Coral Gables, FL, 33146, United States of America, ramin@miami.edu, Cynthia Rudin

For a doctor with enough experience, almost every patient would have similarities to key cases seen in the past and each new patient could be viewed as a mixture of important pieces of these key past cases. Because doctors often tend to reason this way, an efficient computationally aided diagnostic tool might be helpful in locating key past cases of interest that could assist with diagnosis. We develop a model to mimic the type of logical thinking that physicians use when considering past cases.

2 - Falling Rule Lists

Fulton Wang, MIT, 5 Cambridge Center #792, Cambridge, MA, 02142, United States of America, fultonwang@gmail.com, Cynthia Rudin

Falling rule lists are classification models consisting of an ordered list of if-then rules, where (i) the order of rules determines which example should be classified by each rule, and (ii) the estimated probability of success decreases monotonically down the list. These kinds of rule lists are inspired by healthcare applications where patients would be stratified into risk sets and the highest at-risk patients should be considered first.

3 - Machine Learning for Clinical Decision Support for Heart Failure(HF) Readmission

Wei Jiang, PhD Student, Johns Hopkins University, 6606 Copper Ridge Drive Apt. 201, Baltimore, MD, 21209, United States of America, wjiang1990@gmail.com, Sean Barnes, Matthew Toerper, Scott Levin, Eric Hamrock, Sauleh Siddiqui, Stephanie Cabral

Predicting risk of HF readmission have gained increasing attention. Previous studies mainly used administrative data. We will focus on using clinical data from EMR for predicting HF readmission by creating structured data from unstructured clinical data and combining it with administrative data. Then we use classification models such as random forest and support vector machine for predicting purpose. In the end, we will demonstrate the value of clinical data in predicting HF readmission.

4 - Or's of and's for Interpretable Machine Learning: Prediction and Explanation

Tong Wang, Graduate Student, MIT, 70 Pacific Street, apt 242A, Cambridge, MA, 02139, United States of America, tongwang@mit.edu, Cynthia Rudin

We present a form of interpretable models for data prediction and explanation. The model is comprised of a small number of disjunctions of conjunctions (or's of and's). We apply OA models to solve two machine learning tasks, classification and causal effect analysis. We formed two integer linear programs to construct the optimal OA models that can achieve good performance and interpretability, by incorporating regularizations on the sparseness. We show that regularizations reduce computation.

MC32

32-Room 409, Marriott

Statistical Innovations in Computational Biology and Genomics

Cluster: Big Data Analytics in Computational Biology/Medicine
Invited Session

Chair: Mingyao Li, Statistical Innovations in Computational Biology and Genomics, University of Pennsylvania, 213 Blockley Hall, 423 Guardian Drive, Philadelphia, PA, 19104, United States of America, mingyao@mail.med.upenn.edu

1 - Prediction using Multinomial Inverse Regression in Microbiome Studies

Hongzhe Li, Professor of Biostatistics, University of Pennsylvania, 215 Blockley Hall, Philadelphia, PA, United States of America, hongzhe@mail.med.upenn.edu

Next-generation sequencing technologies allow 16S rRNA gene surveys or metagenome shotgun sequencing in order to characterize taxonomic composition. The data can be summarized as k-mer counts. We consider the regression problem for such high dimensional in order to build a model for predicting the clinical outcomes based on microbiome data and demonstrate its applications.

2 - Computational Validation of NGS Variant Calls using Genotype Data

Margaret Taub, Assistant Scientist, Johns Hopkins Department of Biostatistics, 615 N Wolfe St, E3527, Baltimore, MD, United States of America, mtaub@jhsph.edu, Suyash Shringarpure, Ingo Ruczinski, Rasika Mathias, Kathleen Barnes

We performed a comparison of different variant calling algorithms on 642 samples whole-genome sequenced to an average depth of 30x, focusing on characteristics of variants called by different subsets of callers. We developed a classifier which uses genotyping array data, often collected for all sequenced individuals, as a gold standard to improve calibration of variant calls. We found little difference in quality between single- and multi-sample calling methods at 30x coverage.

MC33

33-Room 410, Marriott

Topics in Health Systems

Sponsor: Health Applications

Sponsored Session

Chair: Douglas King, University of Illinois at Urbana-Champaign, 117 Transportation Bldg., 104 S. Mathews Ave., MC-238, Urbana, IL, 61801, United States of America, dmking@illinois.edu

1 - Methods in Treatment Planning with Continuous Dose Delivery

Kimia Ghobadi, Massachusetts Institute of Technology, 77 Massachusetts Ave, Cambridge, MA, United States of America, kimiag@mit.edu, David Jaffray, Dionne Aleman, Caroline Chung

In this work we investigate continuous dose delivery models and algorithms for head-and-neck patients. We discuss the necessary changes and considerations in the optimization models and algorithms for different tumour sites. We will also present the clinical realization of the plans and compare the obtained clinical results with the simulated treatment plans.

2 - Optimal Timing of Living-donor Liver Transplantation under Risk-aversion

Ozlem Cavus, Bilkent University, Department of Industrial Engineering, Ankara, 06800, Turkey, ozlem.cavus@bilkent.edu.tr, Umit Emre Kose, Oguzhan Alagoz, Andrew J. Schaefer

The timing of liver transplantation is crucial as it affects the quality and the length of the patients' life. Previous studies used risk-neutral Markov Decision Processes to optimize the timing of the transplantation. In this study, we model the risk-averse behavior of the patients using coherent dynamic measures of risk. We obtain optimal policies for different patients and donated organs. We also derive the structural properties of the optimal policy. Supported by TUBITAK [Grant 213M442].

3 - Forecasting Outcomes of Donor Liver Allocation Policies Given Growing Disparities in Supply and Demand

Rachel Townsley, North Carolina State University, Industrial and Systems Engineering, Raleigh, NC, rmtownsl@ncsu.edu,
Maria Mayorga

Health trends in the US general population point to a growing gap in the supply and demand of livers for transplantation. Obesity, diabetes, and an aging population are the cause of declining donor liver quality as well as the cause of growing transplant waitlists. We use UNOS data to develop agent based simulation models and evaluate 30-year outcomes of liver allocation in the US in light of these trends.

4 - An Efficient Contiguity-enforcement Algorithm for Practical Geographic Districting Problems

Douglas King, University of Illinois at Urbana-Champaign, 117 Transportation Bldg., 104 S. Mathews Ave., MC-238, Urbana, IL, 61801, United States of America, dmking@illinois.edu,
Sheldon Jacobson, Edward Sewell

Geographic districting applications include congressional districting, police districting, and deployment of emergency services. Often, these districts are required to be contiguous, imposing a substantial computational burden during optimization. By integrating assessment of district holes (i.e., enclaves), this talk presents efficient algorithms for enforcing contiguity when district composition is optimized with local search. Practical scaling properties of these algorithms will be discussed.

■ MC34

34-Room 411, Marriott

Joint Session HAS/MSOM-Healthcare: Managing Healthcare Operations

Sponsor: Health Applications

Sponsored Session

Chair: Craig Froehle, Professor, University of Cincinnati, Lindner College of Business, Lindner College of Business, Cincinnati, OH, 45221-0130, United States of America, froehlec@ucmail.uc.edu

1 - Data-driven Decision Making at Triage: Toward Better Patient Streaming in the Emergency Department

Elham Torabi, University of Cincinnati, Cincinnati, OH, torabiem@mail.uc.edu, Craig Froehle, Christopher Miller

The inadequacy of the ESI triage system potentially contributes to suboptimal patient routing and ED congestion. Using partitioning methods, we define new prioritization policies to further stratify the ESI-3 patients who make 50% of all patients. We evaluate the performance of the system under new policy using queueing models.

2 - The Cost of Waiting in Healthcare and Hospitality Services

Craig Froehle, Professor, University of Cincinnati, Lindner College of Business, Lindner College of Business, Cincinnati, OH, 45221-0130, United States of America, froehlec@ucmail.uc.edu,
Rohit Verma

The perceived cost of waiting to patients and customers has proven difficult to measure. Using a set of experiments, we compare how waiting is perceived in the contexts of healthcare and hospitality services. We examine the perceptions of waiting as well as "sequence" effects — where the wait occurs within the service process — and draw preliminary conclusions about how healthcare and hospitality services might better approach the management and mitigation of customer and patient waiting.

3 - Impact of Inspection Outcomes on Nursing Home Care Quality - Role of Ownership and Affiliation

Rachna Shah, Professor, University of Minnesota, Minneapolis, MN, United States of America, shahx024@umn.edu,
Gopalakrishnan Narayanamurthy, Anand G

Inspections and their impact on quality outcomes have been studied in many different settings. Surprisingly, this relationship has not been examined in the healthcare sector. In this study, we investigate the impact of inspection outcomes on future clinical (evidence-based) and experiential (patient-centered) quality in nursing homes using a unique secondary panel data.

4 - Addressing Challenges of Scheduling Providers at Major Teaching Hospitals

Brian Lemay, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, blemay@umich.edu,
Amy Cohn

When using optimization models for solving healthcare provider scheduling problems, multi-criteria objective functions are necessary, but often result in undesirable schedules. Additionally, it is frequently not possible to satisfy every scheduling preference, so compromises must be made to resolve the infeasible problem instances. We discuss our methods for overcoming these multi-criteria objective and infeasibility challenges for scheduling providers at two major teaching hospitals.

■ MC35

35-Room 412, Marriott

Practice-Based Research in Humanitarian Operations Management

Sponsor: Public Sector OR

Sponsored Session

Chair: Maria Besiou, Kuehne Logistics University, Grosser Grasbrook 17, Hamburg, Germany, Maria.Besiou@the-klu.org

1 - Fundraising for Operational Expenditures in International Humanitarian Aid

Laura Turrini, Köhne Logistics University, Großer Grasbrook 17, Hamburg, 20457, Germany, Laura.Turrini@the-klu.org,
Maria Besiou, Joern Meissner

Effectiveness of humanitarian programs depends on funding. Based on the programs operational needs, international humanitarian organizations estimate the operational expenditures and then appeal for donations. Donations affect services and the number of beneficiaries they will be able to reach. In this paper, using multiple regression analysis, we aim to shed more light on the operational implications of fundraising and on possible improvements of fundraising strategies for humanitarian programs.

2 - Disaster Response Test Cases: Representing Real Disasters

Azrah Azhar, Graduate Student, George Washington University, 800, 22nd Street NW, Washington, DC, 20052, United States of America, azrah@gwu.edu, Erica Gralla

In the humanitarian logistics literature, algorithms and policies are recommended based on their performance in test problem instances. Therefore, it is important that these test problems are representative of real disasters. We study twenty-seven real disaster instances, identify their characteristics and compare them to test problems from the humanitarian literature.

3 - Transition to Practice of Access Restoration in Post-disaster Humanitarian Logistics

Felipe Aros-Vera, Rensselaer Polytechnic Institute, Troy, NY, United States of America, arosvm2@rpi.edu, Jose Holguin-Veras

This presentation focuses on the technical challenges of the transition to practice of access restoration methodologies after disasters. It gives an overview of the integration of systems that provide: (1) initial assessment of transportation network conditions, (2) mathematical modeling, and (3) decision making process on the ground. The presentation builds on the implementation of access restoration models into the disaster response plans in the city of New York.

4 - Volunteer Management in Charity Storehouses

Maria Besiou, Kuehne Logistics University, Grosser Grasbrook 17, Hamburg, Germany, Maria.Besiou@the-klu.org,
Alfonso Pedraza-Martinez

We study volunteer management at a large faith-based organization. The whole supply chain operates exclusively with volunteers (from supply to delivery). We focus our study on the preparation of the beneficiaries' orders by volunteers in a storehouse. There are different categories of volunteers; some are more experienced while others may work in the system for the first time. Using empirical data we build a model to explore the drivers of on-time order fulfillment at the storehouse level.

■ MC36

36-Room 413, Marriott

Community-Based Operations Research II

Sponsor: Public Sector OR

Sponsored Session

Chair: Michael P. Johnson, Associate Professor, University of Massachusetts Boston, 100 Morrissey Blvd., McCormack Hall Room 3-428A, Boston, MA, 02125-3393, United States of America, Michael.Johnson@umb.edu

1 - Resource Allocation for Sustaining Interventions in the Education System

Donna Llewellyn, Executive Director, Boise State University, 1910 University Drive, ISDI - ACS 104, Boise, ID, 83725-1155, United States of America, donnallewellyn@boisestate.edu, Pratik Mital, Roxanne Moore

In this work, the Education System Intervention Modeling Framework (ESIM) is developed that can be used to analyze interventions in the K-12 education system. The framework aids in allocating resources to the more important parts of the system such that probability of sustaining the intervention can be maximized and the cost of implementation remains within the budget constraints. The framework can also be extended to analyze other complex systems like Healthcare, Humanitarian aid etc.

2 - Blending Systems Thinking Approaches for Organisational Diagnosis: Child Protection in England

David Lane, Henley Business School, Reading, United Kingdom d.c.lane@henley.ac.uk

The Department for Education's high-profile 'Munro Review of Child Protection' used a blend of systems thinking ideas. First, a compliance culture that had emerged was diagnosed. Then system dynamics generated a complex map of the intended and unintended consequences of previous policies and helped identify the sector's drivers. This led to recommendations that were systemically coherent, avoiding problems produced by previous policies. Government supported and implemented the recommendations.

3 - Multiple Resource Type Straddling a Standard with Applications in Election Resource Allocation

Theodore Allen, Associate Professor, The Ohio State University, 1971 Neil Avenue, 210 Baker Systems, Columbus, OH, 43221, United States of America, allen.515@osu.edu, Muer Yang

The challenge of guaranteeing that no one will wait over 30 minutes using simulation optimization is explored. Novel selection and ranking methods are proposed. Numerical results illustrate potential new guidelines and associated computational savings.

4 - Measures and Inference of Spatial Access to Pediatric Dental Care in Georgia

Monica Gentili, Georgia Tech, North Ave NW, Atlanta, GA, United States of America, mgentili3@mail.gatech.edu, Shanshan Cao, Nicoleta Serban, Susan Griffin

We develop a measurement and modeling framework to infer the impact of policy changes on disparities in spatial accessibility to pediatric dental care in Georgia. Our measurement models are based on optimization models that match need of service with supply under a series of user and provider system constraints. We compare the derived measures and evaluate the impact of policy interventions for two population groups (publicly insured and privately insured children) and for rural and urban areas.

■ MC37

37-Room 414, Marriott

Health Care Modeling and Optimization VII

Contributed Session

Chair: Kamil Ciftci, PhD Candidate, Lehigh University, H.S. Mohler Laboratory, 200 West Packer Ave., Bethlehem, PA, 18015, United States of America, kac208@lehigh.edu

1 - A Multi-Objective Algorithm for Optimizing Service Consistency in Periodic Vehicle Routing Problems

Kunlei Lian, University of Arkansas, Bell 4113, 1 University of Arkansas, Fayetteville, AR, 72701, United States of America, klian@uark.edu, Ashlea Milburn, Ronald Rardin

This research concerns optimizing service consistency in periodic vehicle routing problem, in which customers require repeatable visits over a time horizon and visits to a customer can only happen on one of his allowable visit day combination. Service consistency, including driver consistency and time consistency is optimized together with travel cost using a heuristic multi-objective algorithm. Large neighborhood search is used in the algorithm framework to optimize each objective separately.

2 - Conjugate Gradient Algorithms to Optimize RBE-weighted Dose in Intensity Modulated Proton Therapy

Guven Kaya, PhD Student, Industrial Engineering, University of Houston, E206 Engineering Bldg 2, Houston, TX, 77204, United States of America, gkaya@central.uh.edu, Gino Lim

Intensity modulated proton therapy (IMPT) usually operates a constant relative biological effectiveness (RBE). In fact, RBE is not constant. RBE is described as a function of dose, linear energy transfer (LET) and tissue type in the structure of the linear-quadratic (LQ) model. We study the optimization of radiobiological effects (dose and rbe-weighted dose) in the context of LQ model by using two conjugate gradient algorithms. For results, we use data for head and neck cancer case.

3 - Robust Surgery Scheduling with Exception Analytics

Yoonseun Lee, The Pennsylvania State University, 236 Leonhard Building, University Park, PA, 16802, United States of America, yxl5250@psu.edu, Vittaldas Prabhu

In this study, we address a surgery scheduling problem with uncertain surgery duration where surgical procedure takes place in multiple operating rooms. We present a robust surgery scheduling model and study its performance using exception analytics approach. We perform numerical experiments to compare performances of various models including simple heuristics, and find out that the results illustrate that the robust models with exception analytics works well across different instances.

4 - Intertemporal Decisions in Hospital Capacity Planning

Jorge Vera, Professor, Universidad Catolica de Chile, Dept. Industrial and System Engineering, Vicuna Mackenna 4860, Santiago, Chile, jvera@ing.puc.cl, Ana Batista

Correct planning of capacity in a hospital is crucial for high standards of service to patients. The problem is complex not only because of the different areas in a large hospital but also because of several uncertainties present in the system, like patient demand or length of stay. In this work we show how we could use an intertemporal hierarchical decisions modeling to address this problem. We present model alternatives as well as solution methods based on Stochastic Optimization

5 - Workload Balancing Problem in an Outpatient Center under Uncertainty

Kamil Ciftci, PhD Candidate, Lehigh University, H.S. Mohler Laboratory, 200 West Packer Ave., Bethlehem, PA, 18015, United States of America, kac208@lehigh.edu

Creating fair nurse workload in infusion center is a difficult task due to uncertainty in patient late cancelation and no-show while patient satisfaction is top priority for hospital. In this study, we propose two-stage stochastic program model to find best combination of nurse workload balancing schedule (NWBS) and patient waiting time (PWT) under different uncertainties. Computational results show that proposed methodology provides better NWBS and keeps average PWT under hospital goal.

■ MC38

38-Room 415, Marriott

Dynamic Programming and Control I

Contributed Session

Chair: Jefferson Huang, Stony Brook University, Dept. Applied Mathematics & Statistics, Stony Brook, NY, 11794-3600, United States of America, jefferson.huang@stonybrook.edu

1 - Dynamic Pricing Mapreduce Model

Minghong Xu, Doctoral Student, University of Illinois at Chicago, 600 S. Morgan St., Chicago, IL, 60607, United States of America, summerinxu@gmail.com, Sid Bhattacharya, Kunpeng Zhang

Dynamic programming breaks the problem down into a collection of simpler subproblems and has the optimal substructure. But it suffers from "curse of dimensionality". On the other hand, distributed implementation using MapReduce has been proved to be an efficient tool that solved a lot of large-scale problems. In this study, the Big Data era technics is used to solve Big State Space. A MapReduce Model is proposed for a Dynamic Pricing problem using E-Commerce data.

2 - Energy Storage Management in Microgrids: A Supplier's Perspective

Arnab Bhattacharya, University of Pittsburgh, 6236 Fifth Avenue, Apt. 102A, Pittsburgh, PA, 15232, United States of America, arb141@pitt.edu, Jeffrey Kharoufeh

We consider a renewable energy supplier's problem of optimally procuring, selling and storing energy when renewable supplies and real-time prices are uncertain. A finite-horizon MDP model is formulated and solved to maximize the supplier's total expected (discounted) net profits, subject to storage capacity and transmission constraints.

3 - Dynamic Credit-collections Optimization

Naveed Chehraz, Assistant Professor, McCombs School of Business, 2110 Speedway Stop B6500, Austin, TX, 78705, United States of America, naveed.chehraz@mcombs.utexas.edu, Peter Glynn, Thomas Weber

We develop a dynamic model of consumer repayment behavior on delinquent credit-card loans using a marked point process. The intensity of this point process can be influenced by costly treatment actions. Both the type and the timing of the account-treatment actions are subject to optimization, leading to an optimal impulse control problem. Using the HJB equation, we obtain a quasi-closed form solution for this control problem.

4 - Complexity Estimates for Policy and Value Iteration Algorithms for Total-cost and Average Cost MDPs

Jefferson Huang, Stony Brook University, Dept. Applied Mathematics & Statistics, Stony Brook, NY, 11794-3600, United States of America, jefferson.huang@stonybrook.edu, Eugene Feinberg

We present two groups of results: an example showing that the value iteration algorithm and its modifications are not strongly polynomial for discounted MDPs, and reductions of certain total-cost and average-cost MDPs to discounted ones. Combining the latter with Yinyu Ye's result on the strong polynomiality of the simplex method and policy iterations for discounted MDPs allows us to design strongly polynomial algorithms for important classes of total-cost and average-cost MDPs.

MC39

39-Room 100, CC

Branding and Bundling

Cluster: Operations/Marketing Interface

Invited Session

Chair: Kathy Steckle, UT Dallas, SM30 JSOM, 800 W Campbell Rd, Richardson, TX, 75080, United States of America, ksteckle@utdallas.edu

1 - Consumer Taste Uncertainty in the Context of Store Brand and National Brand Competition

Saibal Ray, Professor, McGill University, 1001 Sherbrooke Street West, Montreal, Canada, saibal.ray@mcgill.ca, Tamer Boyaci, Arcan Nalca

We focus on the uncertainty in consumer taste and study how a retailer can benefit from acquiring that taste information in the presence of competition between its store brand and a national brand. We also identify the optimal information sharing strategy of the retailer as well as the equilibrium product positioning and pricing of the brands. We generate insights as to when it is most valuable for the retailer to acquire taste information as well its value for the manufacturer.

2 - Retail Assortment and Price Competition when Consumers are Uncertain about Product Tastes

Steve Gilbert, Professor, University of Texas at Austin, 1 University Station, B6500, The University of Texas at Austin, Austin, TX, 78712, United States of America, Steve.Gilbert@mcombs.utexas.edu, Haoying Sun

For many products, at least some consumers may need to physically experience them in order to assess their valuations. For such products, we provide conditions under there will be an equilibrium between two symmetric retailers in which one carries both products and the other carries only one. In addition, we find that the pricing strategy that should be adopted by each retailer differs substantially depending upon his rival's assortment.

3 - Demand Shaping through Bundling and Configuration:**A Dynamic Multiproduct Inventory-pricing Model**

Zhengliang Xue, IBM Research Center, Yorktown Heights, NY, United States of America, zxue@us.ibm.com, Jeannette Song

Motivated by the industrial practice of using product bundling to shape demand, we present a dynamic model to analyze the optimal joint inventory, pricing, and bundling decisions for a firm selling vertically differentiated bundles over a finite horizon. We study the factors driving the bundling strategy, and provide insights into when to change the bundling strategies. Such strategies have a broad application in practice such as pricing the configuration of server and accessories.

4 - Should a Retailer Consider Adding a Social Network Enabled Channel?

Gulver Karamemis, University of Florida, 355A STZ, Gainesville, FL, 32611, United States of America, gulver.karamemis@warrington.ufl.edu, Narendra Agrawal, Subhajyoti Bandyopadhyay, Asoo Vakharia

Social networks are one of the most exciting recent developments that have influenced the relationships between individuals and between individuals and organizations. However, due to its relative infancy as well as the myriad data and security related concerns of consumers, retailers have been slow to dive into social networks as a sales channel. Our research sheds light on the question of when retailers should consider adding a social network channel to their existing channel architecture.

MC40

40- Room 101, CC

Micro-Underpinnings of Mobility, Knowledge, and Performance in Groups and Organizations

Sponsor: Organization Science

Sponsored Session

Chair: Aimee Kane, Duquesne University, Pittsburgh, PA, kanea@duq.edu

Co-Chair: Gina Dokko, University of California, Davis, CA

1 - Managing Talent across Organizations: the Portability of Individual Performance

Gina Dokko, University of California, Davis, Davis, CA, Winnie Jiang

As individuals' careers increasingly unfold in diverse ways, the question of what they carry with them as they cross organizational or institutional boundaries becomes increasingly important. In this essay, we review findings on the portability of individual performance and develop a framework for thinking about talent management in organizations that accounts for the movement of individuals in and out of organizations and the complexity of modern careers.

2 - Using What You Know: Inventor Mobility to Young Firms

Erin Fahrenkopf, Carnegie Mellon University, Pittsburgh, PA, efahrenkopf@gmail.com

The research addresses the conditions under which individuals at entrepreneurial firms exploit knowledge from prior organizational experiences. In particular, I examine the effect of engaging in collaborative work and organizational roles on individuals' knowledge use at young firms. I study a sample of inventor movements, both founders and employees, in the US laser industry and provide implications for the study of entrepreneurship and knowledge transfer by employee movements.

3 - Overcoming Barriers to Team Receptivity to Newcomers

Aimee Kane, Duquesne University, Pittsburgh, PA, kanea@duq.edu, Floor Rink

Newcomers bring with them unique perspectives drawn from prior experience, but, due to social psychological barriers, there is a pervasive tendency for teams to push newcomers to assimilate to the team rather than utilize their valuable knowledge. This contribution draws on evidence from small group experiments and vignette studies to suggest ways of replacing this resistance with receptivity to newcomer's unique knowledge, which are also amendable to managerial, team, and newcomer intervention.

4 - Shady Characters: How Illicit Roles Contribute to Team Performance

Colleen Stuart, Johns Hopkins University, Baltimore, MD, cstuart@jhu.edu, Celia Moore

In this paper we theorize about illicit roles, roles that specialize in activity that contravenes rules or regulations to support group goals. We use data on professional hockey teams to examine how team performance is disrupted when the enforcer, a player who specializes in the prohibited activity of fighting, is injured. We discuss how our understanding of illicit roles can be used to build theory about informal organizational roles and the implications of these roles for mobility in teams.

■ MC41

41-Room 102A, CC

Joint Session MSOM-Health/HAS/Analytics: Data-Driven Modeling in Healthcare III

Sponsor: Manufacturing & Service Oper

Mgmt/Healthcare Operations

Sponsored Session

Chair: Mehmet Ayyaci, Asst Professor, University of Texas-Dallas, School of Management, Richardson, TX, 75080, United States of America, mehmet.ayyaci@utdallas.edu

1 - Making the Case for Case Management

Margret Bjarnadottir, Assistant Professor of Management Science and Statistics, Robert H. Smith School of Business, University of Maryland, 4324 Van Munching Hall, College Park, MD, 20742, United States of America, margret@rhsmith.umd.edu, David Anderson

Most case management programs target current high-cost patients. However the real cost savings potential is including lower cost patients at high risk of future high costs. We demonstrate the potential of association rules for identification of these high value patients and derive a general upper bound methodology on classification performance.

2 - Managing Office Revisit Intervals and Patient Panel Sizes in Primary Care

Hessam Bavafa, Assistant Professor, Wisconsin School of Business, Madison, WI, United States of America, hbavafa@bus.wisc.edu

In recent years, the drive to contain health care costs in the US has increased scrutiny of the traditional mode of delivering primary care where a patient is treated by his primary care physician during a face-to-face visit. In particular, two approaches, the use of “e-visits” and greater reliance on non-physician providers, have been suggested as lower-cost alternatives to the traditional set-up. In this paper, we consider a patient panel and develop a new model of patient health dynamics.

3 - Outpatient-clinic Capacity Management when Continuity of Care Matters

Yichuan Ding, UBC, 2053 Main Mall, Sauder School of Business, Vancouver, BC, V6T1Z2, Canada, daniel.ding@sauder.ubc.ca, Diwakar Gupta, Xiaoxu Tang

We study how to manage capacity in an outpatient clinic with the goal of maximizing service volume as well as maintaining high level of continuity of care (COC). We consider a simple strategy that doctors may use to improve COC — book a follow-up appointment (FUA) for a patient before she leaves the clinic. In order to encourage the doctor to use this strategy, the current fee-for-service mechanism must be revised to compensate doctors for FUAs that are no show or late cancelled.

4 - The Impact of Health Information Exchanges on Emergency Department Length of Stay

Jan Vlachy, PhD Student, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, vlachy@gatech.edu, Turgay Ayer, Mehmet Ayyaci, Zeynal Karaca

Electronic exchange of health information (HIE) is expected to improve coordination in emergency departments (ED). We empirically study the impact of HIEs on ED length of stay (LOS) using a large longitudinal dataset comprising about 5.8 million visits to 63 EDs over three years. Overall, we find that HIE adoption is associated with substantial reductions in LOS, but this impact depends on various contextual and situational factors.

■ MC42

42-Room 102B, CC

Joint Session MSOM-Health/HAS/Analytics: Healthcare Analytics

Sponsor: Manufacturing & Service Oper

Mgmt/Healthcare Operations

Sponsored Session

Chair: Tinglong Dai, Assistant Professor, Johns Hopkins University, 100 International Dr, Baltimore, MD, 21202, United States of America, dai@jhu.edu

Co-Chair: Song Hee Kim, Assistant Professor, Marshall School of Business, University of Southern California, Los Angeles, CA, United States of America, songheck@marshall.usc.edu

1 - Efficient Spatial Allocation of Epidemic Intervention Resources with a Focus on Ebola in West Africa

Eike Nohdurft, Research Assistant, WHU - Otto Beisheim School of Management, Burgplatz 2, Vallendar, 56179, Germany, eike.nohdurft@whu.edu, Elisa Long, Stefan Spinler

The recent Ebola outbreak has shown that containment of an infectious disease relies on deployment and allocation of intervention resources. A model reducing the number of infections through improved allocation is proposed. Allocation decisions are based on a spatial compartmental epidemic model with a novel factor dynamically incorporating behavioral change in the population. Our approach could avoid up to 23% of the infections.

2 - Information Aggregation and Classification under Anchoring Bias: Application to Breast Imaging

Mehmet Eren Ahsen, Researcher, IBM Research, 1101 Route 134 Kitchawan RD #13-146C, Yorktown Heights, NY, 10598, United States of America, mahsen@us.ibm.com, Mehmet Ayyaci, Srinivasan Raghunathan

We study optimal aggregation and subsequent classification for the case of two sources of information where the interpretation of the primary information (mammography) is biased by the secondary information (risk profile). We examine the relationship between bias, weights assigned, and the decision thresholds in the context of optimal utility or the optimal discriminative ability.

3 - Priority and Predictability

Jillian A Berry Jaeker, Assistant Professor, Boston University, 595 Commonwealth Avenue, Boston, MA, 02215, United States of America, jjaeker@bu.edu

This study explores how patient admission characteristics (i.e. whether a patient is scheduled or emergent; medical or surgical) moderate the effects of high workload and demand. In particular, the probabilities of admission and discharge, by patient type are analyzed. The results of this study provide an estimation of the impact of predictability on patient flow.

4 - Decision Ambiguity and Conflicts of Interests in Interventional Cardiology Decision-Making

Tinglong Dai, Assistant Professor, Johns Hopkins University, 100 International Dr, Baltimore, MD, 21202, United States of America, dai@jhu.edu, Chao-wei Hwang, Xiaofang Wang

With the rapidly rising cost of health care, there is a renewed urgency for reducing inappropriate use of percutaneous coronary interventions (PCI). In this work, we provide a quantitative analytical model of clinical and non-clinical factors influencing PCI decision-making processes. Our model helps inform policy-makers designing guidelines to optimize the use of PCI.

■ MC43

43-Room 103A, CC

Game Theoretic Models in Revenue Management II

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Santiago Balseiro, Assistant Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, srb43@duke.edu

Co-Chair: Ozan Candogan, University of Chicago, Booth School of Business, Chicago, IL, United States of America, ozan.candogan@chicagobooth.edu

1 - Learn and Screen: A Strategic Approach to Collaborative Inventory Management

Bharadwaj Kadiyala, PhD Candidate, The University of Texas at Dallas, 800 West Campbell Road, 3.218, Dallas, TX, 75080, United States of America, bharadwaj.kadiyala@utdallas.edu, Ozalp Ozer

We propose a dynamic mechanism for a supplier who periodically replenishes inventory with partial knowledge of demand distribution. By combining the best of Bayesian updating and screening mechanism, we show that in addition to maximizing profit, inventory decisions also serve a strategic purpose in eliciting demand information from the buyer.

2 - Optimal Contracts for Intermediaries in Online Advertising

Santiago Balseiro, Assistant Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, srb43@duke.edu, Ozan Candogan

The prevalent method online advertisers employ to acquire impressions is to contract with an intermediary. We study the optimal contract offered by the intermediary when advertisers' budgets and targeting criteria are private. We introduce a novel approach to tackle the resulting multi-dimensional dynamic mechanism design problem, and show that an intermediary can profitably provide bidding service to a budget-constrained advertiser and at the same time increase the overall market efficiency.

3 - Selling Information in Oligopolies

Alireza Tahbaz-Salehi, Columbia Business School, 3022 Broadway, Uris Hall 418, New York, NY, 10023, United States of America, alirezat@columbia.edu, Kostas Bimpikis, Davide Cripis

This paper studies the strategic interaction between a monopolist seller of an information product and a set of potential buyers that compete in a downstream market. We argue that the nature of competition among the buyers largely determines the price and accuracy of the product that the monopolist decides to sell.

4 - Analysis of a Simple Cost Allocation Rule for Joint Replenishment

Xuan Wang, New York University, 44 West 4th Street, Suite 8-154, New York, NY, 10012, United States of America, xwang3@stern.nyu.edu, Jiawei Zhang, Simai He, Jay Sethuraman

We consider the joint replenishment game in which the major setup cost is split equally among the retailers who place an order together. Each retailer pays his own holding and minor setup cost. Under this allocation rule each retailer determines his replenishment policy to minimize his own cost anticipating the other retailers' strategy. We show that a payoff dominant Nash equilibrium exists and quantify the efficiency loss of the non cooperative outcome relative to the social optimum.

■ MC44

44-Room 103B, CC

Empirical and Data-Driven Research in Revenue Management and Pricing

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Jun Li, Assistant Professor, Ross School of Business, University of Michigan, 701 Tappan St, Ann Arbor, 48103, United States of America, junwli@umich.edu

Co-Chair: Serguei Netessine, Professor, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, Serguei.Netessine@insead.edu

1 - Interpreting "3 Seats Left": An Empirical Analysis of Airline Inventory Announcements

Kate Ashley, UC Berkeley Haas School of Business, 2220 Piedmont Ave, Berkeley, CA, 94720, United States of America, kate_ashley@haas.berkeley.edu, Pnina Feldman, Jun Li

Does inventory announcement affect the timing of customer purchases? We estimate the impact of inventory announcement policy on purchases of airline tickets. We analyze the extent to which customers treat messages from the firm as cheap talk or credible information, and the extent to which firms use announcements strategically to influence demand.

2 - Contextual Treatment Selection and its Application to Pricing Optimization

Yan Zhao, MIT, 77 Mass Ave, 1-245, Cambridge, MA, United States of America, zhaoyan@mit.edu

With the rapid growth of eCommerce, the wealth of data makes it possible to exploit the heterogeneity among customer pricing sensitivity and maximize revenue. We develop a general framework for the customized pricing problem and propose a tree-based algorithm, which shows superior performance on both simulated data and real transaction data. Under mild regularity conditions we prove the upper bound of the difference of expected revenue between a simplified version of our algorithm and an oracle.

3 - Dynamic Pricing and Inventory Management: An Empirical Perspective

Yan Shang, PhD Student, Duke University, 845 Ivy Meadow Ln, Apt. 3D, Durham, NC, 27707, United States of America, yan.shang@duke.edu, Yiting Deng, Jing-Sheng Song

This paper applies structural modeling to study joint inventory and pricing management of perishable product, using fresh vegetable data from the largest state-owned supermarket chain in China. Demand of fresh vegetables depends not only on price but also freshness, and complementarity exists between items. We use a multiple continuous model to incorporate these features. Based on demand estimates, optimal prices are solved, which achieves significant profit improvement and waste reduction.

■ MC45

45-Room 103C, CC

From Store to Omni-Channel: Choice-Driven Pricing Models

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Stefanus Jasin, Stephen M. Ross School of Business, University of Michigan, Ann Arbor, MI, United States of America, sjasin@umich.edu

Co-Chair: Joline Uichanco, Asst. Professor, University of Michigan, Ross School of Business, 701 Tappan Ave, Ann Arbor, MI, 48109, United States of America, jolineu@umich.edu

1 - Drivers of Demand for Consumer Packaged Goods that Have Wide Variations in Price and Perceived Quality

Olga Pak, Student, University of South Carolina, 1014 Greene Street, Columbia, SC, 29208, United States of America, olga.pak@grad.moore.sc.edu, Mark Ferguson

In joint work with Oracle Retail, we identify the drivers of demand for consumer packaged goods that have wide variations in price and perceived quality. We investigate the problem with the use of hierarchical models on retail transaction data across multiple market and store locations to analyze the influence of prices, promotions and individual store effects.

2 - Integrated Lifecycle Price and Inventory Optimization in an Omni-channel Environment

Pavithra Harsha, IBM, 1101 Kitchawan Road, Room 34-225, Yorktown Heights, NY, 10598, United States of America, pharsha@us.ibm.com, Shivaram Subramanian, Joline Uichanco, Markus Ettl

In an omni-channel environment, inventory is shared across channels through multiple fulfillment options (e.g. ship-from-store). Without accounting for this, existing pricing solutions take steep markdowns in stores. We present a tractable optimization model to determine optimal lifecycle channel prices, inventory allocations and partitions across channels that maximizes the total chain level profit. Our experiments show a 6-12% improvement in profit over multiple categories of a large retailer.

3 - Data-driven Learning in Dynamic Pricing using Adaptive Optimization

Phebe Vayanos, Assistant Professor, University of Southern California, 3551 Trousdale Pkwy, University Park, Los Angeles, CA, 90089, United States of America, pvayanos@mit.edu, Dimitris Bertsimas

We consider the pricing problem faced by a retailer endowed with a finite inventory of a product with unknown demand curve offered to price-sensitive customers. We formulate the seller's problem as an adaptive optimization problem with decision-dependent uncertainty set and propose a tractable solution approach.

■ MC46

46-Room 104A, CC

Pricing and Strategic Behavior in Queueing Systems

Sponsor: Manufacturing & Service Oper Mgmt/Service Operations

Sponsored Session

Chair: Philipp Afeche, Associate Professor, University of Toronto, 105 St. George Street, Toronto, ON, M5S3E6, Canada, afeche@rotman.utoronto.ca

1 - Pricing, Diagnosis and Overtreatment in Expert Services

Senthil Veeraraghavan, Associate Professor, The Wharton School, 3730 Walnut St, Philadelphia, PA, 19104, United States of America, senthily@wharton.upenn.edu

In many services, consumers must rely on advice of experts to identify the type of treatment/service they need. The information asymmetry between service provider and the consumers creates inefficiencies in the form of cheating and over-treatment. We show that congestion and waiting costs act as natural "fraud costs" which mitigate cheating, inducing honesty and increasing social welfare. We show the informational value of pricing in inducing either honesty or overtreatment.

2 - Value of Dynamic Pricing in Congestible Systems

Jeunghyun Kim, University of Southern California, Marshall School of Business, Bridge Hall 401, Los Angeles, CA, 90089, United States of America,
jeunghyun.kim.2015@marshall.usc.edu, Ramandeep Randhawa

From UBER to express lanes on highways, dynamically changing the premium for access to limited resources based on congestion is prevalent. Our research question is: what is the value of dynamic pricing over static pricing in such systems. By modeling a firm that caters to price- and delay-sensitive customers, we analytically prove that the value can be significant and a simple dynamic scheme of using only two price points reaps most of this value.

3 - Price Competition with Customer Search in Congested Environments

Laurens Debo, Associate Professor, Dartmouth College, 100 Tuck Hall, Hanover NH 03755, United States of America,
laurens.g.debo@tuck.dartmouth.edu, Varun Gupta, Luiyi Yang

We study how firms compete in service rate when congestion-sensitive customer search, at some cost, for the firm with the shortest line. We find that decreasing search costs increases search and intensifies service rate competition, which reduces firms' equilibrium profits. Firms can get around by inflicting random costs on customers.

4 - Learning and Earning for Congestion-prone Service Systems

Philipp Afeche, Associate Professor, University of Toronto, 105 St. George Street, Toronto, ON, M5S3E6, Canada,
afeche@rotman.utoronto.ca, Bora Keskin

We consider a firm that sells a service in a congestion-prone system to price- and delay-sensitive customers. The firm faces Bayesian uncertainty about the consumer demand for its service and can dynamically make noisy observations on the demand. We characterize the structure and performance of the myopic Bayesian policy and well-performing variants. Our results show that capacity constraints have an important effect on performance.

MC47

47-Room 104B, CC

Energy Operations and Energy Efficiency

Sponsor: Manufacturing & Service Oper Mgmt/Sustainable Operations

Sponsored Session

Chair: Nur Sunar, Assistant Professor, University of North Carolina, Kenan-Flagler School of Business, Chapel Hill, NC, United States of America, Nur_Sunar@kenan-flagler.unc.edu

1 - A Unifying Framework for Consumer Surplus under Stochastic Demand

Georgia Perakis, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, georgiap@mit.edu, Maxime Cohen, Charles Thraves

We present a general extension of the consumer surplus for stochastic demand under several capacity rationing rules. We derive this extension from a graphical approach as well as from a utility maximization perspective. We then use this definition to study the impact of demand uncertainty on consumers in interesting applications including the electric vehicle market. We show that in many cases demand uncertainty may actually hurt consumers.

2 - Optimal Utilization of Energy Storage for Energy Shifting

Gilvan (Gil) Souza, Professor, Indiana University, Kelley School of Business, Bloomington, IN, 47405, United States of America, gsouza@indiana.edu, Shanshan Hu, Shanshan Guo

Batteries may be used for energy shifting in the power system: storing electricity when the power supply is abundant and cheap, and releasing electricity when the supply is tight and more expensive. Both permanent capacity loss and useful life of a battery are affected by discharge decisions in energy shifting. This paper studies the optimal discharge decisions that maximize the total profit of energy shifting in a battery's entire life.

3 - Do Profitable Carbon Emission Reduction Opportunities Decrease Over Time? A Perspective Based on CDP

Christian Blanco, University of California-Los Angeles, Los Angeles, CA, United States of America
christian.noel.blanco@gmail.com, Felipe Caro, Charles Corbett

Using climate change-related surveys collected by CDP (formerly the Carbon Disclosure Project), we investigate if firms experience decreasing opportunities for profitable initiatives to reduce greenhouse gas emissions. We also characterize payback and marginal abatement costs of these energy efficiency investments over time.

4 - Strategic Commitment to a Production Schedule with Supply and Demand Uncertainty: The Renewable Power

Nur Sunar, Assistant Professor, University of North Carolina, Kenan-Flagler School of Business, Chapel Hill, United States of America, Nur_Sunar@kenan-flagler.unc.edu, John Birge

How should a renewable power producer strategically commit to a production schedule in a day-ahead electricity market? How does this commitment affect the day-ahead price? Motivated by these important questions, we introduce and analyze via the ODE theory a supply function competition model with demand and supply uncertainty. Using our novel equilibrium characterization, we study the implications of different penalty schemes and subsidy for equilibrium production schedules and market outcomes.

MC49

49-Room 105B, CC

Emerging Topics in Supply Chain Management

Sponsor: Manufacturing & Service Oper Mgmt/Supply Chain

Sponsored Session

Chair: Hakjin Chung, Stephen M. Ross School of Business, University of Michigan, Ann Arbor, MI, United States of America, hakjin@umich.edu

Co-Chair: Kun Soo Park, Assistant Professor, KAIST College of Business, 85 Hoegi-ro, Dongdaemun-gu, Seoul, 130722, Korea, Republic of, kunsoo@kaist.ac.kr

1 - The Newsvendor under Demand Ambiguity: Combining Data with Moment and Tail Information

Soroush Saghafian, Harvard University, 79 JFK Street, Cambridge, MA, 02138, United States of America, Soroush.Saghafian@asu.edu, Brian Tomlin

Data-driven approaches typically assume that the planner has no information beyond the evolving history of demand observations. The planner may, however, have partial information about the demand distribution in addition to demand observations. We propose a non-parametric, maximum-entropy based technique, termed SOBME (Second Order Belief Maximum Entropy), which allows the planner to effectively combine demand observations with partial distributional information.

2 - Managing The Supply-demand Mismatch with Complementary Product Flow Options

Alexander Angelus, University of Texas, Jindal School of Management, Dallas, TX, United States of America, alexandar.angelus@utdallas.edu, Ozalp Ozer

To address the pervasive supply-demand mismatch in multi-stage supply chains with stochastic demand, we use the option to expedite shipments downstream to manage excess demand, and allow for returns of stock upstream to deal with excess inventory. We identify the optimal policy that decomposes this multi-dimensional problem into single-dimensional subproblems. Our numerical studies of supply chains with both expediting and returns of stock find those two product flow options to be complementary.

3 - Capacity Investment with Demand Learning

Anyan Qi, Assistant Professor, University of Texas at Dallas, 800 W Campbell Rd, Richardson, TX, 75080, United States of America, axq140430@utdallas.edu, Amitabh Sinha

We study a firm's strategy to adjust its capacity using information learned from observed demand. We characterize the firm's optimal policy and develop an easily-implementable and data-driven heuristic about when and by how much the firm should adjust its capacity. We also numerically validate the performance of our heuristic.

4 - Sequential Capacity Allocation under Order Manipulation: Efficiency and Fairness

Kun Soo Park, Assistant Professor, KAIST (Korea Advanced Institute of Science and Technology), 410 Supex Bldg, 85 Hoegiro, Dongdaemun-g, Seoul, Korea, Republic of, kunsoo@business.kaist.ac.kr, Seyed Iravani, Bosung Kim

We analyze the strategic behaviors of the supplier and manufactures in sequential capacity allocations when the manufacturers' order strategy is not necessarily truthful to the supplier. We show how an allocation changes under order manipulation and consider two directions to improve sequential allocation mechanisms under order manipulation from the perspective of efficiency and fairness of an allocation.

■ MC50

50-Room 106A, CC

Retail Supply Chain: From Demand Forecast to Order Fulfillment

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Santiago Gallino, Tuck School of Business,
100 Tuck Hall, Hanover, NH, United States of America,
santiago.gallino@tuck.dartmouth.edu

1 - How an e-Retailer can Profit from the Right Free Shipping Policy: A Model and Evidence

Joseph (Jiaqi) Xu, The Wharton School, University of
Pennsylvania, 3730 Walnut Street, Suite 500, Philadelphia, PA,
United States of America, jiaqixu@wharton.upenn.edu,
Gerard Cachon, Santiago Gallino

We present a model of online retail profitability when customers purposely increase their order size to qualify for free shipping. While this behavior results in more sales, it also adds cost from less shipping revenue and more product returns. We find that free shipping threshold often decreases profitability and is effective only for retailers with high fulfillment cost relative to shipping revenue and with low probability of return. The model is applied to data from an online retailer.

2 - Can Supply Chain Flexibility Facilitate Information Sharing?

Mohammad M. Fazel-Zarandi, PhD Candidate, Rotman School of
Management, 105 St. George Street, Toronto, M5S 3E6, Canada,
M.FazelZarandi10@Rotman.Utoronto.Ca, Oded Berman,
Dmitry Krass

We attempt to provide an explanation for a long-standing observation in supply chain management: while simple contracts cannot induce credible forecast sharing between different supply chain parties, firms often use them in practice, and exchange information through unverifiable communication. Using a stylized supply chain model, we show that if the reporting firm is uncertain about the receiving firm's reaction to its report, it may truthfully share its private information in equilibrium.

3 - Improving Color Trend Forecasting using Social Media Data

Youran Fu, PhD Student, The Wharton School,
3730 Walnut St, Philadelphia, PA, United States of America,
youranfu@wharton.upenn.edu, Marshall Fisher

We partnered with a leading apparel retailer to investigate how to use social media data to improve fashion color trend forecasting. We find that using fine-grained Twitter data and a Google search volume index to predict style-color sales three months out reduces forecast error by 11% compared to conventional methods.

4 - Wisdom of Crowds: Forecasting using Prediction Markets

Ruomeng Cui, Assistant Professor, Indiana University, 309 E.
Tenth Street, Bloomington, IN, 47401, United States of America,
cui@indiana.edu, Achal Bassamboo, Antonio Moreno-Garcia

Prediction markets are virtual markets created to aggregate predictions from the crowd. We examine data from a public prediction market and internal prediction markets run at three corporations. We study the efficiency of these markets in extracting information from participants. We show that the distribution forecasts, such as sales and commodity prices predictions, generated by the crowds are perfectly calibrated. In addition, we run a field experiment to study drivers of forecast accuracy.

■ MC51

51-Room 106B, CC

Dynamic Contracts in Operations Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Hao Zhang, Associate Professor, University of British Columbia,
Sauder School of Business, Vancouver, BC, V6T1Z2, Canada,
hao.zhang@sauder.ubc.ca

1 - Optimal Long-term Supply Contracts with Asymmetric Demand Information

Wenqiang Xiao, Associate Professor, New York University, Stern
School of Business, 44 West Fourth Street, 8-72, New York, NY,
10012, United States of America, wxiao@stern.nyu.edu,
Ilan Lobel

We consider a manufacturer selling to a retailer with private demand information arising dynamically over an infinite time horizon. We show that the manufacturer's optimal dynamic long-term contract takes a simple form: in the first period, based on her private demand forecast, the retailer selects a wholesale

price and pays an associated upfront fee, and, from then on, the two parties stick to a simple wholesale price contract with the retailer's chosen price.

2 - Dynamic Mechanisms for Online Advertising

Hamid Nazerzadeh, University of Southern California, Bridge
Memorial Hall, 3670 Trousdale Parkway, Los Angeles, CA, 90089,
United States of America, hamidnz@marshall.usc.edu,
Vahab Mirrokni

I will discuss designing dynamic contracts for selling display advertising. I will show that under natural but rather restricted assumptions, the traditional reservation contracts can be revenue-optimal. I will also present the optimal mechanism in a general setting and discuss their practical implementations.

3 - Dynamic Short-term Contracts under Private Inventory Information and Backlogging

Lifei Sheng, PhD Candidate, University of British Columbia, 2053
Main Mall, Vancouver, BC, V6T1Z2, Canada,
Fay.Sheng@sauder.ubc.ca, Mahesh Nagarajan, Hao Zhang

We study a setting where a supplier sells to a retailer facing random demand over multiple periods. At the beginning of each period, the supplier offers a one-period contract and the retailer decides his order quantity before the demand realizes. The retailer carries leftover inventory or backlogs unmet demand, which is unobservable by the supplier. We show interesting properties of the supplier's optimal contract and study special cases when the problem is tractable.

4 - Structures of Optimal Dynamic Mechanisms

Alexandre Belloni, Professor Of Decision Sciences, Duke
University, 100 Fuqua Drive, Duke University, Durham, NC,
27708, United States of America, abn5@duke.edu, Peng Sun,
Bingyao Chen

Consider a principal procures up to one unit of a product/service in every period from an agent who is privately informed about its marginal production cost in each period. We identify regularity conditions on the distribution of private information under which the optimal contracts offer at most two different procurement levels depending on the newly reported cost. Our results rely on "dynamic virtual valuation," a generalization of the Myersonian virtual valuation in the static setting.

■ MC52

52-Room 107A, CC

Analytics for IT Services

Sponsor: Service Science

Sponsored Session

Chair: Aly Megahed, Research Staff Member, IBM Research, 650 Harry
Road - Office D3-428, San Jose, CA, 95120, United States of America,
aly.megahed@us.ibm.com

1 - Operations Research and Analytics Solutions for IT Service Providers

Aly Megahed, Research Staff Member, IBM Research,
650 Harry Road - Office D3-428, San Jose, CA, 95120,
United States of America, aly.megahed@us.ibm.com,
Hamid Reza Motahari Nezhad, Peifeng Yin, Taiga Nakamura

Large IT service providers compete to win highly-valued outsourcing IT deals via submitting proposals to potential clients. In this talk, you will learn about some of the analytics and OR work done for managing such complex service engagements. A case management approach that analyzes costs and prices of deals in preparation will be presented. Additionally, a predictive analytics tool for identifying the influential factors on the outcome of deals will be shared.

2 - Measuring Cloud Services Profitability

Ray Strong, Impact Of Future Technology, IBM Research,
650 Harry Road, San Jose, CA, 95120, United States of America,
hrstrong@us.ibm.com, Jeanette Blomberg, Sunhwan Lee, Anca
Chandra, Pawan Chowdhary, Susanne Glissmann, Robert Moore

The costs of providing cloud services are not easily attributable to revenue. We present a complex modeling approach to understanding the profitability of individual service offerings and individual service contracts. We explore ways of creating long running models of cloud service performance in spite of the month-to-month and pay-for-use nature of many cloud contracts. We suggest an approach to estimating the total current value of a cloud service contract to a vendor.

3 - Request for Service Process (RFS) Process Reengineering for IBM Strategic Outsourcing (SO) Business

Pawan Chowdhary, Software Research, IBM Research,
650 Harry Road, San Jose, CA, 95120, United States of America,
chowdhar@us.ibm.com, Jeanette Blomberg, Anca Chandra

RFS's are small work items that were not covered in strategic SO contract and are highly profitable. For a typical contract there could be hundreds of RFS that needs to be executed. The traditional processes to manage these RFS's were very cumbersome and often got delayed. In this talk, I will present the findings and the process reengineering work that IBM Research did to improve the performance of the RFS's along with increased customer satisfaction.

■ MC53

53-Room 107B, CC

Opportunities and New Directions for Behavioral OM

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Stephen Leider, University of Michigan, 701 Tappan Ave R4486, Ann Arbor, MI, 48104, United States of America, leider@umich.edu

1 - Supply Chain Risk: Behavioral Research Opportunities

Brian Tomlin, Professor, Tuck School of Business, Dartmouth College, 100 Tuck Hall; Hanover, NH, United States of America, Brian.T.Tomlin@tuck.dartmouth.edu

I will give an overview of the theoretical research in supply chain risk and attempt to identify some interesting questions for behavioral research.

2 - Humans Versus Machines: Impact on Network Capacity

Jan Van Mieghem, Professor, Kellogg School of Management, 2001 Sheridan Road, 5th Floor, Evanston, IL, 60201, United States of America, vanmieghem@kellogg.northwestern.edu, Itai Gurvich, Lu Wang

One of the fundamental questions in operations is to determine the maximal throughput or productivity of a process. Does it matter whether humans or machines execute the various steps in the process? If so, how do we incorporate this difference in our planning and performance evaluation? We propose some answers by discussing two examples: a theoretical analysis and an empirical study.

3 - Sustainability: Challenges and Research Opportunities

Erica Plambeck, Professor, Stanford Graduate School of Business, 655 Knight Way, Stanford, CA, United States of America, elp@stanford.edu

Environmental sustainability requires profound changes in the production of goods and services. Behavioral OM researchers can guide and learn from those changes.

■ MC54

54-Room 108A, CC

Equilibrium Routing and its Paradoxes

Cluster: Tutorials

Invited Session

Chair: Asu Ozdaglar, Massachusetts Institute of Technology, 32 Vassar St, Cambridge, MA, United States of America, asuman@mit.edu

1 - Tutorial: Equilibrium Routing and its Paradoxes

Asu Ozdaglar, Massachusetts Institute of Technology, 32 Vassar St, Cambridge, MA, United States of America, asuman@mit.edu

We study equilibrium routing of flows in congested traffic and communication networks. We investigate efficiency implications of decentralized routing with and without prices and with different information structures. Despite the tractable nature of the models, both the equilibrium properties and the potential types of inefficiencies are rich and can sometimes change in unexpected directions in response to modifications in network and information structures.

■ MC55

55-Room 108B, CC

Efficiency in the Higher Education and Banking Sectors

Cluster: Data Envelopment Analysis

Invited Session

Chair: Jill Johnes, Professor, University of Huddersfield, The Business School Queensgate, Huddersfield, HD1 3HG United Kingdom j.johnes@hud.ac.uk

1 - Does Bank Performance and Corruption Matter for Economic Growth? An International Exploratory Study

Abdel Latif Anouze, Assistant Prof, Qatar University, College of Business and Economic-DMM, Doha, No, 2713, Qatar, a.anouz@qu.edu.qa

While previous economic development studies take into account the impact of financial sector performance on economic growth, the role of corruption as economic factors remain yet to be assessed. This paper integrates DEA and Structural Equation Modelling (SEM) to explore these relationships. Experimental experiences are reported on a sample of banks from different countries. The analytical results provide illustration on how to integrate DEA and SEM to examine and predict economic development

2 - Bank Branch Operational Performance: A Robust Multivariate and Clustering Approach

Kostas Triantis, John Lawrence Professor, Virginia Tech, 7054 Haycock Rd, Room 428, Falls Church, VA, 22043, United States of America, triantis@vt.edu, Joseph Paradi, Haiyan Zhu, Oscar Herrera-restrepo, William Seaver

We investigate bank branch operational performance by integrating robust techniques for clustering analysis and data envelopment analysis (DEA). By applying robust techniques based on principal component analysis, we look for the detection of branches exhibiting extreme operating behaviors (i.e., influential), and the clustering of branches based on operating characteristics. Our premise is that influential branches affect both the clustering and the determination of efficiency performance.

3 - Costs and Efficiency in the English Higher Education Sector: Latent Class Stochastic Frontier Models

Jill Johnes, Professor, University of Huddersfield, The Business School Queensgate, Huddersfield, HD1 3HG United Kingdom j.johnes@hud.ac.uk, Geraint Johnes

Using panel data from 2002/03 to 2010/11 we estimate a cost function for English higher education institutions (HEIs) using the latent class variant of the stochastic frontier model. We are able to: identify clusters of institutions based on the data; evaluate the parameters of the cost function for each cluster; estimate economies of scope and of scale within each cluster; measure efficiency of each institution relative to all HEIs and other HEIs in the same cluster.

■ MC56

56-Room 109A, CC

Location Analytics

Sponsor: Location Analysis

Sponsored Session

Chair: Alan Murray, Professor, Drexel University, 3141 Chestnut Street, Philadelphia, PA, 19104, United States of America, amurray@drexel.edu

1 - Locating Units in a Data Network with Full Reliability and Redundancy

Sergio García Quiles, Lecturer In Operational Research, University of Edinburgh, James Clerk Maxwell Building, Peter Guthrie Tait Road, Edinburgh, EH9 3FD, United Kingdom, sergio.garcia-quiles@ed.ac.uk, Lukas Schaefer, Andreas Mitschke, Vassili Srithammavanh

We study the problem of designing a data network that has to fulfil some restrictions while being optimal under certain criteria. Some data flows must be sent between certain units to be located and there must be full reliability and redundancy. A network is fully reliable if the probability of any given function failing is less than a given safety threshold. Full redundancy means that no single failure leads to the loss of any function. This problem is motivated by a real application.

2 - A Maximal Conditional Covering Location Problem to Relocate Emergency Response Enterprise Units

Brian Lunday, Assistant Professor Of Operations Research, Department of Operational Sciences, Grad. Sch. of Engr. & Mgmt., Air Force Institute of Technology, Wright Patterson AFB, OH, 45433, United States of America, Brian.Lunday@afit.edu, Nicholas Paul, Sarah Nurre

We analyze the collective effectiveness of three hierarchical tiers within an existing enterprise of Department of Defense units designated to respond to a large-scale emergency (e.g., a chemical, biological, or radiological attack), and we identify their optimal locations via a maximal conditional covering problem formulation with side constraints. Acknowledging fiscal and political restrictions on facility relocations, we apply a multiobjective approach to identify Pareto optimal solutions.

3 - Location of Milk Collection Points for the Blended Milk Collection Problem

Vladimir Marianov, Pontificia Universidad Catolica de Chile, Vicuña Mackenna 4860, Macul, Santiago, Chile, marianov@ing.puc.cl, Armin Löer Villagra, Germán Paredes - Belmar, Andrés Bronfman

Different qualities of milk are collected from farms, using a heterogeneous truck fleet. Each farm produces single quality milk. Milk can be blended in the trucks, if convenient. The blend takes the quality of its lower quality component. Collection points are located for farthest farms to bring their milk. Trucks visit some of the farms and the collection points. A model is presented and solved using Branch and Cut for small instances. A heuristic is presented to solve a real problem.

4 - Sensor Location Problems: Open Locating-dominating Sets

Robin Givens, College of William & Mary, Computer Science Department, McGlothlin 126, Williamsburg, VA, 23185, United States of America, rmgivens@cs.wm.edu, Gexin Yu, Rex Kincaid

We consider the problem of fault location via sensors in parallel and multiprocessor networks with the goal of minimizing the number of sensors required throughout the system. We prove the lower bound of the minimum open locating-dominating set size for two different circulant graphs using two proof techniques, the discharging method and Hall's Theorem. We also provide constructions for the upper bound at the same size.

■ MC57

57-Room 109B, CC

Policy Issues in Energy Markets

Sponsor: ENRE – Energy II – Other (e.g., Policy, Natural Gas, Climate Change)

Sponsored Session

Chair: Andrew Liu, Assistant Professor, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47907, United States of America, andrewliu@purdue.edu

1 - Environmental and Economic Performance of Stochastic Market Clearing under High Wind Penetration

Ali Daraeepour, PhD Student, Duke University, Box 90328, Duke University, Durham, NC, 27707, United States of America, a.daraeepour@duke.edu, Xin Li, Dalia Patino-Echeverri

Using a scaled version of PJM, and generated wind scenarios and demand data from BPA data, this paper explores a comparison of the performance between stochastic and deterministic models for market clearing in terms of total operational costs, wind curtailment, and air emissions. Operating reserves in the deterministic-day-ahead model and Value of Lost Load in the Stochastic-day-ahead model are chosen so that both result in commitments that have the same expected reliability.

2 - Risk and Return under Renewable Support Mechanisms – Towards a Coherent Framework

Christoph Weber, Prof., University Duisburg-Essen, Universitaetsstr. 11, Essen, 45117, Germany, christoph.weber@uni-duisburg-essen.de, Lena Kitzing

Risk exposure resulting from renewable support mechanisms such as feed-in tariffs impacts the incentives for investors. We consider multi-stage decision making, including regulatory settings, financing and investment decisions and operations. Both systematic and unsystematic risks are included in a stochastic cash flow approach. The model is applied to a wind park in Germany. Feed-in-tariffs are found to require lower support levels than other support schemes but transfer more risk to society.

3 - A Natural Gas Model for North America: Impact of Cross-border Flows of Natural Gas with Mexico.

Felipe Feijoo, Postdoctoral Fellow, Johns Hopkins University Whiting School of Engineering, 3400 N Charles St, Baltimore, MD, 21218, United States of America, ffeijoo@jhu.edu, Sauleh Siddiqui, Daniel Huppmann, Larissa Sakiyama

Natural gas is becoming an important energy source due to its low environmental impact and price. New regulations in Mexico and Canada will highly affect the North American natural gas market. We present a long-term dynamic partial-equilibrium model that incorporates a range of regulatory measures to study impacts of various policies, assess the costs and benefits from cross-border flows of natural gas and electricity, and quantify the emissions avoided in Mexico through a switch to natural gas.

■ MC58

58-Room 110A, CC

Analytics in the Petrochemical and Petroleum Industries III

Sponsor: ENRE – Natural Resources II – Petrochemicals and Petroleum

Sponsored Session

Chair: Bora Tarhan, Research Specialist, ExxonMobil, 22777 Springwoods Village Parkway, Spring, TX, 77389, United States of America, bora.tarhan@exxonmobil.com

1 - Convex Relaxations for Calculating Voltage Stability Margins and Certifying Power Flow Insolvability

Daniel Molzahn, Dow Postdoctoral Fellow, University of Michigan, 1301 Beal Avenue, Room 4234A, Ann Arbor, MI, 48109, United States of America, dan.molzahn@gmail.com, Ian Hiskens, Bernard Lesieutre, Christopher Demarco

Ensuring the reliability of electric power systems requires operating with sufficient stability margins. We present a non-convex optimization problem which provides a voltage stability margin. Convex relaxations of this problem upper bound the voltage stability margin and can certify insolvability of the network power flow equations. These relaxations have SOCP and SDP formulations and may include integer constraints to model reactive-power-limited generators.

2 - Inventory and Maintenance Optimization in Oil and Gas Production System

Farnaz Ghazi Nezami, Assistant Professor, Kettering University, 1700 University Ave, Flint, MI, 48504, United States of America, fghazinezami@kettering.edu, Prasanna Tamilselvan

This research is aiming at developing an optimal spare provisioning policy for an offshore oil and gas production facility to jointly optimize the production system availability and maintenance cost. The proposed policy minimizes the downtime which is a function of subsea intervention equipment lead time and spare parts availability.

3 - Oil Supply Chain Risk Identification in Saudi Arabia

Julio Daza, Universidad de Valencia, Valencia, Valencia, Spain, julio.daza@uv.es, Mario Ferrer, Ricardo Santa, Alvaro Sierra, Daniel Romero-Rodriguez

This investigation has a twofold purpose: to operationalize the constructs of the of Supply-Chain-Risk-Management (SCRM), Supply-Chain-Resilience (SCR) and Supply-Chain-Vulnerability (SCV), and to quantitatively test the nature as well as the strength of the relationship between these three constructs within the context of the oil-industry in the Kingdom of Saudi Arabia.

■ MC59

59-Room 110B, CC

Strategy and Geography

Cluster: Strategy Science

Invited Session

Chair: Joanne Oxley, University of Toronto, 105 St. George Street, Toronto, Canada, Joanne.Oxley@Rotman.UToronto.CA

1 - Agglomeration Economies and the Geographic Dimension of Firm Boundaries

Juan Alcacer, Harvard Business School, Soldiers Field, Boston, MA, United States of America, jalcacer@hbs.edu, Jasmina Chauvin

We provide new insights into firm boundary decisions by comparing location strategies of multi-business and single-business firms in the same industry. We find that establishments belonging to multi-business firms agglomerate more, and the difference is related to the potential for sharing of labor resources. Our results suggest that strategic decisions about the geographic and product boundaries of the firm are intimately related, and that resource sharing is implicated in both decision

2 - Ethnic Communities, Informal Institutions, and Foreign Location Choice

Exequiel Hernandez, University of Pennsylvania, Wharton School of Management, Philadelphia, PA, United States of America, exequiel@wharton.upenn.edu

This study examines the institutional role of transnational ethnic communities in MNEs' location choice. We propose that ethnic communities fulfill a governance function by facilitating entry into locations that present high transaction hazards for foreign firms. We test our ideas using a unique dataset on the location choices of Korean banks across Chinese provinces during 1992-2013, taking advantage of a historical event that created a quasi-random distribution of Koreans across provinces.

3 - Vertical Scope and Location Decisions: Evidence from us Manufacturers in Mexico

Octavio Martinez, INCAE, Montefresco, Managua, Nicaragua, Octavio.Martinez09@Rotman.Utoronto.Ca, Joanne Oxley

We explore how vertical integration affects firms' propensity to locate in dense industrial clusters. We argue that since vertically-integrated firms are less dependent on external economies they benefit less from locating within a dense cluster, and thus may opt for lower-cost locations away from the cluster, particularly in the face of high congestion costs. Analysis of location data on new US-owned plants established in Mexico after NAFTA generates evidence consistent with our claims.

4 - Community and Capital in Entrepreneurship and Economic Growth

Olav Sorenson, Yale University, School of Management, New Haven, CT, United States of America, olav.sorenson@yale.edu, Sampsa Samila

We argue that social and financial capital have a complementary relationship in fostering innovation, entrepreneurship and economic growth. Using panel data on metropolitan areas in the US, our analyses reveal that social integration – in the microgeography of residential patterns – moderates the effect of venture capital, with more integrated regions benefitting more from expansions in the supply of financial capital.

■ MC60

60-Room 111A, CC

Project Based Learning

Sponsor: INFORM-ED

Sponsored Session

Chair: Palaniappa Krishnan, Associate Professor, University of Delaware, 212 Townsend Hall, 531 S. College Avenue, Newark, DE, 19711, United States of America, baba@udel.edu

1 - A Stepwise Approach to Implement Flipped Learning in Operations Management

Sungyong Choi, Assistant Professor, Yonsei University, 1 Yonseidae-gil, Wonju, Korea, Republic of, sungyongchoi@gmail.com

This work describes a stepwise and evolutionary process to implement flipped learning in Operations Management classes. It is important to determine initially what should be done in flipped classrooms instead of unilateral lecture. I suggest that a possible strategy can be class discussion based on TBL (Team-Based Learning) and PBL (Problem-Based Learning). Then, I summarize the lessons learned from my Operations Management class.

2 - Bank Service Simulation using ProModel

Palaniappa Krishnan, Associate Professor, University of Delaware, 212 Townsend Hall, 531 S. College Avenue, Newark, DE, 19711, United States of America, baba@udel.edu, Guang Xiao

The problem on hand was to simulate the queuing service of a local branch of a national bank "XYZ" on a Saturday. The students in the graduate simulation class collected data of the customers coming into the branch and leaving the branch. The students calculated the inter arrival data and the service time of the tellers. They then set up the (M/M/c) queuing model. The students used ProModel to conduct the simulation process. During this project, the students learned first hand the importance of collecting good data. The students also worked with different What-if scenarios in their simulation model.

3 - Math and the Mouse: Explorations of Math and Science at Walt Disney World

Kevin Hutson, Associate Professor Of Mathematics, Furman University, 330 Poinsett Hwy, Greenville, SC, 29613, United States of America, kevin.hutson@furman.edu, Liz Bouzarth, John Harris

We developed an immersive, three-week May course providing students the opportunity to see applications of mathematics and science at Walt Disney World. The course focused on typical problems faced by not only Disney professionals but also the consumer who visits the theme parks. In this talk, we will discuss various experiences and projects in which students engaged in the areas of scheduling, touring, and queuing.

■ MC61

61-Room 111B, CC

Nonconvex and Stochastic Electricity Pricing

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Antonio Conejo, Prof., The Ohio State University, 286 Baker Systems Engineering, 1971 Neil Avenue, Columbus, OH, 43210, United States of America, conejonavarro.1@osu.edu

1 - Pricing Electricity in a Stochastic Market Model with Non-convexities

Farzaneh Abbaspourtorbati, PhD Student, EPFL, Route Cantonale, Lausanne, 1015, Switzerland, farzaneh.abbaspourtorbati@epfl.ch

This presentation describes a pricing scheme for a nonconvex stochastic market-clearing model. Our goal is to obtain a set of uniform clearing prices so that the producers recover their costs without uplifts. For this purpose, a model is proposed whose objective is to minimize the duality gap of the relaxed primal market-clearing problem subject to primal, dual, and integrality constraints, plus cost recovery constraints that can be enforced at the market stage, in expectation or per scenario.

2 - Convex Hull Pricing: Rigorous Analysis and Implementation Challenges

Dane Schiro, ISO New England, 1 Sullivan Road, Holyoke, MA 01040, United States of America, dschiro@iso-ne.com, Eugene Litvinov, Feng Zhao, Tongxin Zheng

Several important properties of Convex Hull Pricing are analyzed by studying a new primal formulation. Counterintuitive pricing outcomes are discussed and illustrated through simple examples, and foreseeable difficulties with a realistic application of the method are described. Because Convex Hull Pricing can only be implemented for a very specific market framework, it is unlikely that its perceived benefits could be realized in current electricity markets.

3 - Extended LMP – Pricing of Non-convexities and Demand Responsive Resources

Congcong Wang, Market Design Engineer, MISO, 720 City Center Dr., Carmel, CA, United States of America, cwang@misoenergy.org, Dhiman Chatterjee

This presentation highlights MISO's recent price formation efforts to provide efficient market prices that are more accurately reflective of marginal system cost under all conditions. Developed from the convex hull of the total cost function, ELMP can effectively reflect the cost of committing and dispatching fast-start resources to meet demands and has been proved to minimize uplift payments. ELMP is then expanded to price demand response resources and other emergency resources.

4 - The Trade-off Between Market Efficiency and Compensation Payments in Unit Commitment Problems

Daniel Huppmann, Postdoctoral Fellow, Johns Hopkins University, German Institute for Economic Research (DIW Berlin), 3400 N. Charles St., Baltimore, MD, 21218, United States of America, dh@dergelbesalon.at, Sauleh Siddiqui

We apply an exact solution method for binary equilibrium problems to a large-scale power market unit commitment problem based on a realistic dataset. We illustrate the trade-off between efficient market operations (least-cost dispatch) against the budget required for compensation payments to guarantee incentive-compatibility of all market participants. The results are contrasted with prices and dispatch according to the current practice in market operation.

■ MC62

62-Room 112A, CC

Operations Management with Carbon Restrictions Environmental Concerns

Sponsor: ENRE – Environment I – Environment and Sustainability
Sponsored Session

Chair: Ulku Gurler, Professor, Ihsan Dogramaci Bilkent University, Industrial Engineering Department, Ankara, 06800, Turkey, ulku@bilkent.edu.tr

Co-Chair: Emre Berk, Bilkent University, Management Faculty, 06800 Bilkent, Ankara, Turkey, eberk@bilkent.edu.tr

1 - Supply Chain Coordination with Resource Constraints: Analysis of Buyback and Target Rebate Contracts

A. Serdar Simsek, Cornell ORIE, 282 Rhodes Hall, Ithaca, NY, 14853, United States of America, as2899@cornell.edu, Ulku Gurler, Malek Ebadi

We analyze certain supply chain contracts under resource constraints such as carbon emission or cash constraints. We consider a setting where both the manufacturer and the retailer can trade with their available resources in the marketplace after they decide the order quantities and analyze the range of buyback and target rebate contract parameters that would achieve coordination and the resulting profit share structure. We also provide extensive numerical analysis to study some practical cases.

2 - Multiple Input Newsvendor Problem with Environment Concious Customers

Ulku Gurler, Professor, Ihsan Dogramaci Bilkent University, Industrial Engineering Department, Ankara, 06800, Turkey, ulku@bilkent.edu.tr, Nazli Sonmez

In this work the inventory replenishment problem of a newsvendor with multiple inputs is considered when the customers have environmental concerns. In particular, it is assumed that the carbon emission of the final product is a function of the carbon emissions of the inputs and the customer demand decreases with the product's carbon emissions. The optimal order quantity of the newsvendor is investigated and some numerical results are provided.

3 - Technology Selection for Production Firms in a Carbon Economy

Emre Berk, Bilkent University, Management Faculty, 06800 Bilkent, Ankara, Turkey, eberk@bilkent.edu.tr, Onurcan Ayas

In this study, we address public policy structures and their implications on technology selection decisions for product design and pollution abatement in the presence of carbon emission restrictions and carbon markets. We consider a number of demand/utility functions to capture the firm behavior. We model technology primarily as a knowledge-based input in a multi-input setting. We provide some analytical results on technology enhancement conditions and illustrative numerical examples.

4 - How to use Data Analytics for Smarter Energy Management

Ozge Islegen, Assistant Professor, Northwestern University, Kellogg School of Management, 2001 Sheridan Road, Evanston, IL, 60208, United States of America, o-islegen@kellogg.northwestern.edu

The electricity industry has recently enjoyed the influx of “big data”. Through smart grid technologies, many firms now have access to the consumption behavior of their customers in unprecedented detail. This talk demonstrates how firms use this data to design effective demand side management programs to change the consumption behavior of their customers.

■ MC63

63-Room 112B, CC

Advanced Manufacturing II

Sponsor: Advanced Manufacturing
Invited Session

Chair: Binil Starly, Associate Professor, North Carolina State University, 406 Daniels Hall, Raleigh NC 27607, United States of America, bstarly@ncsu.edu

1 - Out-of-plane Geometric Error Prediction for Additive Manufacturing

Qiang Huang, Associate Professor, University of Southern California, GER 240, USC, Los Angeles CA, United States of America, qiang.huang@usc.edu, Yuan Jin

We aim to establish a methodology to predict the out-of-plane geometric error prediction in additive manufacturing processes. We provide a novel spatial deviation formulation in which both in-plane and out-of-plane errors are placed under a consistent mathematical framework. The derived predictive model for out-of-plane errors is validated through experimentation using a stereolithography process.

2 - Engineering of Surface Microstructure using Severe Plastic Deformation in Machining

Sepideh Abolghasem, Postdoctoral Researcher, Universidad de los Andes, Carrera 1 Este # 19 A - 40, Bogota, Colombia, sea40@pitt.edu, Raha Akhavan-Tabatabaei, Meenakshisundar Ravi Shankar, Roberto Zarama Urdaneta

Severe Plastic Deformation leads to surface microstructures with enhanced properties, which is unfortunately limited by poorly elucidated process-parameters linkages. While research in manufacturing has been traditionally dedicated to phenomenological models, here the effort is to bridge these gaps through understanding the underlying physics of materials and application of statistical techniques. This will provide a powerful tool for microstructure prediction, control, and optimization.

3 - Cellular Biomanufacturing: Expansion of Stem Cells in Rotating Wheel Bioreactors

Binil Starly, Associate Professor, North Carolina State University, 406 Daniels Hall, Raleigh NC 27607, United States of America, bstarly@ncsu.edu

Stem cells are critical components of regenerative medicine therapy. However, the therapy will require millions to billions of therapeutic stem cells. To address the need, we have recently cultured stem cells in 3D microgels and use them as a vehicle for cell expansion within a low shear stress rotating wheel type bioreactor within a 500ml volumetric setting. This study specifically highlights the cell encapsulation, harvesting and operation of microbeads within a dynamic bioreactor environment.

■ MC64

64-Room 113A, CC

Behavioral Decision Analysis

Sponsor: Decision Analysis
Sponsored Session

Chair: Johannes Siebert, University of Bayreuth, Bayreuth, D-95440, Germany, Johannes.Siebert@uni-bayreuth.de

1 - Bayes and Prejudice

Detlof Von Winterfeldt, Professor, University of Southern California, Viterbi School of Engineering, Industrial and Systems Engineering, Los Angeles, CA, 90089, United States of America, winterfe@usc.edu

When judging probabilities, people ignore statistical base rates. For example, when judging the likelihood of fatal pitbull attacks, they think of dramatic examples, ignoring the fact that fatal dog attacks are very rare, by pitbulls or other breeds. Ignoring base rates explains prejudice against minorities among dogs and humans.

2 - Debiasing Overconfidence

Valentina Ferretti, Politecnico di Torino, Corso Castelfidardo 30/A, Torino, Italy, valentina.ferretti@polito.it, Sule Guney, Gilberto Montibeller, Detlof Von Winterfeldt

Overconfidence is a persistent and difficult to correct bias in decision and risk analysis. We conducted an experiment to test the effectiveness of several best practices to reduce this bias. The results suggest that changing the stimulus-response mode from the fixed probability (fractile) method to a fixed value method is effective

3 - Stimulating the Creation of More and Better Alternatives using Objectives

Ralph L. Keeney, Fuqua School of Business, Duke University,
101 Lombard Street, #704W, San Francisco, CA, 94111,
United States of America, KeeneyR@aol.com, Johannes Siebert

The quality of alternatives considered, perhaps more than the quality of the decisions made, influences the desirability of the subsequent consequences. Several experiments investigated the implications of different procedures to create alternatives. From the results, we developed guidelines to effectively create better alternatives for decisions with incomplete sets of alternatives.

4 - Proving the Effectiveness of an Online-course on Decision-making

Johannes Siebert, University of Bayreuth, Bayreuth, D-95440,
Germany, Johannes.Siebert@uni-bayreuth.de, Reinhard Kunz

We use the proactive decision-making (PDM) scale before and after an online-course on decision-making to prove its positive impact on its participants. In line with our hypotheses, the four proactive cognitive skills systematic identification of objectives, systematic search for information, systematic identification of alternatives, and using a 'decision radar' improved significantly while the two proactive personality traits showing initiative and striving for improvement remain stable.

■ MC65

65-Room 113B, CC

Joint Session DAS/MAS:Game Theory, Decision Analysis, and Homeland Security, Part A

Sponsor: Decision Analysis

Sponsored Session

Chair: Jun Zhuang, University at Buffalo, SUNY, 317 Bell Hall, Buffalo, NY, 14221, United States of America, jzhuang@buffalo.edu

1 - Deterrence and Risk Preferences in A Sequential Attacker-defender Game with Continuous Defense Effort

Vineet Madasseri Payyappall, PhD Student, University at Buffalo,
305 Winspear Avenue (Upper), Buffalo, NY, 14215, United States
of America, vineetma@buffalo.edu, Jun Zhuang,
Victor Richmond Jose

Most attacker-defender games consider players as risk-neutral, whereas in reality, attackers and defenders may be risk-seeking or risk-averse. We study the impact of player's risk preferences on their equilibrium behavior and their impact on the notion of deterrence. We present analytic results, numerical illustration, and discussion which provide insights that could be used by policy analysts and decision makers involved in investment decisions in security and safety.

2 - Dynamic Modeling of Bombing Attack Threat Based on Time-series Process and Intervention Analysis

Shuying Li, Tsinghua University, 1017, Building Liuqing,
Tsinghua Uni., Beijing, China, 474042502@qq.com, Jun Zhuang,
Shifei Shen

In the recent years, various kinds of terrorist attacks occurred frequently. Among all tactics of attacks, bombing attack is the highest threat, followed by armed assault. A model for analyzing and predicting bombing attacks threat based on time-series process is developed. The model is validated by using terrorist attack data from the Global Terrorism Database between 2004 and 2014. Intervention analysis is used to analyze the sudden increase in the process.

3 - Identifying and Structuring the Objectives of ISIL and its Followers

Richard John, Associate Professor, University of Southern
California, 3620 McClintock Ave., Dept. of Psychology, MC-1061,
Los Angeles, CA, 90266-1061, United States of America,
richardj@usc.edu, Detlof Von Winterfeldt, Johannes Siebert

This study addresses three questions: (1) What are the objectives of the leaders of ISIL? (2) What are the objectives of the followers of ISIL? (3) How are the two sets of objectives related? We analyzed the transcripts of interviews and presentations of 59 subject matter experts (SMEs) and conducted a separate analysis of speeches of ISIL leaders and Internet sources. In both efforts we identified and structured the strategic, fundamental, and means objectives of ISIL and its followers.

4 - A Robust Resolution of Newcomb's Paradox

Thomas Weber, Associate Professor, EPFL, CDM-ODY 3.01,
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thomas.weber@epfl.ch

Newcomb's problem is viewed as a dynamic game. Depending on whether or not a risk-neutral agent's belief about the move order exceeds a threshold, one obtains the one-box outcome or the two-box outcome, respectively. The findings extend to an agent with arbitrary increasing utility, featuring in general two thresholds. All solutions require only minimal assumptions about the being's payoffs and it is always sure to predict the agent's choice in equilibrium. Some practical settings are discussed.

■ MC66

66-Room 113C, CC

Ongoing Challenges in Airline Operations Planning

Sponsor: Aviation Applications

Sponsored Session

Chair: Norbert Lingaya, Manager Of Optimization Technologies, Kronos Incorporated, 3535 Queen Mary Road, Suite 500, Montreal, QC H3V 1H8, Canada, nlingaya@Kronos.com

1 - Broadening the Manpower Planning Horizon with Altitude Insight

Luc Charest, Operations Research Specialist, AD OPT, A Kronos
Division, 3535 chemin Queen-Mary Ouest, Montréal, QC, H3V
1H8, Canada, luc.charest@kronos.com, Alain Marcotte

AD OPT's Altitude Insight addresses crew manpower planning for airline operations by producing optimized staffing plans that satisfy expected company requirements. In the short and medium term, Insight identifies position openings to be assigned and scheduled as trainings to crew members. As the horizon widens, the focus shifts to budgetary objectives with constraints on volumetric distributions. In this talk, we present some long-term manpower planning concepts and their related challenges.

2 - Improving Branching in Airline Crew Pairing Problem with Base Constraints

Frederic Quesnel, GERAD, 2900 Boulevard Edouard-Montpetit,
Montreal, Canada, frederic.quesnel@gerad.ca, François Soumis,
Guy Desaulniers

In the context of crew pairing, many of the real-world crew pairing solvers consider restrictions on the total number of working time at each crew base. These base constraints have not been often studied academically. We propose a Danzig-Wolfe decomposition formulation for crew pairing problem that includes base constraints. We show how they degrade the resolution of the problem. We propose different branching schemes to improve the computational time and the objective value of our instances.

3 - Simultaneous Airline Crew Recovery Problem

Atoosa Kasirzadeh, GERAD & Ecole Polytechnique de Montreal,
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Montreal, Canada, atoosa.kasirzadeh@gerad.ca, François Soumis

Different sources of unpredicted disturbances such as adverse weather conditions may affect the planned schedules for airline crew members. These disruptions may result in delayed or canceled flights and affect the crew schedules. Due to delay propagation, robust crew recovery problem will be very significant. We study the simultaneous cockpit recovery problem where the planned schedules are constructed using personalized scheduling approach.

4 - Airline Fleet Assignment with Stochastic Demand and Limited Re-fleeting Recourse Actions

Guy Desaulniers, Polytechnique Montreal and GERAD,
2900 Boulevard Edouard-Montpetit, Montreal, Canada,
guy.desaulniers@gerad.ca, David Lasalle lalongo

We introduce a new fleet assignment model that considers a stochastic demand and the possibility to perform re-fleeting on pre-computed chains of flights as recourse actions. This integer model is solved by the Cplex MIP solver and embedded in a loop with a passenger assignment model to compute the revenues. We report computational results on data sets derived from a North American carrier schedule involving more than 5,000 flights over a week and 20,000 passenger itineraries.

■ MC67

67-Room 201A, CC

Integrated Vehicle Routing Problems I

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Bhupesh Shetty, University of Iowa, Iowa City, IA, United States of America, bhupesh-shetty@uiowa.edu

1 - Vehicle Routing with Mileage Bands

Maciek Nowak, Loyola University Chicago, Chicago, IL, United States of America, mnowak4@luc.edu, Michael Hewitt

A gap in vehicle routing research is the use of mileage bands as a basis for determining travel costs. While the trucking industry regularly uses mileage bands to price routes, research has widely ignored this pricing structure. In this research, we develop a methodology for shippers to create routes that minimize cost based on mileage bands and for carriers to create bands that maximize profits.

2 - Solving the Fleet Size and Mix Vehicle Routing Problem with Backhauls: A Successive Approximation Approach

Javier Belloso, Spain, javier.belloso@unavarra.es, Javier Faulin, Adrian Serrano, Angel A. Juan

The Fleet Mixed Vehicle Routing Problem with Backhauls (FSMVRPB) is a variant of the vehicle routing problems where delivery and pick-up customers are served from a central depot and the fleet of vehicles is unlimited and heterogeneous. The proposed algorithm utilizes a successive approximation approach that obtains a heterogeneous solution by iteratively solving homogeneous problems. The method combines three randomized criteria to improve the greedy behavior of the base heuristic applied to solve each particular problem. An ILP is presented for the FSMVRPB considering both fix and variable costs. Benchmark instances for the FSMVRPB have been selected in order to assess the efficiency of our approach, and results show that our approach is able to provide promising solutions by improving some of the best solutions reported in the literature.

3 - Inventory Routing in a Two-Echelon Supply Chain with Cross-Docks

Forough Pourhossein, University of Waterloo, Waterloo, ON, Canada, fpourhossein@uwaterloo.ca, Hossein Abouee Mehrizi, James Bookbinder

Consider a supply chain whose suppliers serve multiple customers, each ordering several product types. Products are shipped to cross-docks from the suppliers, and several customers are served by each route from a cross-dock; multiple routes can originate from a single cross-dock. We design optimal routes considering the total transportation, inventory carrying, and pipeline inventory costs. We restructure the model as a set-covering problem and develop a column generation algorithm to solve it.

4 - Periodic Vehicle Routing with Inventory Considerations

Bhupesh Shetty, University of Iowa, Iowa City, IA, United States of America, bhupesh-shetty@uiowa.edu, Jeffrey Ohlmann

We study the problem of designing the inbound supply routes for a manufacturing plant to minimize transportation and inventory costs. We consider a routing plan that is periodic and supports pickup amounts that are proportional to the amount of time between visits. We develop a heuristic and present computational results to demonstrate the effect of inventory holding costs on the routing plans.

■ MC68

68-Room 201B, CC

Logistics and Supply Chain under Disruption and Disasters

Sponsor: Transportation, Science and Logistics

Sponsored Session

Chair: Xiaopeng Li, Assistant Professor, Mississippi State University, Mississippi State University, Starkville, MS, 39762, United States of America, xli@cee.msstate.edu

1 - G-Network Models for Relief Activity Coordination at Disaster Sites

Merve Ozen, University of Wisconsin, Madison, WI, United States of America, mozen@wisc.edu, Ananth Krishnamurthy

We use generalized queuing networks (G-network) to model relief item distribution and activity coordination following a major disaster. The models capture key aspects of victim behavior including changing needs for relief items and variability in staffing. We investigate the existence of product form solution for the queuing network models and develop theoretical approximations to estimate performance measures. We analyze the developed networks under

various conditions and provide insights.

2 - Hierarchical Emergency Shelter Location Optimization

Brett Decker, University of Connecticut, 261 Glenbrook Rd, Unit 3037, Storrs, CT, 06269, United States of America, brett.decker@uconn.edu, Nicholas Lownes

Many jurisdictions use only qualitative methods of locating emergency shelters and supply hubs. A hierarchical capacitated emergency shelter location problem is presented. The tradeoffs between local access and economies of scale are investigated. The model is applied to a case study along the southern shore of Connecticut.

3 - Reliable Supply Chain Design with Expedited Shipment Service

Meng Zhao, Harbin Institute of Technology, Harbin Institute of Technology, Harbin, China, 14b332001@hit.edu.cn, Xiaopeng Li, Jianxun Cui, Mohsen Parsafard

This study proposes a reliable location-inventory model that considers expedited shipments under probabilistic supplier disruptions. This model allows a facility to be reassigned to backup suppliers when its primary supplier disrupts. A customized algorithm is developed and numerical examples are conducted to test the algorithm and draw managerial insights.

4 - Humanitarian Facility Location and Supply Prepositioning Considering Road Vulnerability

Melih Celik, Middle East Technical University, ODTÜ Kampüsü Endüstri Mühendisliği, Oda 219 Cankaya, Ankara, 06800, Turkey, cmelih@metu.edu.tr, Ece Aslan

An important challenge in relief item and service delivery in the aftermath of a disaster is that roads may become unusable. In this study, we consider the problem of locating distribution centers and prepositioning supplies in the pre-disaster stage, and routing of deliveries in the aftermath. Given the uncertainty of various aspects of the disaster, we develop a two-stage stochastic programming model and propose heuristics, which we test on real-life disaster scenarios for Istanbul, Turkey.

■ MC69

69-Room 201C, CC

Facility Logistics V

Sponsor: TSL/Facility Logistics

Sponsored Session

Mahmut Tutam, PhD Student, University of Arkansas, 1617 N. Evening Shade Dr., Fayetteville AR 72703, United States of America, mtutam@uark.edu

1 - Performance Analysis of Vehicle-based Order-pick Systems with Dual-command Cycles

Kaveh Azadeh, PhD Candidate, Rotterdam School of Management Erasmus University, Burgemeester Oudlaan 50, Mandeville Building T09-41, Rotterdam, 3062PA, Netherlands, azadeh@rsm.nl, Debjit Roy, Rene De Koster

In the new generation of vehicle-based order-pick systems, vehicles travel in both horizontal and vertical direction using the racking structure to access all storage positions within an aisle. We develop queuing models to evaluate the performance measures and analyze the performance trade-offs with other vehicle-based goods-to-picker systems.

2 - A Conceptual Model for Operational Control in Discrete Event Logistics Systems (DELS)

Timothy Sprock, Georgia Tech, 755 Ferst Dr NW, Atlanta, GA, 30332, United States of America, tsprock3@gatech.edu, Leon McGinnis

To support design of smart operational controllers, this paper proposes a conceptual model capable of integrating a description of the control activities with a description of the physical system and an explicit interface to optimal-control analyses. These smart operational control mechanisms must not only integrate real-time data from system operations, but also formulate and solve a wide variety of optimal-control analyses efficiently and then translate the results into executable commands.

3 - Effects of Multiple Docks on Expected Distance Traveled in a Unit Load Warehouse with a Cross-aisle

Mahmut Tutam, PhD Student, University of Arkansas, 1617 N. Evening Shade Dr., Fayetteville, AR, 72703, United States of America, mtutam@uark.edu, John A. White

The warehouse configuration that minimizes expected travel distance is obtained for a unit load warehouse with a cross-aisle and multiple docks. Single- and dual-command operations are considered. Continuous and discrete formulations are employed. Considering multiple docks and their locations yields more general formulations than found in the research literature. Cases treated include receiving from an adjacent production area and external suppliers and the use of multiple docks for shipping.

4 - Optimizing Space Utilization in Block Stacking Warehouses

Shahab Derhami, PhD Student, Auburn University, 3301 Shelby Center, Auburn University, Auburn, AL, 36849, United States of America, sderhami@auburn.edu, Kevin R. Gue, Jeffrey S. Smith

Block stacking storage systems are unit load storage systems which are widely used in manufacturing facilities. However, determining the optimal lane depth in this storage system under the finite production rate constraint has not been adequately addressed in the literature. In this research, we propose mathematical models to obtain the optimal lane depth for a single and multiple SKUs where the pallet production rates are finite.

MC70

70-Room 202A, CC

International Rail Freight

Sponsor: Railway Applications

Sponsored Session

Chair: Steven Harrod, Associate Professor, Technical University of Denmark, Building 116B, Niels Koppels Allé, Kgs. Lyngby, 2800, Denmark, stehar@transport.dtu.dk

1 - Growth Potential for Rail Freight in Short Distance Markets

Steven Harrod, Associate Professor, Technical University of Denmark, Building 116B, Niels Koppels Allé, Kgs. Lyngby, 2800, Denmark, stehar@transport.dtu.dk, Matthias Schett

The Scandinavian countries have traditionally been maritime economies, dependent on sea shipping. Recent bridge and tunnel links now connect Scandinavia to the European continent, but a large volume of freight still moves by sea. This presentation discusses the successful short distance intermodal shuttles operating in Scandinavia, and their potential for expansion. Examples from Sweden and Denmark are presented.

2 - Freight Operations from a North American Perspective

Marc Meketon, Oliver Wyman, 1 University Square, Princeton, NJ, 08540, United States of America, Marc.Meketon@oliverwyman.com, Carl Van Dyke

Freight operations in Europe differ in many respects to those in North America for reasons including regulatory, physical differences, IT systems (especially wagon ordering systems) and interactions with passenger trains. This talk will describe freight operations in several European countries, and also contrast them to North American operations.

3 - An Integrated Model for Locomotive Routing and Fueling Facility Locating

Gongyuan Lu, Southwest Jiaotong University, 111 Erhuan Road, Bei yi Duan, Chengdu, China, lugongyuan@qq.com, Xuesong Zhou

In this presentation, we will present a 3-dimensional time-space network which adds the resource dimension to the traditional TS network. Via this method, the problem formulation can be simplified tremendously. Meanwhile, the Lagrangian relaxation associated with Dynamic Programming is applied to solve this model efficiently.

MC71

71-Room 202B, CC

Shared Mobility Analysis and Optimization

Sponsor: TSL/Urban Transportation

Sponsored Session

Chair: Wei Lu, Texas A&M University, CE/TTI Building, Room 601-D, 3136 TAMU, College Station, TX, 77843-3136, United States of America, luwei.blues@gmail.com

1 - Optimizing Ridesharing Services

Wei Lu, Texas A&M University, CE/TTI Building, Room 601-D, 3136 TAMU, College Station, TX, 77843-3136, United States of America, luwei.blues@gmail.com, Luca Quadrioglio

Ridesharing services, which aim to bring together travelers with similar itineraries, may provide substantial societal and environmental benefits. We study the most generalized setting of ridesharing problems – given a set of travelers and their origins/destinations, we aim to simultaneously make optimal decisions on driver/rider role assignment, customer partition and route planning, with the goal of minimizing/maximizing the system-wide total vehicle-miles/ridesharing value.

2 - Ride-Matching Problem in Peer-to-Peer Multi-Hop Ridesharing Systems with Stochastic Demand

Neda Masoud, University of California, Irvine, CA, United States of America, R. Jayakrishnan

We propose a stochastic program with recourse to formulate the peer-to-peer multi-hop ride-matching problem with stochastic demand. We propose an algorithm to efficiently generate a set of scenarios that can be used to formulate and solve the IP equivalence of the stochastic program, and solve it using an L-shaped algorithm.

MC72

72-Room 203A, CC

Panel Discussion on “Publishing in Quality and Reliability: The Editor's Perspective”

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Hui Yang, Associate Professor, Pennsylvania State University, 310 Leonhard Building, Industrial and Manufacturing Eng., State College, PA, 16801, United States of America, huy25@psu.edu

1 - Panel Discussion on iPublishing in Quality and Reliability: The Editor's Perspective

Moderator: Hui Yang, Associate Professor, Pennsylvania State University, 310 Leonhard Building, Industrial and Manufacturing Eng., State College, PA, 16801, United States of America, huy25@psu.edu, Panelists: Trevor Craney, Jianjun Shi, Douglas Montgomery, Peihua Qiu, Peter Parker, Fugee Tsung

This panel brings journal editors to share their perspectives and experiences with the audience and answer questions pertaining to publication in Quality, Reliability and Data Sciences. Panelists are: Dr. Jianjun Shi, IIE Transactions; Dr. Fugee Tsung, Journal of Quality Technology; Dr. Peihua Qiu, Technometrics; Dr. Douglas Montgomery, Quality and Reliability International; Dr. Peter Parker, Quality Engineering.

MC73

73-Room 203B, CC

Modeling and Analysis of Data with Quantitative and Qualitative Variables

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Xinwei Deng, Assistant Professor, Department of Statistics, Virginia Tech, 211 Hutcheson Hall, Blacksburg, VA, United States of America, xdeng@vt.edu

Co-Chair: Ran Jin, Virginia Tech., Grado Department of Industrial and Systems Engineering, Blacksburg, VA, 24061, United States of America, jran5@vt.edu

1 - Bayesian Hierarchical Models for Quantitative and Qualitative Responses

Lulu Kang, Assistant Professor, Illinois Institute of Technology, 10 W 32nd Street, E1-208, Chicago, IL, 60615, United States of America, lkang2@iit.edu, Xinwei Deng

In many engineering systems both quantitative and qualitative output measurements are collected. If modeled separately, the important relationship between the two type of responses is ignored. In this paper we propose a Bayesian hierarchical modeling framework to jointly model a continuous and a binary response. Both simulation and real case studies are shown to illustrate the proposed method.

2 - A Latent Process Approach to Modeling and Analysis of Mixed-type Observations

Shuyu Chu, Virginia Tech, 1210 University City Blvd, J113, Blacksburg, VA, 24060, United States of America, cshuyu@vt.edu, Xinwei Deng

In many applications, mixed-type observations are commonly present. To analyze the data with mixed-type observations, one key challenge is to quantify the hidden association among them. In this work, we proposed a latent process approach to jointly modeling the mixed observations. The proposed method adopts the combined Discrete Particle Filter and Sequential Monte Carlo algorithm for parameter estimation and Bayesian inference.

3 - Quantitative and Qualitative Evaluation of Printed Electronics Based on Microscopic Images

Hongyue Sun, Virginia Tech., Grado Department of Industrial and Systems Engineering, Blacksburg, VA, 24061, United States of America, hongyue@vt.edu, Yifu Li, Chuck Zhang, Ran Jin, Kan Wang

Aerosol jet printing is an additive manufacturing technology to fabricate printed electronics. Although various types of machine vision sensors are used to take images for qualitative evaluation, no methods have been reported to use image features to quantitatively characterize the quality of electronics. This work use a quantitative method to model the correlation of image features and quality variables. A case study to fabricate silver conducting wires is used to evaluate the performance.

4 - On the Asymptotics of Pairwise Modeling for Multivariate Gaussian Process

Yongxiang Li, Research Assistant, City University of Hong Kong, Department of SEEM, 83 Tat Chee Avenue, Kowloon, Hong Kong - PRC, novern.li@gmail.com, Qiang Zhou

Multivariate Gaussian process is a popular method for emulating computer models with multiple outputs. But its complexity poses significant challenges to parameter estimation due to high dimensionality and huge computational burden. A pairwise modeling approach is proposed to solve the issue. The asymptotic normality for parameter estimation is studied. Simulation studies are conducted and the pairwise method is applied to model the low-E glass data for such purposes as quality control.

■ MC74

74-Room 204A, CC

Modern Monitoring Applications

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Irad Ben-Gal, Professor, Tel Aviv University, Tel Aviv, Israel, bengal@tauex.tau.ac.il

1 - An Application of Sensor Selection Based on Information Theoretic Measurements for Change Detection

Marcelo Bacher, PhD Candidate, Tel Aviv University, Ramat Aviv, Tel Aviv, Israel, mgbacher@post.tau.ac.il, Irad Ben-Gal

Feature selection based on Information Theoretic measurements has been used with great success in Machine Learning applications in special for classification tasks. Nevertheless, less effort has been applied to process monitoring. In this work we propose a framework that aims at finding the most significant subset of features for change detection and bounded false alarm rate when monitoring a process.

2 - Correlated Gamma-based Hidden Markov Model for Asthma Control Status Diagnosis

Junbo Son, PhD Candidate, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, json5@wisc.edu, Patricia Brennan, Shiyu Zhou

To effectively manage the asthma as a chronic disease, a statistical model based on the everyday patient monitoring is crucial. Taking advantages from the remote patient monitoring system, we propose a data-driven diagnostic tool for assessing underlying asthma condition of a patient based on hidden Markov model (HMM). The proposed correlated gamma-based HMM can visualize the asthma progression to aid therapeutic decision making. Its promising features are shown in both simulation and case study

3 - Project Management Monitoring

Irad Ben-Gal, Professor, Tel Aviv University, Tel Aviv, Israel, bengal@tauex.tau.ac.il

We consider the monitoring of large projects (software/hardware) and propose an analytical approach for identifying the optimal project monitoring points by using concepts from the Information Theory. The methodology used is based on simulation-optimization scheme - selecting the monitoring points that provide the highest potential information gain on the project duration. (joint work with Shiva Kashi-Cohen and Shay Rozanes)

4 - Leveraging Analytics to Support Health-monitoring and Management of Infrastructure Facilities

Pablo Durango-Cohen, Associate Professor, Northwestern University, 2145 Sheridan Road, A332, Evanston, IL, 60208, United States of America, pdc@northwestern.edu, Yikai Chen

Motivated by recent technological advances, we describe the development and validation of a statistical framework to support health-monitoring and management of transportation infrastructure. The framework consists of formulation of structural time-series models to explain, predict, and control for common-cause variation, and use of multivariate control charts to detect special-cause variation. We present several examples from an in-service bridge to validate the framework.

■ MC75

75-Room 204B, CC

Innovations in Healthcare Products and Services

Cluster: New Product Development

Invited Session

Chair: Nitin Joglekar, Boston University, Questrom School of Business, Boston, MA, United States of America, joglekar@bu.edu

1 - Healthtech Platforms: Barriers to Innovation

Edward Anderson, Professor, McCombs School of Business, The University of Texas at Austin, 1 University Station B6500, Austin, TX, 78712-1277, United States of America, Edward.Anderson@mcombs.utexas.edu, Shi Ying Lim

The state of mobile and digital health is far behind that of other platform industries, such as travel, retail, and even banking. Using qualitative analysis, we present some of the more important barriers to healthtech startup success (and, but extension, health tech in general) and outline some initial suggestions to create an ecosystem to counter them.

2 - Platform Innovations in Healthcare Delivery

Geoffrey Parker, Professor, Tulane University, 7 McAlister Drive, New Orleans, LA, 70118, United States of America, ggparker@tulane.edu

Network platform systems have reshaped the computer and telecommunications industries and are now transforming other industries such as transportation, lodging, and contract labor. The shift to platforms is slower in highly regulated industries, but changes are coming quickly. We survey likely mechanisms and entry points for a platform shift in healthcare.

3 - Patient, Heal Thyself! A Learning Algorithm to Predict How Telemedicine Affects Patient Activation

Kellas Cameron, PhD Student, Boston University, Questrom School of Business, Boston, MA, 02215, United States of America, kellas@bu.edu, Carrie Queenan, Nitin Joglekar

The Patient Activation Measure (PAM) assesses an individual's knowledge and confidence for managing one's health. This paper proposes a learning algorithm to predict a patient's PAM with data from a controlled telemedicine study, accounting for social and technology effects. The algorithm allows for the analysis of Type I and II errors and learning versus testing tradeoffs. Implications of this study create opportunities for operational improvements to reduce patient readmission rates.

■ MC76

76-Room 204C, CC

Accounting for Input Uncertainty in Stochastic Simulations

Sponsor: Simulation

Sponsored Session

Chair: Canan Gunes Corlu, Assistant Professor, Boston University, 808 Commonwealth Avenue, Boston, MA, 02215, United States of America, canan@bu.edu

1 - A Sequential Experiment Design for Input Uncertainty Quantification in Stochastic Simulation

Xie Wei, Assistant Professor, Rensselaer Polytechnic Institute, 400 McChesney Ave. Ext. 5-9, Troy, NY, United States of America, xiew3@rpi.edu

When we use simulations to estimate the performance of a stochastic system, simulations are often driven by input distributions that are estimated from real-world data. Non-parametric bootstrap could be used to quantify both input model and parameter uncertainty. A sequential experiment design is proposed to efficiently propagate the input uncertainty to output mean and deliver a percentile confidence interval to quantify the impact of input uncertainty on the system performance estimate.

2 - Input Uncertainty in Stochastic Simulations: Dependent Input Variables of Mixed Types

Alp Akcay, Eindhoven University of Technology, Department of Industrial Engineering, Netherlands, A.E.Akcay@tue.nl, Bahar Biller

We consider stochastic simulations with correlated input random variables having NORMal-To-Anything (NORTA) distributions. We assume that the marginal distribution functions and the NORTA base correlation matrix are unknown. Given that the dependent input variables can take discrete and continuous values, we develop a Bayesian procedure that decouples the input model estimation into two stages. We investigate the role of the corresponding input uncertainty in simulation output data analysis.

3 - Norta Random Vector Generation with Deterministic Constraints

Kalyani Nagaraj, Department of Statistics, Purdue University,
250 N University Street, West Lafayette, IN, 47907, United States
of America, kalyanin@purdue.edu, Raghu Pasupathy,
Soumyadip Ghosh, Jie Xu

We consider the problem of a NORTA random vector generation with given deterministic constraints. This question is of relevance in settings such as CVaR estimation in finance, and estimation of expected penalties in large-scale service systems. We propose a Weibull-like importance sampling twist to NORTA that is easily implemented and frequently achieves surprising reductions in variance. We will discuss the asymptotic optimality of the proposed estimator with an implementable sampler.

MC77

77-Room 300, CC

Supply Chain Management VII

Contributed Session

Chair: Sang Won Kim, Assistant Professor, CUHK Business School,
Shatin, N.T., HK, Hong Kong - PRC, skim@cuhk.edu.hk

1 - Competition under Power Structure in a Two-echelon Supply Chain

Abhishek Chakraborty, XLRI, Jamshedpur, 831001, India,
abhishekc@xlri.ac.in

In this work we bring the importance of power in decision making in a two echelon supply chain in which a single manufacturer sells to multiple retailers. We have analyzed the role of differential power structure within the retailers in affecting the supply chain performance in a Manufacturer-Stackelberg case where the retailers compete on quantity. Further, we bring in the countervailing nature of the same where the benefits from the fringe retailers are passed on to the final customers.

2 - Revenue Management in a Manufacturing Supply Chain

Ahmet Ozkul, Associate Professor Of Management, University of
New Haven, 14 Wellington Dr, Orange, CT, 06477, United States
of America, aozkul@newhaven.edu, Mehmet Barut

In this paper, we take the yield/revenue management problem in a capacity restrained manufacturing company, and put it in a supply chain framework integrating customer order acceptance decisions with the supplier end in a manufacturing supply chain. A conceptual model is presented.

3 - How Joint Ventures Business Environment and Vertical Partnering Relationship Influence Performance

Weixi Han, University of Southampton, Building 2 Highfield
Campus, Southampton, SO17 1BJ, United Kingdom,
WH3G12@soton.ac.uk

There is a paucity of research regarding vertical partnering relationship played in a cross-border setting. This study focus on the dyadic relationships as the unit of analysis, using a qualitative case study and interview in the Chinese automotive industry, shows how relationship played is performance by both buyers and suppliers, and how it is critical when viewing the different nationalities joint ventures backgrounds.

4 - A Study on Supply Chain Sustainability Impact Factors and Related Empirical Analysis

Zhiduan Xu, Professor, School of Management,
Xiamen University, 422 Siming South Road, Xiamen, China,
zhidianx@xmu.edu.cn, Danxia Guo

This paper mainly discusses the impact factors of supply chain sustainability. The empirical results showed that supply chain context has a significant positive effect on learning and development ability of the supply chain, and the learning and development ability have a significant positive effect on supply chain sustainability. Some of the cases in the enterprises have a significant effect on its supply chain context, learning and development ability, and supply chain sustainability.

5 - Supplier Development in Competitive Supply Chains

Sang Won Kim, Assistant Professor, CUHK Business School,
Shatin, N.T., HK, Hong Kong - PRC, skim@cuhk.edu.hk,
Yannan Jin, Qiying Hu, Sean Zhou

We study manufacturers' decisions on supplier integration and supplier development in a competitive environment, considering two key factors: manufacturers' capabilities and the supply structure. We find the efficiency improvement via supplier integration outweighs the negative impact of increased competition for the more capable manufacturer, and the reverse for the less capable. Also, the shared supply structure lowers market competition and strengthens the benefits of supplier integration.

MC78

78-Room 301, CC

Integer Programming Applications in Energy

Contributed Session

Chair: Mohsen Rahmani, Research Scientist, Carnegie Mellon
University, 5000 Forbes Ave, BH 131, Pittsburgh, PA,
United States of America, rahmani@andrew.cmu.edu

1 - Supply Chain Network Optimization for Biomass Generation

Qiu Dong, Huazhong University of Science and Technology,
School of Management, 1037 Luoyu Road, Wuhan, 430074,
China, 304520244@qq.com, Liu Zhixue

This paper focuses on supply chain design for biomass generation plant. A new biomass supply mode with purchasing station is proposed. An integer programming model about facility location-allocation is build. And a genetic algorithm is design for the model. A case study of Xinneng Company, one of the biggest biomass generation companies of China, is used as an application of the proposed model. In addition, sensitivity analysis is conducted to provide deeper understanding of the proposed model.

2 - Mathematical Optimization Techniques for Selective Catalytic Reduction for a Fleet of Power Plants

Antonio Alanis, University of Texas at Arlington, Box 19017
Arlington, TX, 76019, United States of America,
antonio.alanispena@mavs.uta.edu, Jay Rosenberger, Anoop Ade

Selective Catalytic Reduction (SCR) reduces emissions of oxides of nitrogen (NOx) in coal-fired power plants. With a given set of scheduled outages for a fleet of power plants, we use a multi-commodity flow problem with schedule elimination constraints from the literature and a modified knapsack problem to create an SCR management plan, which minimizes the total SCR operational cost of the entire fleet of power plants and maintains NOx emissions below a desired target.

3 - A Search Space Reduction Strategy for Security Constrained Unit Commitment Problem

Mohsen Rahmani, Research Scientist, Carnegie Mellon
University, 5000 Forbes Ave, BH 131, Pittsburgh, PA,
United States of America, rahmani@andrew.cmu.edu

We proposed a special heuristic algorithm to reduce the number of variables and constraints in the day-ahead security constrained unit commitment (SCUC) problem. SCUC is a mixed integer linear programming problem (MIP) in which a least cost combination of generators are defined to follow the next day electricity demand while considering transmission and generator's thermal and temporal constraints. The size of the SCUC is thus reduced, and it becomes tractable by the MIP solvers.

4 - Strategic Trading in a Multi-leader Multi-follower Framework

Chiara Lo Prete, Assistant Professor Of Energy Economics, The
Pennsylvania State University, 213 Hosler Building,
University Park, PA, 16802, United States of America,
chiaraloprete@psu.edu

Enforcement actions in regard to allegations of electricity price manipulation by financial players have been the source of a great deal of controversy in recent years. We focus on one type of manipulation strategy (placing unprofitable virtual bids to enhance the value of related FTR positions) and construct examples of equilibrium manipulation in the context of a multi-leader multi-follower game played by generators and financial players.

MC79

79-Room 302, CC

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - AIMMS - Experience Optimization Modeling in Real Time

Deanne Zhang, AIMMS Optimization Specialist

What can you do in 45 minutes? Attend a lecture? Watch a TED Talk online? Maybe go on a 5-mile run? There is a lot that can be accomplished in 45 minutes that can provide both a sense of achievement and generates new ideas. We invite you to experience this same kind of feeling in a 45-minute journey with AIMMS! We are going to build an optimization model in real time and publish it on AIMMS PRO, an enterprise level app store. This 45-minute software demo will provide you with a fresh view of how AIMMS delivers broader usage and greater benefits for business users.

2 - MOSEK ApS - using MOSEK at its Best

Andrea Cassioli, Product Manager, MOSEK ApS

MOSEK provides high-quality software for conic optimization. The software tutorial focuses on: 1) the key features and benefits of our objected-oriented API called FUSION API: speed, expressiveness and simplicity; 2) modeling issues and best practices that may be helpful in many cases; 3) insight on the upcoming new release will be presented. Customer inspired examples will be used to show how to use MOSEK at its best.

Monday, 4:30pm - 6:00pm**■ MD01**

01-Room 301, Marriott

Military Applications Society Awards

Sponsor: Military Applications

Sponsored Session

Chair: Andrew Hall, COL, U.S. Army, 4760 40th St N, Arlington, Va, United States of America, AndrewOscarH@aol.com

There will be a brief introduction by Chris Arney. Then presentations will be given by Keith Wormer (2015 winner of the Steinhardt Award): Reflections on My Career in Military OR: The Impact of Steinhardt Awardees Ross Schuchard (2015 Winner of the Bonder Scholarship): Exploring Global Power Dynamics in Cyberspace.

■ MD02

02-Room 302, Marriott

Cyber Security

Cluster: Homeland Security

Invited Session

Chair: Laura Mclay, Associate Professor, University of Wisconsin, 1513 University Ave, ISYE Department, Madison, WI, 53706, United States of America, lmclay@wisc.edu

1 - Data-driven Markov Decision Processes Applied to Cyber Vulnerability Maintenance

Theodore Allen, Associate Professor, The Ohio State University, 1971 Neil Avenue, 210 Baker Systems, Columbus, OH, 43221, United States of America, allen.515@osu.edu, Chengjun Hou

Issues relating to parametric uncertainty in Markov decision processes are described. Recent methods and results are over-viewed including relating to partially observable Markov decision processes. The application to cyber vulnerability maintenance is described using real world data.

2 - A Supply Chain Game Theory Framework for Cybersecurity Investments under Network Vulnerability

Shivani Shukla, PhD Candidate, Isenberg School of Management, University of Massachusetts, 121 Presidents Dr., Amherst, MA, 01003, United States of America, sshukla@som.umass.edu, Ladimer Nagurney, Anna Nagurney

We develop a supply chain game theory framework consisting of retailers and consumers who engage in electronic transactions via the Internet and, hence, may be susceptible to cyberattacks. The retailers compete noncooperatively in order to maximize their expected profits by determining their optimal product transactions as well as cybersecurity investments in the presence of network vulnerability. Theoretical and computational results are given.

3 - Budgeted Maximum Multiple Coverage Problem and its Extensions

Kaiyue Zheng, Industrial & Systems Engineering Department, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, United States of America, kzheng23@wisc.edu, Laura Mclay

This talk will discuss a cyber-security planning application for securing global information technology (IT) supply chain from the myriad of cyber-security risks and vulnerabilities that exist. We propose a budgeted maximum multiple coverage problem for selecting mitigations and discuss its multiple extensions. We examine the problem structures and introduce integer programming and greedy approximation algorithms for identifying optimal and near-optimal solutions.

4 - Managing Technology and Information Sharing in Information Systems Security

Yueran Zhuo, PhD Candidate, University of Massachusetts Amherst, Isenberg School of Management, Amherst, MA, 01003, United States of America, yzhuo@som.umass.edu, Senay Solak

Investment in technology and information sharing with other firms are critical components of a firm's information security strategy. We model the interplay between these two operational decisions for a firm, and identify policies that define optimal technology investments and information sharing levels under different operating environments. We also present results on the value of sharing security information within and across industries.

■ MD03

03-Room 303, Marriott

Scheduling with Applications

Cluster: Scheduling and Project Management

Invited Session

Chair: Hui-Chih Hung, Assistant Professor, National Chiao Tung University, 1001 University Rd., Hsinchu, Taiwan - ROC, hhc@cc.nctu.edu.tw

1 - Job Shop Scheduling with Task Similarity and Knowledge Transfer

Huan Jin, University of Iowa, S210 Pappajohn Business Building, The University of Iowa, Iowa City, IA, 52242, United States of America, huan-jin@uiowa.edu, Michael Hewitt, Barrett Thomas

We consider job shop scheduling problem in which workers improve through experience, both from repeatedly working the same task but also through working similar tasks. In addition, we incorporate knowledge gained through transfer from co-located employees. We demonstrate how we linearly reformulated the problem to overcome the nonlinearity of the learning curves. The reformulation adds many additional variables. We present solution methods as well as insights gained from solutions.

2 - A Simple and Effective Appointment Sequencing Heuristic Algorithm Based on the First Half Rule

Boray Huang, National University of Singapore, 1 Engineering Drive 2, Singapore, Singapore, borayhuang@msn.com, Ahmad Reza Pourghaderi

We propose a simple and effective heuristic algorithm for appointment sequencing that could find solutions with about 60% lower total waiting time compare to the smallest variance first and the shortest expected processing time first rules. This heuristic method is inspired by a new appointment sequencing rule, the first half rule, which implies that the customer with stochastically smaller excess service time must be scheduled in the first half of the available appointment slots.

3 - Appointment Scheduling with Uncertain Patient Arrivals

Mabel C. Chou, National University of Singapore, Mochtar Riady Building, 15 Kent Ridge Dr, BIZ1 #8-66, Singapore, 119245, mabelchou@nus.edu.sg, Cheng-han Yu, Hui-Chih Hung

We consider a single class patient appointment scheduling problem with uncertain patient arrival times and seek to determine the optimal appointment schedule for patient arrivals. We study the trade-off between the expected patient waiting time and the expected makespan of the doctor's working hours. "Passing" occurs when a patient is seen earlier than another patient whose appointment is earlier. We study the problem under no-passing, one-passing, and infinite-passing scenarios analytically.

4 - Order Scheduling with Preemptive Jobs on Fully Flexible Machines to Minimize Number of Late Orders

Hui-Chih Hung, Assistant Professor, National Chiao Tung University, 1001 University Rd., Hsinchu, Taiwan - ROC, hhc@cc.nctu.edu.tw, Jun-min Wei

We consider order scheduling problem with preemptive jobs on fully flexible machine environment. The objective is to minimize number of late orders. It is noted as PFM | pmtn, pk | ?Ui, which is shown to be NP-hard. Integer programming models are prepared for rational and real processing time problems. Traditional heuristics of forward arrangement is considered, but unbounded in worst case. By backward arrangement, we build a tight lower bound and propose a heuristic bounded in worst case.

■ MD04

04-Room 304, Marriott

Panel: International Opportunities

Sponsor: Junior Faculty Interest Group

Sponsored Session

Chair: Raha Akhavan-Tabatabaei, Associate Professor, Universidad de los Andes, Carrera 1 Este # 19 A - 40, Bogota, Colombia, r.akhavan@uniandes.edu.co

Co-Chair: Shengfan Zhang, Assistant Professor, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, United States of America, shengfan@uark.edu

1 - A Panel Discussion on International Opportunities

Moderator: Shengfan Zhang, Assistant Professor, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, AR, United States of America, shengfan@uark.edu, Panelists: Dionne Aleman, Andres Medaglia, Fuguee Tsung

This panel consists of department heads, junior and senior faculty members of universities in Canada, Colombia, Hong Kong and Turkey. They will discuss opportunities in academic jobs, tenure and promotion processes, research resources (funding and visiting opportunities), professional development, recruiting, etc.

■ MD05

05-Room 305, Marriott

Predicting Customer Behavior using Facebook Data

Cluster: Social Media Analytics

Invited Session

Chair: Michel Ballings, Assistant Professor Of Business Analytics, The University of Tennessee, 249 Stokely Management Center, Knoxville, TN, 37996, United States of America, michel.ballings@utk.edu

1 - Using Customers' Facebook Pages to Improve Lead Qualification in a B2B Acquisition Process

Matthijs Meire, PhD Student, Ghent University, Tweekerkenstraat, 2, Ghent, 9000, Belgium, Matthijs.Meire@ugent.be, Michel Ballings, Dirk Van Den Poel

The purpose of this study is to investigate the added value of Facebook data in B2B customer acquisition. We use a Random Forest prediction model. The results indicate that adding customers' Facebook page data can indeed improve B2B lead qualification. Our contribution is twofold. First, to the best of our knowledge it is the first to use Facebook data in B2B lead qualification. Second, we quantify the monetary gains of using Facebook data by conducting a real-life lead targeting experiment.

2 - Investigating the Drivers of Likes and Comments on Facebook

Steven Hoornaert, PhD Student, Ghent University, Ghent, 9000, Belgium, Steven.Hoornaert@ugent.be, Michel Ballings, Dirk Van Den Poel

The objective of this study is to investigate the added value of user context data in Facebook post popularity prediction models. For this purpose, two Random Forest models were built: one including only post variables (e.g., post type) and another containing both post and user variables (e.g., age). Predictability is improved for likes (x3.7) and comments (x3.6). This study is the first to augment post popularity prediction models with user context data and analyze a large quantity of posts.

3 - Predicting Buyer Behavior using Social Media Data

Matthias Bogaert, PhD Student, Ghent University, Tweekerkenstraat 2, Ghent, 9000, Belgium, matthias.bogaert@ugent.be, Michel Ballings, Dirk Van Den Poel

The purpose of this study is to explain customer behavior (offline event attendance) based on SM data. In order to substantiate our findings, we used propensity score matching and built a Random Forest model. This study reveals that social media data can predict offline event attendance with high predictive accuracy. Moreover, the results suggest that the number of friends that are attending the focal event and event attendance on Facebook were highly significant.

4 - The Power of Facebook to Predict Customer Acquisition and Defection

Michel Ballings, Assistant Professor Of Business Analytics, The University of Tennessee, 249 Stokely Management Center, Knoxville, TN, 37996, United States of America, michel.ballings@utk.edu, Matthijs Meire, Dirk Van Den Poel

The main purpose of this study is to investigate the value of Facebook data in predicting individual customer behavior. In addition we study the importance of different online engagement variables such as likes, answers to event RSVP's, and group memberships in predicting acquisition and defection. The results indicate that customer acquisition can be predicted very accurately using Facebook data. In addition Facebook data significantly improve defection prediction over and above customer data.

■ MD06

06-Room 306, Marriott

Finance and Risk Management

Sponsor: Financial Services

Sponsored Session

Chair: Samim Ghamami, Board of Governors of the Federal Reserve System, 20th Street and Constitution Avenue N.W., Washington, DC, United States of America, samim.ghamami@frb.gov

1 - Derivatives Pricing under Bilateral Counterparty Risk

Samim Ghamami, Board of Governors of the Federal Reserve System, 20th Street and Constitution Avenue N.W., Washington, DC, United States of America, samim.ghamami@frb.gov

We consider risk-neutral valuation of a contingent claim under bilateral counterparty risk in a setting similar to that of Duffie and Singleton (1999). We develop probabilistic valuation formulas that have closed-form solution or can lead to computationally efficient pricing schemes. Drawing upon the work of Ghamami and Goldberg (2014), we show that derivatives values under wrong way risk (WWR) need not be less than the derivatives values in the absence of WWR.

2 - Stochastic Intensity Margin Modeling of Credit Default Swap Portfolios

Dong Hwan Oh, Economist, Federal Reserve Board, 20th Street and Constitution Avenue N.W., Washington, DC, 20551, United States of America, donghwan.oh@frb.gov, Samim Ghamami, Baeho Kim

We consider the problem of initial margin (IM) modeling for portfolios of credit default swaps (CDS) from the perspective of a derivatives CCP. Inspired by Cont and Kan (2011), the CCPs' IM models in practice are based on theoretically-unfounded direct statistical modeling of CDS spreads. Using the well-known reduced-form approach, our IM model prices the portfolio constituents in a theoretically meaningful way and shows that statistical IM models can underestimate CCPs collateral requirements.

3 - Evaluating Central Counterparty Risk

Anton Badev, Economist, Federal Reserve Board, 1801 K St. NW, Washington, DC, 20006, United States of America, anton.i.badev@frb.gov, Samim Ghamami

A conceptually sound and logically consistent definition of the CCP risk capital is challenging, and incoherent CCP risk capital requirements may create an obscure environment. Based on novel applications of well-known mathematical models in finance, this paper introduces a risk measurement framework that coherently specifies all layers of the default waterfall resources of typical derivatives CCPs. We apply the proposed framework on DTCC data and evaluate various risk management practices.

4 - Risk Screening in Microfinance: Modeling and an Extragradient-based Online Learning Algorithm

Yuqian Xu, NYU Stern School of Business, 44 West 4th Street, New York City, NY, 10002, United States of America, yxu@stern.nyu.edu, Michael Pinedo, Binqing Xiao

In this paper, we get the business loan application and default data from one of the leading banks in China. We then propose a statistical model with three different types of indexes to quantify the potential performance of a firm: its financial level index, operational level index, and business owner level index and provide an efficient extragradient-based online learning algorithm to solve it.

■ MD07

07-Room 307, Marriott

Quantitative Methods for Financial Applications

Cluster: Risk Management

Invited Session

Chair: Rafael Mendoza-Arriaga, McCombs School of Business,
1 University Station, Austin, TX, 78712, United States of America,
rafael.mendoza-arriaga@mcombs.utexas.edu

1 - Storage Valuation

Long Zhao, PhD Student, UT McCombs Business School, 2110
Speedway Stop B6500, CBA 5.202, Austin, TX, 78712-1277,
United States of America, zhaolong.soul@gmail.com,
Stathis Tompaidis, Kumar Muthuraman

We use moving boundary method to approach the valuation problem of storage with transaction costs. If the storage facility is a price taker and price follows a mean-reverting process with seasonality, we are able to find the optimal strategy of injection and withdraw. Because of discounting, we may hold even price is super cheap. We may choose to hold instead of injection when the price is low because high selling transaction costs prevent us from selling them in the future.

2 - Predictable Forward Mean Variance Preferences

Xiao Han, PhD Student/Teaching Assistant, The University of
Texas at Austin, 7802 Leconte Rd., Austin, TX, 78717, United
States of America, xiao.han@utexas.edu, Thaleia Zariphopoulou

The classical mean variance preference poses a serious challenge when applied in the context of long term portfolio management. In the spirit of the forward utility preference of Musiela and Zariphopoulou, we propose a dynamic, self generating, mean variance preference that is flexible with both horizon and the associated model/parameter uncertainties. We will show that the new preference generates a much higher Sharpe ratio in a market with uncertain, time varying risk premium.

3 - Modelling of Electricity Supply Curves under Correlated Plant Behavior

Vishwakant Malladi, Doctoral Student, UT Austin,
Austin, TX, 78703, United States of America,
Vishwakant.Malladi@phd.mcombs.utexas.edu,
Rafael Mendoza-arriaga, Stathis Tompaidis

We present a framework where the electricity plants in a region are modeled as subordinated Markov Chains. We also develop a factor model for Markov chain generators to separate both the idiosyncratic and correlated behavior of the plants. Calibration shows that supply curves are bent resulting in lower generation capacity available at higher reliability levels.

4 - Modeling Electricity Prices: A Time Change Approach

Rafael Mendoza-Arriaga, McCombs School of Business,
1 University Station, Austin, TX, 78712, United States of America,
rafael.mendoza-arriaga@mcombs.utexas.edu, Zhiyu Mo,
Lingfei Li, Daniel Mitchell

We develop a new framework for modeling electricity spot prices by time changing the basic affine jump diffusion, which successfully captures seasonal spikes. Our model is easy to estimate from data and it is tractable for pricing electricity derivatives.

■ MD08

08-Room 308, Marriott

Mobile-Based Business Model Innovations

Cluster: Business Model Innovation

Invited Session

Chair: Vibhanshu Abhishek, Carnegie Mellon University, 5000 Forbes
Avenue, Pittsburgh, PA, 15213, United States of America,
vibs@andrew.cmu.edu

1 - Big Data Business Analytics from Mobile Marketing Innovation Perspectives

Xueming Luo, Temple University, 1801 Liacouras Walk,
Philadelphia, PA, United States of America,
Xueming.Luo@temple.edu

Xueming Luo will address big data business analytics from mobile marketing innovation perspectives. Over 3.6 billion people worldwide are deeply engaged with smartphone devices, machine-to-machine connected solutions, wearables, Internet-of-things technologies. As marketers can send ads to smartphone users anywhere they are, marketing discipline now faces tremendous opportunities of coming up with new theory and industry practices for manager and consumer insights. Xueming will explore how mobile technologies and connected smart devices affect advertising, promotions, marketing ROI, and omni-channel targeting effectiveness.

2 - Empirical Analysis of the Effectiveness of Mobile Channels

Marcel Goic, Assistant Professor Of Marketing, University of
Chile, Republica #701, Santiago 8370438, Chile,
mgoic@dii.uchile.cl, Jose Guajardo

The continuously growing use of mobile devices provides the opportunity to use this new channel to complement the value proposition that companies offer to their customer. However, the nature of customer responses to these initiatives remains largely unexplored. We empirically investigate the drivers of effectiveness in managing a mobile transactional channel and how to use location-based information to interact with consumers.

3 - Nudging Mobile Advertising with Offline Social Contexts

Beibei Li, Assistant Professor, Carnegie Mellon University, 5000
Forbes Ave, Pittsburgh, PA, 15213, United States of America,
beibeili@andrew.cmu.edu, Anindya Ghose, Siyuan Liu

We conducted a large-scale field experiment in a major shopping mall in Aisa for three weeks in 2015 based on a total of 52,500 unique user responses. Our results allow us to examine how offline social context would affect the effectiveness of mobile advertising.

4 - Evaluating Consumer M-health Services for Promoting Healthy Eating: A Randomized Field Experiment

Vibhanshu Abhishek, Carnegie Mellon University, 5000 Forbes
Avenue, Pittsburgh, PA, 15213, United States of America,
vibs@andrew.cmu.edu, Rema Padman, Yi-chin Lin, Julie Downs

In this paper we provide a systematic study on the effectiveness of using mHealth to promote healthy eating. We examine the effects of an mHealth app on food choices in a 4-month randomized field experiment. Mixed models showed that the mobile-based visual diary might be effective in increasing engagement. Results also showed strong evidence that dietitian support significantly improves consumer engagement in self-monitoring, and this effect was mediated by consumers' intention.

■ MD09

09-Room 309, Marriott

TIMES Distinguished Speaker

Sponsor: Technology, Innovation Management & Entrepreneurship
Sponsored Session

Chair: Leonardo Santiago, Associate Professor, Copenhagen Business
School, Department of Operations Management, Solbjerg Plads 3,
Blok B 5. sal, Frederiksberg, 2000, Denmark, ls.om@cbs.dk

1 - The Structure and Management of Technical Projects

Steven Eppinger, Professor Of Management Science And
Innovation, Massachusetts Institute of Technology,
Sloan School of Management, Cambridge, MA, 02421,
United States of America, eppinger@mit.edu

Design structure matrix (DSM) has been used both as a research method and as a management tool to improve performance of engineering projects. This presentation reviews some key DSM research results and ways in which the method is used today to manage complex technical projects. I will also offer thoughts on frontiers in technology management that may be addressed using DSM modeling and some reflections on why it takes more than 20 years to bring a practical method into common practice.

■ MD10

10-Room 310, Marriott

IT-Enabled Competitive Strategies

Sponsor: E-Business

Sponsored Session

Chair: Hong Guo, University of Notre Dame, 356 Mendoza College of
Business, Notre Dame, IN, 46556, United States of America,
hguo@nd.edu

1 - An Analysis of the Delay in Customer Support Forums: An Analytical and Empirical Approach

Wael Jabr, Assistant Professor, Georgia State University, 35 Broad
Street, Robinson College of Business, Atlanta, GA, 30303,
United States of America, wjabr@gsu.edu, Radha Mookerjee,
Vijay Mookerjee

User forums are a popular alternative to traditional support channels. To understand the dynamics of problem resolution there, we analyze the delay incurred by users waiting for a solution. Using datasets from support forums we find that users who initiate threads suffer a shorter delay than those who join later on. We explain this counter-intuitive result with queuing theory. We use the empirical findings to devise a policy for firm involvement aiming at minimizing overall delay.

2 - Has Production Interdependence Been Changed with Information Technology?

Fengmei Gong, Assistant Professor Of Information Technology,
University of La Verne, La Verne, CA, 91750, United States of
America, fgong@laverne.edu, Barrie R. Nault, Zhuo (June) Cheng

Industries have become increasingly integrated with their suppliers' business processes such as purchasing and Just-in-time (JIT) production; however, whether industries in a supply chain have become more interdependent remains an open question. We examine the impact of an industry's IT investment on its production interdependence with upstream suppliers, where we measure interdependence as direct backward linkage (DBL).

3 - New Platform Announcement Strategies: A Duopoly of Two-sided Platforms

Rajiv Mukherjee, Assistant Professor, Southern Methodist
University, Dallas, TX, United States of America,
rmukherjee@mail.smu.edu, Ramnath Chellappa

We study a duopoly where two firms that are horizontally differentiated in their two sided platform offerings evaluate their release strategies for a new version. The firms chose between two release strategies: I) Formal release whereby the firms commit to their future offering, II) Informal release whereby the firms employ rumor or other seeding mechanisms to announce to the market.

4 - Social Interactions and Product Sales in Social Shopping: An Experimental Approach

Annibal Sodero, Assistant Professor, University of Arkansas,
Sam M. Walton College of Business, Fayetteville, AR, 72701,
United States of America, ASodero@walton.uark.edu,
Elliot Rabinovich, Bin Gu

Social shopping revolves around deeply discounted deals that are offered for a limited time through social networking websites. In this study, we investigate the effect of social interactions on product sales and the contingencies surrounding the interactions. Using an experimental approach, we investigate five social interaction mechanisms and find that three mechanisms act in tandem to accelerate a deal's demand: opinion leadership, network integration, and boundary spanning of early buyers.

MD11

11-Franklin 1, Marriott

Convex Relaxations for Structured Integer Programs

Sponsor: Optimization/Integer and Discrete Optimization
Sponsored Session

Chair: Akshay Gupte, Clemson University, Dept of Mathematical
Sciences, Clemson, SC, 29634, United States of America,
agupte@clemson.edu

1 - On The Polyhedral Structure of a Multi-capacity Mixing Set

Ayse Arslan, PhD Student, University of Florida, Weil 413,
Gainesville, FL, 32611, United States of America,
arslan.aysenur@gmail.com, Jean-philippe P Richard,
Yongpei Guan

In this talk, we study the polyhedral structure of a multi-capacity mixing set. This set arises as part of the formulation of production planning and logistics problems. We derive two families of facet-defining inequalities for the set under consideration by lifting mixing inequalities. We discuss the properties of the associated lifting function and show that lifting can be performed efficiently. We thereby strictly generalize earlier results of Marchand and Wolsey [1998].

2 - Sparse Principal Component Analysis (SPCA) via Convexification

Jinhak Kim, Purdue University, 610 Purdue Mall, West Lafayette,
IN, 47906, United States of America, kim598@purdue.edu,
Mohit Tawarmalani, Jean-philippe P. Richard

We characterize the convex hull of the feasible set of SPCA. The convex hull is described in a lifted space by dualizing the separation problem. The convex hull can be reformulated in terms of majorization inequalities. This interpretation allows us to express each point in the convex hull as a convex combination of points that satisfy the cardinality constraint. We propose an SDP relaxation in the lifted space which is stronger than that of d'Aspremont et al (2007).

3 - A Bilevel Programming Problem Occurring in Smart Grids

Leo Liberti, CNRS & Ecole Polytechnique, LIX Ecole
Polytechnique, Palaiseau, France, liberti@lix.polytechnique.fr,
Sonia Toubaline, Pierre-louis Poirion, Claudia D'Ambrosio

A key property to define a power grid "smart" is its real-time, fine-grained monitoring capabilities. For this reason, a variety of monitoring equipment must be installed on the grid. We look at the problem of fully monitoring a power grid by means of Phasor Measurement Units (PMUs), which is a graph covering problem with some equipment-specific constraints. We show that, surprisingly, a bilevel formulation turns out to provide the most efficient algorithm.

MD12

12-Franklin 2, Marriott

Surrogate-Based and Derivative-Free Optimization II

Sponsor: Optimization/Mixed Integer Nonlinear Optimization and
Global Optimization

Sponsored Session

Chair: Rommel Regis, Saint Joseph's University, Mathematics
Department, 5600 City Avenue, Philadelphia, PA, 19131,
United States of America, rregis@sju.edu

1 - A DFO-based Approach to Computer-aided Mixture Design

Nick Austin, Graduate Student, Carnegie Mellon University, 5000
Forbes Ave, Pittsburgh, PA, 15213, United States of America,
ndaustin@andrew.cmu.edu, Nikolaos Sahinidis, Daniel Trahan

Computer-Aided Mixture Design (CAMxD) relies on complex physicochemical simulation models to design a blend of compounds. We present a novel approach to CAMxD that relies on the use of derivative-free optimization (DFO). We present comparative results from the application of 27 DFO solvers to this challenging problem.

2 - Surrogate-based Optimization for Oral Solid Drug Product Manufacturing

Zilong Wang, Graduate Research Assistant, Rutgers University, 98
Brett Rd, Chemical and Biochemical Engineering, Piscataway, NJ,
08854, United States of America, wzpublic@gmail.com,
M. Sebastian Escotetepinoza, Ravendra Singh,
Fernando J. Muzzio, Marianthi Ierapetritou

Surrogate-based optimization is used to solve computationally expensive simulation models and to optimize functions when the model is not available. However the applicability of such methods can be limited due to the high dimensionality of problem variables. In this presentation we focus on solving high-dimensional design problems in pharmaceutical manufacturing using RBF-based surrogate modeling strategies. Case studies will be used to illustrate the applicability of the proposed approaches.

3 - Applied Results from the Techno-economic Optimization of a High-flux Solar Thermal Receiver

Michael Wagner, Mechanical Engineer, National Renewable
Energy Lab, 15013 Denver West Parkway, Golden, CO, 80401,
United States of America, Michael.Wagner@nrel.gov,
Alexandra Newman, Robert Braun

We optimize a novel concentrating solar power tower receiver technology by choosing the geometry and optical design. We use computationally expensive engineering models to generate surrogates that represent the objective function, which accounts for revenue as a function both of the design of the system and of the annual plant electricity production. Nonlinear constraints are incorporated via Lagrangian terms. We present results that guide the applied technology configuration.

4 - Applications of Surrogate-based Optimization

Cameron Turner, Associate Professor Of Mechanical Engineering,
Colorado School of Mines, 1500 Illinois St., Department of
Mechanical Engineering, Golden, CO, 80401,
United States of America, cturner@mines.edu

Many engineering design problems are characterized by nonlinear behaviors, mixed discrete-continuous variables, multiple objective functions, & uncertain or limited precision data about the problem. What data that exists is often derived from empirical measurements, experimental studies, or models & simulations; each with errors, limited precision & data collection costs. We focus on the use of the techniques, tradeoffs and decisions necessary to employ surrogates in optimization.

■ MD13

13-Franklin 3, Marriott

Stochastic Integer Programming

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Kibaek Kim, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439, United States of America, kimk@anl.gov

1 - A Scalable Approach to Solving Multi-stage Stochastic Integer Programs

Osman Ozaltin, Assistant Professor, North Carolina State University, Raleigh, NC, United States of America, oyozahti@ncsu.edu, Burhaneddin Sandikci

Despite being a flexible modeling framework, multi-stage SPs are not widely adopted in practice, mostly due to their unbearable size. Moreover, incorporating integer variables renders multi-stage SPs even less tractable. We propose a bounding-based solution approach, which does not assume convexity but it rather relies on scenario decomposition and is inherently parallelizable. Our results demonstrate that the proposed method scales nicely with problem size and produces high quality solutions.

2 - On Solving General Two-stage Stochastic Programs

Manish Bansal, Postdoctoral Fellow, Department of Industrial Engineering and Management Science, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, manish.bansal@northwestern.edu, Sanjay Mehrotra

We study general two-stage stochastic programs (TSSPs) and present conditions under which the second stage programs can be convexified. This generalizes the results of Bansal et al. (2015) for two-stage stochastic mixed integer programs. We present finitely convergent decomposition algorithms to solve many classes of TSSPs including TSSP with some non-convex program in the second stage. We computationally evaluate our convexification approach by solving two-stage stochastic lot-sizing problems.

3 - Algorithmic Innovations and Software for the Dual Decomposition Method Applied to SMIP

Kibaek Kim, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439, United States of America, kimk@anl.gov, Victor M. Zavala

We develop algorithmic innovations for the dual decomposition method to address two-stage stochastic programs with mixed-integer recourse and provide a parallel software implementation. Our innovations include the derivation of valid inequalities that tighten Lagrangian subproblems and the stabilization of dual variables by solving the master problem with a primal-dual interior point method and provide termination criteria that guarantee finite termination of the algorithm.

4 - Updates to PIPS-SBB: A Parallel Distributed Memory Stochastic Mip Solver

Geoff Oxberry, Lawrence Livermore National Laboratory, P.O. Box 808, L-792, Livermore, CA, United States of America, oxberry1@llnl.gov, Deepak Rajan, Thomas Edmunds, Pedro Sotorrio, Lluís Miquel Munguía, Cosmin Petra

Deterministic equivalent formulations of stochastic MIPs from applications such as unit commitment (UC) can exceed available memory on a single workstation. To overcome this limitation, we have developed PIPS-SBB, a parallel distributed memory stochastic MIP solver based on the distributed memory stochastic LP solver PIPS-S. Here, we discuss ongoing work on PIPS-SBB, with a focus on parallel implementations of B&B techniques. We also present a path forward to solving large UC problem instances.

■ MD14

14-Franklin 4, Marriott

Robust Optimization in Radiation Therapy Planning

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Wei Liu, Assistant Professor, Mayo Clinic Arizona, 5777 E Mayo Blvd., Phoenix, AZ, 85054, United States of America, Liu.Wei@mayo.edu

1 - Scenario-based Radiotherapy Margins: Handling Tissue Inhomogeneity, Range Errors, and Organ Motion

Rasmus Bokrantz, RaySearch Laboratories, Sveavägen 44, Stockholm, 111 34, Sweden, rasmus.bokrantz@raysearchlabs.com, Albin Fredriksson

We consider a scenario-based optimization formulation to handle the effects of errors in radiotherapy planning. The formulation coincides with margin-based planning if the implicit assumptions made when the margins are delineated are valid, but also generalizes to more difficult situations such as irradiation of

inhomogeneous tissue or irradiation with proton fields. We extend the model to account for tissue inhomogeneity, proton range errors, and organ motion.

2 - Robust Optimization Methods for Breast Cancer Radiation Therapy

Houra Mahmoudzadeh, University of Toronto, Toronto ON, Canada., houra@mie.utoronto.ca, Timothy Chan, Thomas Purdie

We explore robust optimization methods for improving the quality of treatment in left-sided breast cancer radiation therapy. Our robust models take into account breathing uncertainty and minimize the dose to the organs at risk while meeting the clinical dose-volume limits on the cancerous target. We use clinical data from several breast cancer patients and compare the outcomes of our robust models with those of the current clinical methods.

3 - Chance-constrained Robust Optimization in Proton Therapy to Account for Beam Delivery Uncertainties

Yu An, Mayo Clinic, 5777 East Mayo Blvd., Phoenix, AZ, 85054, United States of America, an.yu@mayo.edu, Jianming Liang, Wei Liu

We propose a chance-constrained model in intensity-modulated proton therapy treatment planning by explicitly accounting for range and patient setup uncertainties in optimization algorithm. Decomposition methods are applied to render the large-scale optimization problems tractable and achieve the best trade-off between plan quality and robustness. The results are then checked by patient population study to demonstrate the statistically significant advantages of our planning method.

4 - Robust Spatiotemporally Integrated Fractionation in Radiotherapy

Archis Ghate, University of Washington, Industrial & Systems Engineering, University of Washington Box 352650, Seattle, United States of America, archis@uw.edu, Ali Ajdari

Feasibility of the fluence-maps in the spatiotemporally integrated fractionation problem crucially depends on the linear-quadratic dose-response parameters of the organs-at-risk. We present a robust formulation of this problem whereby the resulting dosing schedule remains feasible as long as the dose-response parameters vary within a known range. This robust model is non-convex and high-dimensional. We discuss approximate solution techniques rooted in convex programming.

■ MD15

15-Franklin 5, Marriott

Distributed Convex Optimization

Sponsor: Optimization/Nonlinear Programming

Sponsored Session

Chair: Necdet Serhat Aybat, Assistant Professor, Industrial Engineering Dept., Penn State University, University Park, PA, United States of America, nsa10@engr.psu.edu

1 - A New Globally Convergent Incremental Newton Method

Mert Gurbuzbalaban, Massachusetts Institute of Technology, 32 Vassar St, Cambridge, MA, United States of America, mertg@mit.edu, Asu Ozdaglar, Pablo Parrilo

We develop and analyze a new globally convergent incremental Newton method for minimizing the sum of strongly convex functions, motivated by machine learning problems over large data sets and distributed optimization over networks. We discuss its convergence rate and prove its linear convergence under some assumptions.

2 - Multiagent Distributed Admm: Rate of Convergence

Ali Makhdomi, Massachusetts Institute of Technology, 32 Vassar St, Cambridge, MA, 02139, United States of America, makhdom@mit.edu, Asu Ozdaglar

We consider a multi agent optimization problem where a network of agents collectively solves a global optimization problem with the objective function given by the sum of locally known convex functions. This problem arises in many applications in large-scale distributed statistical estimation. We propose a fully distributed ADMM algorithm and characterize its rate of convergence as well as its dependence on the network structure.

3 - An Asynchronous Distributed Proximal Method for Composite Convex Optimization

Zi Wang, Penn State University, 1400 Martin St, Apt. 2112, State College, PA, 16803, United States of America, zwx121@psu.edu, Necdet Serhat Aybat, Garud Iyengar

We propose an asynchronous distributed first-order augmented Lagrangian (DFAL) algorithm to minimize sum of composite convex functions, where each term is a private function to one node, and only nodes connected by an edge can communicate. We show any limit point of iterates is optimal; an eps-optimal and eps-feasible solution can be computed with probability at least $1-p$ within $O(1/(\text{eps} \log(1/p)))$ communications. We demonstrate the efficiency of DFAL on large scale sparse-group LASSO problems.

■ MD16

16-Franklin 6, Marriott

Application of Linear and Conic Programs with Complementarity Constraints

Sponsor: Optimization/Linear and Conic Optimization

Sponsored Session

Chair: Xin Shen, RPI, 110 8th Street, Troy, NY, 12180, United States of America, shenx5@rpi.edu

1 - Robust Optimization for Network Design Problems with Equilibrium Flows

Liu Su, Iowa State University, 0076 Black Engineering, Ames, IA, 50011, United States of America, suliu@iastate.edu, Lizhi Wang, Guiping Hu

To identify optimal network capacity expansion, we build up a bi-level model for network design problems with equilibrium flows under the robust optimization paradigm. We transformed the lower level problem into a mixed-integer linear program and use a branch and cut algorithm to solve the bi-level optimization problem.

2 - Application of Complementarity Problems in Multibody Dynamics and Robotics

Ying Lu, Rensselaer Polytechnic Institute, 2408 21st St. Apt. 6, Troy, NY, 12180-1811, United States of America, rosebudflyaway@gmail.com, Jeff Trinkle

Frictional contacts in multibody dynamics and robotic simulation are generally written as differential Complementarity Problems (dCPs), which are solved as a series of CPs. We compare several models and solution algorithms, as well as a GPU based CUDA parallel solver to solve the Complementarity Problems arising in physical simulation.

3 - Property of a Relaxation Scheme for Rank Constrained Optimization Problems

Xin Shen, RPI, 110 8th Street, Troy, NY, 12180, United States of America, shenx5@rpi.edu, John Mitchell

Recently rank constrained optimization problems have received increasing interest because of their wide application. This class of problems has been considered computationally challenging because of its nonconvex nature. In this talk we focus on a mathematical program with semidefinite cone complementarity constraints formulation of the class. We'll consider a relaxation scheme for the formulation and discuss its properties including stationary conditions and local optimality.

4 - Heuristics for QPLCCS using Nlp Solvers Aided by Semidefinite Relaxations

Patricia Gillett, PhD Candidate, Département de Mathématiques et de Génie Industriel, École Polytechnique de Montréal, Montréal, QC, Canada, patricia-lynn.gillett@polymtl.ca, Miguel Anjos, Joaquim Júdice

We present a semidefinite programming relaxation technique with iterative cutting planes for quadratic programs with linear complementarity constraints (QPLCC). We discuss how an optimal solution to the SDP relaxation can be used to warmstart the solution of the QPLCC using common local and global NLP solvers. We report some numerical results demonstrating the quality of the SDP bound and the effectiveness of the warmstarting procedures.

■ MD17

17-Franklin 7, Marriott

Modeling Social Influence in Networks

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Vladimir Boginski, University of Florida, 303 Weil Hall, Gainesville, FL, United States of America, boginski@reef.ufl.edu

1 - Fashion Supply Chain Network Competition with Ecolabelling

Min Yu, Assistant Professor, University of Portland, 5000 N. Willamette Blvd., Portland, OR, 97203, United States of America, yu@up.edu, Jonas Floden, Anna Nagurney

We develop a competitive supply chain network model for fashion that incorporates ecolabelling. We capture the individual profit-maximizing behavior of the fashion firms which incur ecolabelling costs with information associated with the carbon footprints of their supply chains revealed to the consumers. Consumers, in turn, reflect their preferences for the branded products of the fashion firms through their demand price functions, which include the carbon emission information.

2 - Impact of Sub-networks on the Diffusion of Innovation

Xu Dong, Research Assistant, University of Miami, 1251 Memorial Drive, Coral Gables, FL, 33146, United States of America, x.dong3@umiami.edu, Nazrul Shaikh

Extant research shows that the structural properties of social networks influence the diffusion of innovation; however, these studies assume that the network is one giant cluster. Networks can have disconnected clusters (sub-networks) that introduce discontinuities in the diffusion pathways. Our research provides an understanding of the impact of discontinuities on diffusion.

3 - Identifying High Value Customers in a Network: Individual Characteristics Versus Social Influence

Sang-Uk Jung, Assistant Professor, Hankuk University of Foreign Studies, Imunro 102, Dongdaemun-gu, Seoul, 130-791, Korea, Republic of, sanguk.jung@hufs.ac.kr, Qin Zhang, Gary Russell

Firms are interested in identifying customers who generate the highest revenues. In a social network setting, customer interactions can play an important role in purchase behavior. This study proposes a spatial autoregressive model that explicitly shows how network effects and individual characteristics interact in generating firm revenue. Using model output, we develop a method of identifying individuals whose purchase behavior most impacts the total revenues in the network.

■ MD18

18-Franklin 8, Marriott

Methodologies in Text Mining for Big Data

Cluster: Modeling and Methodologies in Big Data

Invited Session

Chair: Onur Seref, Virginia Tech, 2060 Pamplin Hall (0235), Blacksburg, VA, 24061, United States of America, seref@vt.edu

1 - A Tangled Web: Evaluating the Impact of Displaying Fraudulent Reviews on Review Portals

Uttara Ananthakrishnan, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh PA 15213, United States of America, umadurai@andrew.cmu.edu, Michael D Smith, Beibei Li

This paper studies how users respond to fraudulent reviews and how platforms can leverage such knowledge to design better fraud management. We combine randomized experiments, behavioral economics with machine learning using large-scale data from Yelp. We find to improve user trust platforms should display the fraudulent information. Finally, our statistical analysis using MLE allows us to design a novel fraud-awareness reputation system.

2 - Strength in Numbers: Can Big Data Eliminate the Need for Complex Opinion-mining Algorithms?

Theodoros Lappas, Assistant Professor, Stevens Institute of Technology, 335 Washington, Apt. 2, Hoboken, NJ, 07030, Greece, tedlappas@gmail.com

Opinion mining, defined as the task of identifying the polarity of text segments, is a building block for many popular applications. Relevant methods have evolved from simple lexicon-based approaches to expensive NLP algorithms that try to emulate human thought. What if there was a simpler way to capture complex linguistic patterns, by utilizing the unprecedented availability of opinion-rich datasets? Our work addresses this question and motivates a new line of applications for Big Data.

3 - Restaurant Hygiene Grades and Online Reviews

Jorge Mejia, University of Maryland, Robert H. Smith School of Business, College Park, MD, United States of America, jmejia@rhsmith.umd.edu, Shawn Mankad, Anand Gopal

We focus on understanding the relationship between online reviews and a significant public health problem: restaurant-related foodborne illness. Recent initiatives to publicize the results of restaurant health inspections have been shown to reduce the occurrence of foodborne illness. We use the semantic information in online reviews to forecast health inspection results for restaurants in NYC. This approach can be used to improve the effectiveness of health inspection programs.

4 - Automatic Sequence Extraction for Sequence Alignment in Text Mining

Michelle Seref, Virginia Tech, Pamplin 1007, 0235, Blacksburg, VA, 24061, United States of America, mmhseref@vt.edu, Onur Seref

We illustrate novel methods to automatically extract sequences from pre-labeled text in order to apply sequence alignment for classifying text. Sequences are initially generated using n-gram approaches and then aggregated into semantically unique sequences. Sequence alignment uses these sequences to detect semantically equivalent text with either exact word or synonym matches. We demonstrate our method on several text domains.

■ MD19

19-Franklin 9, Marriott

Application of Nonlinear Optimization using Sequential Linear Programming Techniques with Xpress

Sponsor: Computing Society

Sponsored Session

Chair: Zsolt Csizmadia, Principal Engineer, FICO, FICO House, Starley Way, Birmingham, B37 7GN, United Kingdom, zsolt.csizmadia@gmail.com

1 - State of Optimization in Advanced Process Control

Rishi Amrit, Shell International, Houston, TX, United States of America, R.Amrit@shell.com

Process Control forms the backbone as well as the driving agent for almost all of process industries today. Smart algorithms combined with superior computational capabilities allow us to automate processes in a controlled fashion while optimizing environmental, safety and economic performance. This talk discusses recent advances in commercial Advanced Process Control technology by harnessing the latest developments in the optimization community along with the challenges going forward.

2 - Modeling Recursive Formulae in Xpress using Variable Eliminations

Libin Varghese, Lead Modeling Developer, FICO, 1500 Broadway, Suite 1101, New York, NY, 10036, United States of America, LibinVarghese@fico.com

Modeling a deposit pricing problem, that optimizes rates for a multiyear period, involves handling of various recursive formulae that link each time period to the next. We shall focus on how we modeled the problem in the Mosel modeling language using the new variable elimination feature of Xpress-Nonlinear and the performance improvements achieved.

3 - A New Optimality Measure for Sequential Linear Programming Methods

Zsolt Csizmadia, Principal Engineer, FICO, FICO House, Starley Way, Birmingham, B37 7GN, United Kingdom, zsolt.csizmadia@gmail.com

The KKT conditions are regarded as the definite first order optimality conditions for nonlinear programming though regularity conditions relatively rarely hold in practice. The convergence of nonlinear optimization algorithms based on first order approximations often focus on the progress made rather than the solution properties. We introduce a new optimality measure derived from the KKT conditions and explore the connection between the convergence of first order methods and the new measure.

■ MD20

20-Franklin 10, Marriott

Stochastic Models and Analysis for Cloud Computing

Cluster: Cloud Computing

Invited Session

Chair: Yingdong Lu, IBM Research, 1101 Kitchawan Rd, Yorktown Heights, United States of America, yingdong@us.ibm.com

1 - Model Based Autoscaling of Hadoop Clusters

Parijat Dube, IBM, 1101 Kitchawan Road, Yorktown Heights, United States of America, pdube@us.ibm.com, Li Zhang, Andrzej Kocut, Anshul Gandhi

We develop novel performance models for Hadoop workloads that relate job execution time to various workload and system parameters such as input size and resource allocation. We employ statistical techniques to tune the models for specific workloads, including TeraSort and Kmeans. The tuned models are used to determine the resources required to successfully complete the Hadoop jobs as per the user-specified execution time SLA.

2 - Navigating the Amazon Cloud

Aaron Yan, Data Scientist, Gravitant, 11940 Jollyville Road, #325N, Austin, TX, 78759, United States of America, aaron.yan@gravitant.com, Ilyas Iyooob

Selecting the right level of reservation in the cloud is a tricky problem, especially when there are multiple reservation levels. In this paper, we explore the optimal levels of reservation for a portfolio of cloud servers that satisfy the CapEx and OpEx budget. The team has developed a web application that solves this problem and demonstrates the savings incurred from choosing the correct reservation pricing models.

3 - Optimal Resource Allocation Algorithms for Cloud Computing

Siva Theja Maguluri, Postdoctoral Researcher, IBM TJ Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, smagulu@us.ibm.com

Jobs arrive at a cloud computing system according to a stochastic process and request resources like CPU, memory, etc and need service for a random amount of time. These jobs need to be scheduled on servers. The jobs are first routed to one of the servers when they arrive and are queued at the servers. Each server then chooses a set of jobs from its queues so that it has enough resources to serve all of them simultaneously. We present an optimal load balancing and scheduling algorithm.

■ MD21

21-Franklin 11, Marriott

Stochastic Models in Healthcare

Sponsor: Health Applications

Sponsored Session

Chair: Sait Tunc, UW-Madison, 3233 Mechanical Engineering Building, 1513 University Avenue, Madison, WI, 53706, United States of America, stunc@wisc.edu

Co-Chair: Oguzhan Alagoz, UW-Madison, 3242 Mechanical Engineering Building, 1513 University Avenue, Madison, WI, 53706, United States of America, alagoz@engr.wisc.edu

1 - Robustness of Markov Decision Processes for Medical Treatment Decisions

Lauren Steimle, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, steimle@umich.edu, Brian Denton

Markov decision process (MDP) models are frequently used to study optimal policies for treatment of patients with chronic diseases. However, these models can be sensitive to estimates of transition probabilities and rewards. We discuss an approach for quantifying robustness of MDP-based policies with respect to parameter uncertainty. We illustrate our findings based on a model for optimal treatment of blood pressure and cholesterol in patients with type 2 diabetes.

2 - Ambulance Emergency Response Optimization in Dhaka, Bangladesh

Justin Boutillier, University of Toronto, 5 King's College Road, Toronto, ON, M5S 3G8, Canada, j.boutillier@mail.utoronto.ca, Moinul Hossain, Timothy Chan

Dhaka, the capital city of Bangladesh and the tenth largest city in the world, does not currently have a centralized emergency medical service (EMS) system or 9-1-1 type number. As a result, patients experience restricted access to healthcare. To address this problem, we have developed a novel data-driven robust location-routing model that can be applied to Dhaka and other developing urban centers. The model uses traffic data collected via GPS to construct an uncertainty set for travel times.

3 - Score Based Anticipative Transfer Requests in the Intensive Care Units

Yasin Ulukus, University of Pittsburgh, Pittsburgh PA, United States of America, myu1@pitt.edu, Gilles Clermont, Guodong Pang, Andrew J. Schaefer

The efficient operation and management of ICUs is critical to providing high quality of care while managing costs. We construct a new Transfer Score to estimate readmission and death probabilities. We further show that an anticipative transfer request policy combined with effective use of clinical markers can significantly decrease transfer delays without increasing the capacity. We present a Markov Decision Process (MDP) model for the transfer request problem and solve it via approximations

4 - Optimal Breast Cancer Diagnostic Decisions under the Consideration of Overdiagnosis

Sait Tunc, UW-Madison, 3233 Mechanical Engineering Building, 1513 University Avenue, Madison, WI, 53706, United States of America, stunc@wisc.edu, Oguzhan Alagoz, Elizabeth Burnside

Breast cancer overdiagnosis issue becomes more severe every year, a recent study approximates the annual cost of overdiagnosis to the United States as \$243 million. We propose a large-scale MDP model to determine the optimal diagnostic strategy under the consideration of overdiagnosis by incorporating cytologic grade into the traditional breast cancer diagnostic decision problem.

■ MD22

22-Franklin 12, Marriott

Joint Session Prize/CPMS: 2015 Inform's Prize Winner

Cluster: 2015 INFORMS Prize Presentation

Invited Session

Chair: Peter Buczkowski, Manager, Workforce Management, Disney Parks & Resorts, P.O. Box 10000, Lake Buena Vista, FL, 32830, United States of America, Peter.S.Buczkowski@disney.com

1 - 2015 Inform's Prize Presentation by Chevron

Margery Connor, Chevron, 6001 Bollinger Canyon, F-2080, San Ramon, CA, 94583, MHCO@chevron.com, Bill Klimack, Wen Chen

Chevron, 2015 INFORMS Prize Winner for excellence in analytics and operations research, will present their long and innovative history of applying analytics and operations research across their worldwide energy company. Highlighted projects include: • Petro: Chevron's refinery planning tool • Workforce forecasting to ensure the right people on the right projects • genOpt: Optimization model to maximize oil and gas production. Chevron will also share their journey applying decision analysis.

■ MD23

23-Franklin 13, Marriott

Markov Lecture

Sponsor: Applied Probability

Sponsored Session

Chair: Tolga Tezcan, Associate Professor, London Business School, Regent's Park, London NW14SA, United Kingdom, ttezcan@london.edu

Co-Chair: Neil Walton, University of Amsterdam, Science Park 904, Amsterdam, Netherlands, n.s.walton@uva.nl

1 - Risk Analytics

David D. Yao, Columbia University, Department of Industrial Engineering, 500 West 120 St, New York, NY, 10027-6699, United States of America, yao@columbia.edu, Jose Blanchet, Paul Glasserman

This year's Markov lecture and discussions will provide a survey of risk analytics as a fundamental tool in operations research. While the focus of business analytics is on issues of productivity and efficiency: cost savings and revenue/profit optimization, risk analytics address the complementary issues of sustainability and resiliency: risk-return tradeoff and related resource allocation decisions and mitigation strategies. Some of the applications to be highlighted include: resilient urban infrastructures, production planning with risk hedging, financial systemic risk, and securitized insurance products.

■ MD24

24-Room 401, Marriott

Latent Variable Models in Biomedical Informatics

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Madeleine Udell, Postdoctoral Fellow, Caltech, CMS, Mail Code 9-94, Pasadena, CA, 91125, United States of America, madeleine.udell@gmail.com

1 - Computational Phenotyping from Electronic Health Records using Tensor Factorization

Joyce Ho, University of Texas at Austin, 1 University Station C0803, Austin, TX, 78712, United States of America, joyceho@utexas.edu, Jimeng Sun, Joydeep Ghosh

A computational phenotype (a set of clinical features or clinical condition) can enable cohort identification, allow decision-makers to identify patients for interventions, and be integrated with systems for real-time clinical decision support. We developed sparse, nonnegative tensor factorization models to obtain phenotypes with minimal human supervision. Results on real EHRs demonstrate the effectiveness of our models to extract medically interpretable concepts from complex health data.

2 - Unfolding Physiological State: Mortality Modelling in Intensive Care Units

Marzyeh Ghassemi, MIT, 32 Vassar Street., 32-257, Cambridge, MA, 02139, United States of America, mghassem@mit.edu

Accurate knowledge of a patient's disease state and trajectory is critical in modern clinical settings. We examined the use of latent variable models to decompose free-text hospital notes into meaningful features, and the predictive power of these features for patient mortality. We found that latent topic-derived features were effective in determining patient mortality both in-hospital and post-discharge, and a combination of structured and topic features performed best.

3 - Unsupervised Learning of Disease Progression Models

David Sontag, Assistant Professor, NYU, 715 Broadway, 12th Floor, Room 1204, New York, NY, 10003, United States of America, dsontag@cs.nyu.edu

Chronic diseases such as diabetes and COPD progress slowly over many years, causing increasing burden to patients and the healthcare system. Better understanding progression is instrumental to early diagnosis and precision medicine. Inferring disease progression from real-world evidence is challenging due to the incompleteness and irregularity of observations, as well as the heterogeneity of patient conditions. We propose a probabilistic disease progression model that address these challenges.

■ MD25

25-Room 402, Marriott

Economics of IS & OM

Sponsor: Information Systems

Sponsored Session

Chair: Lin Hao, University of Notre Dame, 351 Mendoza College of Business, Notre Dame, IN, United States of America, lhao@nd.edu

1 - Exploring a New Marketing Platform of Credit Card Companies

Soohyun Cho, University of Florida, 355F STZ, Gainesville, FL, United States of America, soohyun.cho@warrington.ufl.edu, Subhajyoti Bandyopadhyay, Liangfei Qiu

Some credit card companies (CCs) and partner merchants have launched an exclusive marketing platform for their cardholders. The platform provides either public promotion through Social Network Services (SNS) or targeted promotion through their websites. We examine which promotion is more profitable to CCs and to competitive partner merchants.

2 - Bundling of Digital Products in Music Industry: An Empirical Study

Kyungsun Rhee, PhD Student, University of Washington, University of Washington, Seattle, WA, 98105, United States of America, ksr22@uw.edu, Yong Tan, Jianping Peng

It is becoming increasingly competitive for music websites nowadays. Due to highly heterogeneous demand, offering music bundles is a popular strategy to attract consumers. In this work, we examine the effectiveness of various bundling strategies using a unique dataset from a music mobile application which contains variables such as music downloads, ringtone purchase logs and user behavior in monthly subscription.

3 - E-book Platform Competition in the Presence of Two-sided Network Externalities

Yabing Jiang, Florida Gulf Coast University, 10501 FGCU Blvd, Fort Myers, FL, United States of America, yjiang@fgcu.edu

The success of the Kindle e-book platform and the increased popularity of e-books among readers have attracted extensive competition in the e-book market. We model the direct competition in the e-book platform market through a two-sided network externality model and show that publishers can influence consumers' e-book platform adoption decisions and the total e-book sales by strategically deciding the size of contents available on each platform.

4 - The Effect of Online "Following" on Contributions to Open Source Communities

Mohammadmahdi Moqri, University of Florida, 299 Diamond Blvd, Apt. 5, Gainesville, United States of America, mahdi.moqri@warrington.ufl.edu, Liangfei Qiu, Subhajyoti Bandyopadhyay, Ira Horowitz

Although numerous studies have examined members' motivation to contribute to online communities, the positive effect of social factors has not been unanimously confirmed in different settings. In this study, we estimate the effect of social factors on members' contributions in an open source software (OSS) community, using a large scale dataset of 4 million online members. The results have implications for online community designers and OSS scholars.

■ MD26

26-Room 403, Marriott

Analytics Maturity Model

Sponsor: INFORMS Practice

Sponsored Session

Chair: Aaron Burciaga, Analytics Executive, INFORMS Analytics Maturity Model, 4305 Majestic Ln, Fairfax, VA, 22033, United States of America, adburiaga@gmail.com

1 - The 2015 State of Analytics Report - Informs Analytics Maturity Model

Aaron Burciaga, Analytics Executive, INFORMS Analytics Maturity Model, 4305 Majestic Ln, Fairfax, VA, 22033, United States of America, adburiaga@gmail.com, Paul Lima

INFORMS' members and cadre of credentialed analytics professions from across academia, business, and government now update, govern, and operate the new standard for assessing and benchmarking the application of analytics in organizations and across industries: the INFORMS Analytics Maturity Model (IAMM). During this session, the "2015 State of Analytics Report" will premier, introducing the benchmarks by industry for any organization beginning, developing, or advancing their analytics journey.

■ MD27

27-Room 404, Marriott

Spatial Multi-Criteria Decision Analysis

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Valentina Ferretti, Politecnico di Torino, Corso Castelfidardo 30/A, Torino, Italy, valentina.ferretti@polito.it

1 - Decision Analysis with Geographically Varying Outcomes

Jay Simon, American University, Washington, DC, jaysimon@american.edu

This work develops theory to support decisions based on data from geographic information systems (GIS). Preference conditions are introduced, leading to corresponding value and utility functions over GIS data for both single-attribute and multiple-attribute cases. These models of preferences are then applied to example decisions based on GIS data.

2 - Application of the New Gear Geospatial MCDA Tool to Humanitarian Assistance Site Selection Decisions

Matthew Bates, Research Engineer, US Army Corps of Engineers, Engineer R&D Center, 696 Virginia Rd, Concord, MA, 01742, United States of America, Matthew.E.Bates@usace.army.mil, Patrick Doody, John Nedza, Erin Hughey, Richard Curran, Igor Linkov, Heather Bell, Paul Kailiponi, Michelle Hamilton

Humanitarian assistance and disaster response (HADR) decisions are multifaceted, involving many stakeholders, limited funding and competing areas of need. Spatially explicit data are increasingly available to support these decisions at fine scales. We introduce GEAR, a new US-Govt-developed tool for spatial multi-criteria decision analysis that is currently being transitioned to the Pacific Disaster Center to support the HADR community. We demonstrate its application to site selection decisions.

3 - Key Challenges and Meta-choices in Designing Spatial Multi-criteria Evaluations

Gilberto Montibeller, London School of Economics, Houghton Street, London WC2A 2AE, London, United Kingdom, G.Montibeller@lse.ac.uk, Valentina Ferretti

Spatial multi-criteria decision analysis is being increasingly employed in environmental decision-making and in related fields. However, there are key challenges when designing such evaluations, which impose important meta-choices to decision analysts, as they may lead to different contents of the evaluation model and to distinctive outcomes of the analysis. In this paper we provide a systematic and comprehensive discussion of these key challenges and the associated meta-choices.

4 - Terrestrial Condition Assessment for National Forests of the USDA Forest Service in the Continental U.S.

Keith Reynolds, Research Forester, USDA Forest Service, PNW Research Station, 3200 SW Jefferson Way, Corvallis, OR, 97331, United States of America, kreynolds@fs.fed.us, David Cleland, Barbara Schrader, Robert Vaughan

The Terrestrial Condition Assessment of the National Forest System is using a spatial decision support system to assess effects of uncharacteristic stressors and disturbance agents, with an emphasis on identifying restoration opportunities at a national scale. When outcomes were classified into categories of very good, good, moderate, poor, and very poor terrestrial condition, corresponding percent areas on national forests were 9.78, 46.37, 19.22, 16.75, and 7.89%, respectively.

■ MD28

28-Room 405, Marriott

Auctions for Spectrum

Cluster: Auctions

Invited Session

Chair: Robert Day, University of Connecticut, 2100 Hillside Road, U-1041, Storrs, CT, 06269, United States of America, Bob.Day@business.uconn.edu

1 - Optimal Bidding Strategies in Core Selecting Auctions

Van Vinh Nguyen, The Fuqua School of Business, Duke University, 100 Fuqua Drive, Durham, NC, van.vinh.nguyen@duke.edu, Ozan Candogan, Sasa Pekec

We analyze optimal bidding strategies of a single bidder in core selecting auctions with homogeneous items. We use robust optimization approach to formulate the bidder's optimization problem and show that gains from non-truthful reporting are significant.

2 - Vickrey-based Pricing in Iterative First-price Auctions

Oleg Baranov, University of Colorado Boulder, Boulder, CO, United States of America, oleg.baranov@colorado.edu, Lawrence Ausubel

For achieving efficient outcomes in practical auction settings, an auction design should use the opportunity cost pricing principle to the extent possible to promote truthful revelation of bidder preferences, and the pricing mechanism should be implemented via an iterative "first-price" process where all bidders are fully informed about their current price at each iteration. For the heterogeneous environment with substitutes, we develop an auction design that adheres to both principles.

3 - The Use of the Clearing Target Optimization Model Within the FCC Incentive Auction

Karla Hoffman, Systems Eng and OR Dept., George Mason University, Fairfax, VA, 22030, United States of America, khoffman@gmu.edu, Brian Smith, Steven Charbonneau, James Costa, Tony Coudert, Steve Schmidt, Rudy Sultana

We present an important component of the upcoming FCC Incentive Auction: How to choose a "clearing target", i.e. the maximum amount of spectrum to try to buy back from broadcasters to sell to the broadband industry. A difficult combinatorial optimization problem is used to determine this target. This talk will present the formulation of this problem and our approaches to solving the problem. We also describe how this model was used to inform policy at the FCC.

4 - Multi-option Descending Clock Auction

Tuomas Sandholm, Professor, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, sandholm@cs.cmu.edu, Tri-dung Nguyen

In descending clock auctions (DCAs), bidders (sellers) can accept or reject. Yet in many settings, e.g., the FCC's upcoming incentive auction, each bidder can sell one from a set of options. We present a DCA that offers each bidder prices for the options. We develop a Markov chain model of the dynamics of each bidder's state, and a method for optimizing prices to offer in each round. Experiments with real FCC constraint data show it dramatically outperforms percentile-based price decrements.

■ MD29

29-Room 406, Marriott

Joint Session Analytics/CPMS: 2015 Innovative Applications in Analytics Award Winner Reprise

Sponsor: Analytics

Sponsored Session

Chair: Pooja Dewan, BNSF Railway, Fort Worth, TX, 76092, United States of America, Pooja.Dewan@bnsf.com

1 - Intelligent Surgical Scheduling System

Kalyan Pasupathy, Associate Professor, Mayo Clinic, 200 First Street SW, HA 2-43, Rochester, MN, 55905, United States of America, Pasupathy.Kalyan@mayo.edu, Narges Hosseini, Jeanne Huddleston, Paul Huddleston, Yariv Marmor, Thomas Rohleder

Orthopedic Surgery was facing highly fluctuating utilization of their operating rooms due to inaccurate estimation and scheduling of procedures. The existing scheduling optimization problems in literature were insufficient with just a single "optimal" solution. The team conducted descriptive research of clinical and operational factors, developed predictive models for surgical durations, and a prescriptive scheduling algorithm. Implementation results exhibit improvement in key metrics.

■ MD30

30-Room 407, Marriott

Practice Presentations by INFORMS Roundtable Companies III

Sponsor: INFORMS Practice

Sponsored Session

Chair: Stefan Karisch, Digital Aviation Optimization & Value Strategy, Boeing Commercial Aviation Services, 55 Inverness Drive East, Englewood, CO, 80112, United States of America, stefan.karisch@jeppesen.com

1 - Xpress-mosel: New Modeling Features for Distributed and Cloud Computing

Susanne Heipcke, FICO Xpress Optimization, FICO House, Starley Way, Birmingham, B37 7GN, United Kingdom, susanneheipcke@fico.com

A major concern when deploying optimization models in distributed computing environments are questions related to security for the transmission and storing of data, and the protection of the model itself - we show examples how these are addressed by the new Mosel module mmsl. We further discuss the new concept of model annotations, metadata that can be used to configure optimization applications, and touch on new interfaces (HTTP, XML, JSON, Hadoop, R).

2 - Solving the Airline Pilot Manpower Planning Problem.

Per Sjögren, Jeppesen systems AB, Odinsgatan 9, Gothenburg, 41311, Sweden, per.sjogren@jeppesen.com

The pilot manpower planning problem consists of the long term planning of recruitment and promotion to meet the forecasted crew need. Complicating factors are strict seniority promotion rules and limited training resources. We further consider movable activities such as vacation and overtime distribution as well as required recurrent training. We will present a high level description of the mixed integer model, the heuristic solution process and successful applications.

3 - Prescriptive Analytics on the Cloud with Python

Vincent Beraudier, Architect And Program Manager, IBM ILOG CPLEX, Porte Neuve, Bat A, 4 Av Alphonse Morel, Grasse, AL, 06130, France, vincent.beraudier@fr.ibm.com, Philippe Couronne

Python's scipy provides tools for large-scale predictive/ prescriptive analysis for manipulating, cleaning, and crunching data, and publication-quality graphics. The use of these web based tools with both state-of-the-art OR solvers and cloud computing will allow new users to enter the world of OR. Users with few development skills can leverage state-of-the-art solvers to develop, tune and publish their results without installing software. Come and discover those scientific python pillars.

4 - A Mixed Integer Programming Model for Optimizing Wheel Tru Operations for a Locomotive

Rajeev Namboothiri, GE Global Research, John F Welch Technology Centre, Bangalore, India, Rajeev.Namboothiri@ge.com, Srinivas Bollapragada, Reejo Mathew, Mark Smith

FRA regulations mandate tolerance limits on locomotive wheel measurements for safe locomotive operations. The wheel tru machine operator needs to decide the amount of material to be trued from each wheel, and the wheels that need to be replaced with inventory wheels, in order to comply with FRA regulations. In this

talk, we will present a novel MIP formulation for automating this complex decision, which minimizes the total cost of the wheel tru operation, thereby enhancing locomotive wheel life.

■ MD32

32-Room 409, Marriott

Big Biological Data: Computational and Analytical Challenges

Cluster: Big Data Analytics in Computational Biology/Medicine

Invited Session

Chair: Jian Peng, Assistant Professor, University of Illinois, 2118 Siebel Center, 201 N Goodwin Ave, Urbana, IL, 61801, United States of America, jianpeng@illinois.edu

1 - Reconstruction of Species Histories using Genomic Data

Siavash Mirarab, UCSD, Jacobs Hall, EBU1, 2nd Floor, University of California, San Diego, San Diego, CA, 92093, United States of America, smirarab@gmail.com, Shamsuzzoha Bayzid, Bastien Boussau, Tandy Warnow

Reconstructing phylogenies, trees that show evolutionary histories of species, can be now attempted using genomic data. Building these species trees is complicated by potential differences between evolutionary histories across the genome. In this talk, we introduce two new methods used to infer whole-genome phylogenies of 48 birds and 103 plants. These new algorithms can analyze datasets with thousands of genes and species with high accuracy, and can account for weak signal across the genome.

2 - Entropy-Scaling Search of Massive Biological Data Sets

Noah Daniels, MIT, 32 Vassar St., 32G-572, Cambridge, MA, 02139, United States of America, ndaniels@csail.mit.edu

Recently, we have seen an exponential increase in biological data, outpacing advances in computing power. Extracting new science from these massive datasets requires algorithms that scale sublinearly in the size of the datasets. We present a novel entropy-scaling data structure for similarity search. Applying this data structure provides massive acceleration of several standard tools in three biological domains: genomics, high-throughput drug screening, and protein structure search.

■ MD33

33-Room 410, Marriott

Radiation Therapy Optimization: Algorithms and Biological Effects

Sponsor: Health Applications

Sponsored Session

Chair: Gino Lim, Department Chair, Hari And Anjali Agrawal Faculty Fellow, Associate Professor, University of Houston, E206, Engr. Bldg 2, Houston, TX, 77204, United States of America, ginolim@Central.UH.EDU

1 - Benders Decomposition and an LP-based Heuristic for Selecting IMRT Treatment Beam Angles

Sifeng Lin, The University of Texas at Austin, 1 University Station C2200, Austin, TX, 78712, United States of America, sifenglin@utexas.edu, Jonathan Bard, Gino Lim

This talk presents two Benders decomposition algorithms and a novel two-stage integer programming-based heuristic to optimize the beam angle and fluence map in Intensity Modulated Radiation Therapy planning. The results indicated that implementing Benders using the lazy constraint usually led to better feasible solutions than the traditional approach. Moreover, the LP rounding heuristic can generate good solutions quickly, with further improvement obtained with the local branching search.

2 - Robust Optimization for Craniospinal Irradiation using Intensity Modulated Proton Therapy

Li Liao, Research Assistant, University of Houston, 4800 Calhoun Rd, Houston, TX, 77004, United States of America, lliao5@uh.edu, Gino Lim, Xiaodong Zhang

Conventional passive scattering proton therapy (PSPT) is an extremely complex technique for craniospinal irradiation (CSI). In this study, we proposed a robust intensity modulated proton therapy (IMPT) for CSI. A small dose deviation can be achieved when ± 3 mm mis-alignment errors were applied on field junction for the robust IMPT plans, whereas this index was more than 40% for PSPT plans. A simplified dose model was introduced to predict dose deviation in different field arrangement situation.

3 - A Chance Constrained Programming Approach to Handle Uncertainties in Radiation Treatment Planning

Maryam Zaghian, University of Houston, 4800 Calhoun Rd, Houston, TX, United States of America, mzaghian@uh.edu, Azin Khabazian, Gino Lim

A chance constrained programming (CCP) framework is developed to handle set-up uncertainties in radiation treatment planning. By allowing some degree of violations of constraints, the proposed approach optimizes the treatment plan while satisfying the planner's tolerance level on the constraint violation in a probabilistic environment. Linear deterministic equivalences of the chance constraints are derived under distributional assumptions on uncertainties.

■ MD34

34-Room 411, Marriott

Decision Models for Women's and Children's Health

Sponsor: Health Applications

Sponsored Session

Chair: Karen Hicklin, PhD Student, North Carolina State University, 111 Lampe Drive, Campus Box 7906, Raleigh, NC, 27695, United States of America, khickli@ncsu.edu

1 - Modeling Comorbidity in Women with Diabetes

Nisha Nataraj, PhD Student, North Carolina State University, 111 Lampe Drive, Campus Box 7906, Raleigh, NC, 27695, United States of America, nnataraj@ncsu.edu, Fay Cobb Payton, Julie Ivy

Comorbidity is the presence of two or more concurrently existing conditions in an individual. A 2012 CDC report estimates that one in four US adults have comorbid conditions, contributing heavily to healthcare spending. Our focus is on diabetes since it is associated with significant comorbidity. Using National Inpatient Sample data (2006-2011), we build a modeling framework that helps evaluate how comorbidity impacts prognosis and outcomes for women with diabetes at a population level.

2 - Using Simulation to Determine a Balance between Cost and Quality of Care for Critically Ill Infants

Emily Lada, Principal Operations Research Specialist, SAS Institute Inc., SAS Campus Drive, Cary, NC, United States of America, Emily.Lada@sas.com, Chris Derienzo, David Tanaka, Phillip Meanor

Discrete-event simulation techniques are used to assess the relationship between cost, average length of stay, and patient outcomes in a neonatal intensive care unit (NICU). The model represents a general method that can be applied to any NICU, thereby providing clinicians and administrators with a tool to quantitatively support staffing decisions. Over time, the use of the model can lead to significant benefits in both patient safety and operational efficiency.

3 - A Bayesian Markov Decision Process to Evaluate Mode of Delivery for Laboring Women

Karen Hicklin, PhD Student, North Carolina State University, 111 Lampe Drive, Campus Box 7906, Raleigh, NC, 27695, United States of America, khickli@ncsu.edu, Fay Cobb Payton, Vidyadhar Kulkarni, Meera Viswanathan, Evan Myers, Julie Ivy

A laboring woman will deliver through one of two ways: successful trial of labor or C-section. We combine Bayesian updating into a Markov decision process to determine under what circumstances it is appropriate to gather more information before making a decision regarding mode of delivery. The goal is to maximize the utility of health outcomes for the mother and child as a function of the belief that the woman will have a safe vaginal delivery as a function of cervical dilation progression.

■ MD35

35-Room 412, Marriott

Joint Session PPSN/Analytics: Pro Bono Analytics Panel Discussion

Sponsor: Public Sector OR

Sponsored Session

Chair: David Hunt, Manager, Oliver Wyman, One University Square, Suite 100, Princeton, NJ, 08540, United States of America, David.Hunt@oliverwyman.com

1 - Pro Bono Analytics Panel Discussion

Moderator: David Hunt, Manager, Oliver Wyman, One University Square, Suite 100, Princeton, NJ, 08540, United States of America, David.Hunt@oliverwyman.com, Panelists: Evan Fieldston, Joel Zarrow

Pro Bono Analytics (PBA) is a new initiative within INFORMS to match members willing to volunteer their skills with non-profit organizations working in underserved and developing communities. To launch PBA, representatives from prominent Philadelphia area non-profit organizations will participate in a panel discussion exploring the types of problems they face and ways that analytics/OR methods can help. Please join us to learn about the types of analytical problems at non-profits, and about PBA.

■ MD36

36-Room 413, Marriott

Modeling Broader Policy Impacts at the Local Scale

Sponsor: Public Sector OR

Sponsored Session

Chair: Ronald McGarvey, Indust. & Manuf. Systems Engineering; Truman School Of Public Affairs, University of Missouri, 225 Engineering Building North, Columbia, MO, 65211, United States of America, mcgarveyr@missouri.edu

1 - Using Big Data to Inform Mental Health Policies

Maryam Alsadat Andalib, PhD Student, Virginia Tech, 536F Whittemore Hall, 1185 Perry Street, Blacksburg, VA, 24061, United States of America, maryam7@vt.edu, Vida Abedi, Arash Baghaei Lakeh, Ramin Zand, Navid Ghaffarzadegan, Niyousha Hosseinichimeh, Grant Hughes

The accuracy of survey data for analyzing health policy problems depends on people's willingness to admit and honestly respond to survey questions. In the mental health context, stigma is a barrier which affects accuracy of survey data. We investigate fidelity of using another data source, Google search queries, to understand mental health illnesses. We specifically offer three examples of analyzing mental health illnesses in the United States.

2 - Robust Optimization for Biopower Generation

Bayram Dundar, University of Missouri-Columbia, 200 Engineering Building North, Columbia, MO, 65211, United States of America, bd5zc@mail.missouri.edu, Ronald McGarvey, Francisco X. Aguilar

The U.S. Environmental Protection Agency (EPA) has proposed a rule that aims to reduce carbon emissions from coal-fired power plants. We develop an MILP model to identify min-cost approaches for satisfying these proposed standards via biopower generation subject to spatially-explicit biomass constraints. We next propose a robust optimization model to address parameter uncertainty, and compare the two models' results to illustrate the impact of data uncertainty on overall cost and emissions.

3 - Modeling the Recruitment and Retainment of Employees at a Rural Montana Community Health Center

Andreas Thorsen, Assistant Professor Of Management, Montana State University, 330 Jabs Hall, Bozeman, MT, 59717, United States of America, holger3000@gmail.com, Don Greer, Laura Black, Edward Gamble

Community Health Centers (CHC) are not-for-profit health care corporations which provide comprehensive medical and dental care for their communities regardless of the individual's insurance coverage or ability to pay. For a CHC in rural Montana, there are unique challenges related to recruitment and retention of highly qualified, mission-driven employees. We identify and address these challenges using a system dynamics modeling approach.

4 - Technoeconomic and Policy Considerations for Large-scale Solar Deployment in India

Aimee Curtright, Senior Physical Scientist, RAND Corporation, 4570 Fifth Ave, Suite 600, Pittsburgh, PA, 15213, United States of America, acurtrig@rand.org, Zhimin Mao, Oluwatobi Oluwatola, Mridula Dixit Bharadwaj

The SERIUS consortium aims to develop and assess PV and CSP solar technologies that can support India's ambitious solar deployment goals, recently increased to a target of 100 GW by 2022. RAND and CSTEP are collaborating to conduct technoeconomic and policy analyses to support the SERIUS consortium. This presentation will discuss recent and ongoing work, including progress made by U.S.-based Pardee RAND students during their visiting internships at CSTEP in India.

■ MD37

37-Room 414, Marriott

Health Care Modeling and Optimization VIII

Contributed Session

Chair: Yunzhe Qiu, Peking University, NO. 298 Chengfu Road, Haidian District, Beijing, China, qiuyunzhe92@163.com

1 - Improving Surgical Instrument Delivery using Optimization and Process Flow Modeling

Rama Mwenesi, Center for Healthcare Engineering and Patient Safety, University of Michigan, IOE Building, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, rmwenesi@umich.edu, Joseph Derosier, James Bagian, Shawn Murphy, Amy Cohn

Efficiency in surgical instrument reprocessing is a key challenge for high-volume surgical centers. Insufficiently cleaned or maintained instruments adversely impact patient safety and surgical outcomes. This study examines how i) instrument cleanability and ii) instrument-set configurations impact efficiencies in reprocessing as well as quality of care and costs of delivery. We evaluate process flow variations in the delivery of instruments and present optimization-based models for improvement.

2 - A Queueing Model of Critical Care Outreach Team in Hospitals

Ali Haji Vahabzadeh, PhD Student, The University of Auckland, Private Bag 92019, Auckland, 1142, New Zealand, a.vahabzadeh@auckland.ac.nz, Valery Pavlov

The considerable evidence of failed CCOT implementations in hospitals demonstrate a lack of genuine understanding of the CCOT roles and capabilities. Such an evidence suggests that many times implementations follow, in effect, trial and error approach. To allow hospitals making better informed decisions this research proposes a queueing model for understanding the effectiveness of the CCOT on the intensive care unit performance and patient outcomes.

3 - Optimal Incentives for HIV Prevention Funds Allocation under Asymmetric Information

Monali Malvankar, Assistant Professor, Western University, St. Joseph's Hospital, 268 Grosvenor St., London, ON, N6A 4V2, Canada, mmalvan@uwo.ca, Gregory Zaric, Xinghao Yan

Resource allocation models often require cost and effectiveness data on the results of an intervention. However, these data may not be available in practice due to several reasons. We model information asymmetry in a multi-level HIV/AIDS resource allocation process with an attempt to answer the following questions. What is the impact of incentives if the preferences and infections prevented at the lower level are unknown at the upper level?

4 - Elective Surgery Scheduling for Multiple Operating Rooms Considering Patient Health Condition

Joonyup Eun, PhD Candidate, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47907-2023, United States of America, eunj@purdue.edu, Sang-phil Kim, Yuehwen Yih

This research is motivated by the fact that surgery scheduling considering patient condition can contribute to improving patient safety. Surgeons and patients may want to schedule their surgeries early in order to escape from the risk of worsening patient condition. However, the resource limitation on surgeons, operating rooms, etc., forces surgical schedulers to prioritize surgeries. This research suggests a systematic mathematical model to consider patient condition in surgery scheduling.

5 - Who is the Right Kid for the Next Service? A Real Time Access Control Policy in the Pediatric Clinic

Yunzhe Qiu, Peking University, No. 298 Chengfu Road, Haidian District, Beijing, China, qiuyunzhe92@163.com, Zekun Liu, Jie Song

This paper develops a real-time appointment scheduling policy considering both the difference and fairness of waiting time among heterogeneous patients. We use the utility theory to measure service satisfaction, which is integrated with CTMDP model. A myopic policy considering heterogeneous patients' waiting patience is provided to minimize the overall disutility. A case based on the collaborated hospital is investigated, where the results confirm the effectiveness of the policy.

■ MD38

38-Room 415, Marriott

Dynamic Programming and Control II

Contributed Session

Chair: Akram Khaleghei, University of Toronto, 1706, 35 Charles Street West, Toronto, ON, M4Y 1R6, Canada, akhalegh@mie.utoronto.ca

1 - Tractable Sampling Strategies for Ordinal Optimization

Dongwook Shin, PhD Candidate, Columbia Business School, 612 W 114th Street, Apt. 4R, New York, NY, 10025, United States of America, dshin17@gsb.columbia.edu, Assaf Zeevi, Mark Broadie

We consider the problem of selecting one of several competing configurations (systems), where probability distributions are not known, but can be learned via sampling. The objective is to dynamically allocate a finite sampling budget to ultimately select the best system. We introduce a tractable performance criterion and a sampling policy that seeks to optimize it.

2 - Analysis and Modeling of the Aggregate Production Planning via Control Oriented Approaches

Yasser A. Davizón, Professor, Universidad Politécnica de Sinaloa, Carretera Libre Mazatlán, Mazatlan, Mexico, ydavizon@asu.edu, César Martínez-Olvera

This research work addresses the application of control oriented approaches for the analysis and modeling of the Aggregate Production Planning problem. Analysis is provided for second order dynamical systems with the interest to model Capacity, Inventory level, Work force costs, production rate and demand along the Supply Chain Management by a novel mathematical formulation. Control oriented approaches considered in this paper are: Model Predictive Control and Linear Quadratic Regulator.

3 - Conditional-based Maintenance Policy for a System Subject to Random Failure

Akram Khaleghei, University of Toronto, 1706, 35 Charles Street West, Toronto, ON, M4Y 1R6, Canada, akhalegh@mie.utoronto.ca, Viliam Makis

The maintenance optimization of a partially observable degrading system subject to condition monitoring and observable random failure is investigated considering cost minimization. The deterioration process is modeled as a continuous time hidden semi-Markov model with three states: healthy, warning and failure. Only the failure state is observable. Bayesian control chart is designed to prevent the costly system failure.

4 - Capacity Allocation of Appointment Admission Control in a Hierarchical Healthcare System

Xin Pan, College of Engineering, PKU, Founder Building 512, Chengfu Street 298, Beijing, 100871, China, paxi_91@126.com, Jie Song, Bo Zhang

Motivated by unbalanced demand between General Hospital (GH) and Community Healthcare center (CHC) in a hierarchical healthcare system, we proposed a MDP model where multi-class slots are allocated to multi-class patients. We derive a policy that blocks slots in GH for low-class patients so as to satisfy high-class patients. The policy finally intends to lower the mismatching level in the hierarchical healthcare system, maximizing both the system's and patients' revenue in the long-term.

5 - Identification of Parameters in Mathematical Biology

Ugur Abdulla, Professor of Mathematics, Florida Institute of Technology, 3627 Mount Carmel Lane, Melbourne, FL, 32901, United States of America, abdulla@fit.edu, Roby Poteau

We consider inverse problems for the identification of constant and functional parameters for systems of nonlinear ODEs arising in mathematical biology. We implement a numerical method suggested in U.G.Abdulla,JOTA,85,3(1995). The idea of the method is based on the combination of quasilinearization with sensitivity analysis and Tikhonov's regularization. We apply the method to various biological models such as the bistable switch model in genetic regulatory networks and angiogenesis model.

■ MD39

39-Room 100, CC

Innovative Strategies in the Interface of Operations and Marketing

Cluster: Operations/Marketing Interface

Invited Session

Chair: Tingliang Huang, Assistant Professor, Boston College, Carroll School of Management, 140 Commonwealth Avenue, Chestnut Hill, MA, 02467, United States of America, tingliang.huang@bc.edu

1 - Dynamic Management of Opaque Selling with Boundedly Rational Customers

Tingliang Huang, Assistant Professor, Boston College, Carroll School of Management, 140 Commonwealth Avenue, Chestnut Hill, MA, 02467, United States of America, tingliang.huang@bc.edu, Zhe Yin

We study a practically important problem, where a firm sells an opaque product to boundedly rational customers and has to dynamically determine its selling strategies. We characterize the optimal selling policies depending on the market environment.

2 - Optimal Staffing under Endogenous Arrivals with Heterogeneous Customer Time-of-service Preferences

Yang Li, Rotman School of Management, University of Toronto, 105 St. George Street, Toronto, ON, M5S3E6, Canada, Yang.Li10@Rotman.Utoronto.Ca, Philipp Afeche

The service operations literature usually treats arrivals as exogenous processes. However, arrival processes may be endogenous in many settings. That is, customers may account for system congestion in choosing their time of service. We propose an equilibrium model that captures how rational customers with heterogeneous preferences decide their time-of-service. We also study the optimal staffing policies, taking into account customers' time-of-service choices.

3 - Money-back Guarantees in a Distribution Channel: Bargaining Power and Downstream Competition

Yufei Huang, PhD Student, University College London, Gower Street, London, United Kingdom, yufei.huang.10@ucl.ac.uk, Tingliang Huang, Ying-ju Chen

Although existing literature emphasizes the usefulness of Money-back Guarantees (MBG), little is known about why retailers may adopt different MBG choices in practice. To understand this, we examine two competing retailers' MBG decisions, who also simultaneously bargain for wholesale prices with a wholesaler in a distribution channel. We show that, retailers' asymmetric bargaining power may lead to asymmetric MBG choices. We provide economic rationales for all possible MBG outcomes.

4 - Effects of Channel Decentralization on Optimal Product Quality under Uncertainty

Hongyan Shi, Assistant Professor, Nanyang Business School, Nanyang Technological University, BLK S3-B1A-32, 50 Nanyang Ave, Singapore, 639798, Singapore, hyshi@ntu.edu.sg, Qin Geng, Nicholas Petrucci, Yan Liu

We provide insights on how a manufacturer's optimal quality decision depends on its channel structure when its market is defined by consumer heterogeneity and market size uncertainty. We find that, in contrast to the quality-decreasing effect of decentralization by consumer homogenization, market size uncertainty fuels an opposing quality-increasing effect of decentralization. Moreover, we find that the effect by market size uncertainty by and large prevails over that by consumer homogenization.

■ MD40

40- Room 101, CC

Gender, Leadership, and Governance

Sponsor: Organization Science

Sponsored Session

Chair: Susan Perkins, Northwestern University, Evanston, IL, s-perkins@kellogg.northwestern.edu

1 - Can Female Leaders Mitigate the Negative Effects of Racial Diversity? National Leaders and Structural Shifts

Susan Perkins, Northwestern University, Evanston, IL, United States of America, s-perkins@kellogg.northwestern.edu, Jae Cho, Katherine W. Phillips, Negin R. Toosi

Using a multi-method research design we study the effects of inequality and exclusion on productivity. We find that female leaders are expected improve economic outcomes more than male leaders; are associated with greater tolerance for diversity and self-expression, and have mitigating effects on diversity that

resulted in positive economic growth. The results imply that leadership in more diverse environments is key to making positive structural shifts around inequality and participation.

2 - Hierarchy Maintenance and Whites' Decreased Support for High-identity White Politicians

Sora Jun, Stanford University, Stanford, CA, sorajun@stanford.edu, Lucia Guillory, Brian Lowery

We hypothesized and found that Whites withhold their political support for high racial identity White candidates (Experiments 1-3) because of concerns that such candidates will provoke minority discontent with the racial hierarchy (Experiment 1). In Experiments 2 (hypothetical candidates) and 3 (real politicians) this effect was eliminated when the social hierarchy was described as stable, suggesting that this reduced support for high-identity candidates is a hierarchy maintenance strategy.

3 - Naming Your Daughter Jack: The Effect of Gender in the Evaluation Process

Tristan L. Botelho, Massachusetts Institute of Technology, Cambridge, MA, tbotelho@mit.edu, Mabel Abraham

Double standards, or the belief that women are held to unfairly higher standards, is commonly invoked as an explanation for observed gender differences in evaluative outcomes. Despite lab-based evidence supporting this argument, it remains unclear whether double standards affect evaluations in organizational and market contexts, where competitive pressures create a disincentive to discriminate. Thus, we lack a complete understanding of when and how double standards penalize women in the evaluation process. Drawing on broader status theory, we identify the conditions under which this status-based source of discrimination is most prevalent. Using data from a financial market setting, comprised of investment professionals, we find that double-standards disadvantaging women are most likely when evaluators are faced with higher levels of uncertainty stemming from search costs and variation in the availability of pertinent information. We also rule out that systematic gender differences in the behavior, or characteristics, of these investment professionals are driving these results.

4 - Leadership and the Single Woman Penalty: A Role Expectations Account of Promotion Penalties toward Female Professionals

Damon Phillips, Columbia University, New York, NY, dp2588@columbia.edu, Jennifer Merluzzi

We advance scholarship on workplace gender inequality by drawing attention to professional single women. We contend that single non-mother status is inconsistent with the role expectations of leadership associated with both men (agentic) and women (communal). We test our thesis on the early careers of business professionals using a multi-method approach. The result support a discrimination-based penalty where the status and role of professional single womanhood conflicts with that of leadership.

■ MD41

41-Room 102A, CC

High-dimensional Data Models for Cost-effective Healthcare

Sponsor: Manufacturing & Service Oper
Mgmt/Healthcare Operations

Sponsored Session

Chair: Mohsen Bayati, Assistant Professor, Stanford Graduate School of Business, 655 Knight Way, Stanford, CA, United States of America, bayati@stanford.edu

1 - Accurate Emergency Department Wait Time Prediction

Sara Kwasnick, Stanford Graduate School of Business, 655 Knight Way, Stanford, CA, United States of America, kwasnick@stanford.edu, Mohsen Bayati, Erica Plambeck

We develop a new method for predicting Emergency Department wait times. The method combines fluid model estimators and statistical learning, and is much more accurate than existing approaches to ED wait time prediction. We validate the method on historical and post-implementation data from four hospitals and discuss lessons learned from the implementation.

2 - Online Decision-making with High-dimensional Covariates

Hamsa Bastani, Graduate Student, Stanford University, Stanford, CA, United States of America, hsriddhar@stanford.edu, Mohsen Bayati

Big data has enabled decision-makers to tailor choices at the individual-level. However, this involves learning a model of decision rewards conditional on individual-specific covariates, which are often high-dimensional. We present an efficient method to solve this problem in an online setting and a corresponding regret analysis. Unlike previous methods whose regret scales with the cube of the covariate's dimension, our method's regret scales linearly with the number of sparse features.

3 - A Low-cost Method for Multiple Disease Prediction

Mohsen Bayati, Assistant Professor, Stanford Graduate School of Business, 655 Knight Way, Stanford, CA, United States of America, bayati@stanford.edu, Andrea Montanari, Sonia Bhaskar

Recently, in response to the rising costs of healthcare, companies have been investing in programs to improve the health of their workforce. These programs aim to reduce the incidence of chronic illnesses and require a low-cost screening to detect individuals with a high risk of developing such diseases. We offer a multiple disease prediction procedure that maximizes the predictive power while minimizes the screening cost. Our method is based on multi-task learning from machine learning.

■ MD42

42-Room 102B, CC

Joint Session MSOM-Health/HAS: Operations Research/Management for Public Health: Data-Driven and Dynamic Decision-Making

Sponsor: Manufacturing & Service Oper Mgmt/Healthcare Operations

Sponsored Session

Chair: Soroush Saghafian, Harvard University, 79 JFK Street, Cambridge, MA, 02138, United States of America, Soroush.Saghafian@asu.edu

1 - New Data-driven Approach to Safety and Risk Management in ICUs

Retsef Levi, J. Spencer Standish (1945) Professor of Operations Management, Sloan School of Management, MIT, 100 Main Street, BDG E62-562, Cambridge, MA, 02142, United States of America, retsef@mit.edu, Patricia Folcarelli, Yiqun Hu, Jeffrey Adam Traina, Daniel Talmor

We develop an innovative system approach to safety in ICUs. The approach is based on the innovative concept of risk drivers, which are states of the ICU, its environment and its staff that affect the likelihood of harms, as well as an innovative aggregated measure of the 'burden of harm'. Using real data we develop statistical models that identify risky states in the ICUs of a major academic medical center.

2 - Developing Optimal Biomarker-Based Prostate Cancer Screening Policies

Christine Barnett, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, United States of America, clbarnet@umich.edu, Brian Denton, James Montie

Recent advances in the development of new biomarker tests, which physicians use for the early detection of cancer, have the potential to improve patient survival by catching cancer at an early stage. We describe a partially observable Markov decision process (POMDP) to compute near optimal prostate cancer screening strategies. We present results based on Monte Carlo simulation to compare the policies developed using our approximated POMDP methods with those recommended in the medical literature.

3 - Optimizing Hepatitis C Screening and Treatment Allocation Strategy

Yuankun Li, University of Washington, Seattle, WA, United States of America, yuankunl@uw.edu, Zelda Zabinsky, Hao Huang, Shan Liu

Chronic hepatitis C (HCV) is a significant public health problem affecting 2.7-3.9 million Americans. The U.S. healthcare systems are ramping up combined HCV screening and treatment efforts, but screening and treatment programs are very costly. We design the optimal HCV screening and treatment allocation strategies in the next 10 years under yearly budget constraint from a national perspective. The method includes simulation optimization using adaptive probabilistic branch and bound.

4 - A Robust POMDP Framework for the Management of Post-transplant Medications

Alireza Boloori, PhD Student Of Industrial Engineering, Arizona State University, 699 S Mill Avenue, Office # 313, Tempe, AZ, 85282, United States of America, aboloori@asu.edu, Curtiss B. Cook, Soroush Saghafian, Harini A. Chakkerla

Patients after organ transplantations receive high dosages of immunosuppressive drugs (e.g., tacrolimus) to reduce the risk of organ rejection. However, this practice has been shown to increase the risk of New-Onset Diabetes After Transplantation (NODAT). We propose a robust POMDP framework to generate effective medication management strategies for tacrolimus and insulin. Our approach increases the patient's quality of life while reducing the effect of transition probability estimation errors.

■ MD43

43-Room 103A, CC

Empirical Revenue Management

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Dan Zhang, University of Colorado at Boulder, 995 Regent Dr, Boulder, United States of America, Dan.Zhang@colorado.edu

1 - Would You Like to Upgrade to a Premium Room? An Empirical Analysis on Standby Upgrades

Ovunc Yilmaz, PhD Student, University of South Carolina, 1014 Greene St, Columbia, SC, 29208, United States of America, oyilmaz@email.sc.edu, Mark Ferguson, Pelin Pekgun

Standby upgrades, where the guest is only charged if the upgrade is available at the time of arrival, is one technique that has become increasingly popular in the hotel industry. Working on a data set from a major hotel chain, we analyze the linkage between guest attributes, hotel characteristics and guest decision-making for standby upgrades through an empirical study.

2 - Analytics for an Online Retailer – Demand Forecasting and Price Optimization at Rue La La

Kris Johnson Ferreira, Harvard Business School, Morgan Hall 492, Boston, MA, 02163, United States of America, kferreira@hbs.edu, David Simchi-levi, Bin Hong Alex Lee

We present our work with Rue La La, an online retailer who offers limited-time discounts on designer apparel. One of their main challenges is revenue management for new products. We use machine learning to build a demand prediction model, the structure of which poses challenges on creating a pricing policy. We develop theory around multi-product price optimization and use this to create and implement a pricing decision support tool. Field experiment results show significant increases in revenue.

3 - A Model to Estimate Individual Preferences using Panel Data

Gustavo Vulcano, NYU, 44 West Fourth St, Suite 8-76, New York, NY, 10012, United States of America, gvulcano@stern.nyu.edu, Srikanth Jagabathula

In a retail operation, customer choices may be affected by stockout and promotion events. Given panel data with the transaction history of each customer, we use a general nonparametric framework in which we represent customers by partial orders of preferences. Numerical experiments on real-world panel data show that our approach allows more accurate, fine-grained predictions for individual purchase behavior compared to state-of-the-art existing methods.

4 - Estimation of Arrival Rates and Choice Model with Censored Data

Anton Kleywegt, Georgia Tech, 755 Ferst Drive NW, Atlanta, GA, 30332, United States of America, anton@isye.gatech.edu

Revenue management models with customer choice behavior include two types of parameters: (1) customer arrival rates and (2) choice parameters. Revenue managers usually have censored arrival data only, because no-purchase data are not included. For both homogenous and nonhomogeneous Poisson arrivals we give necessary and sufficient conditions for the arrival rates and choice parameters to be identifiable with such censored data, and we give algorithms for parameter estimation, with numerical results with airline data

■ MD44

44-Room 103B, CC

Pricing and Information in Innovative Business Models

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Jose Guajardo, University of California Berkeley, 545 Student Services Bldg #1900, Berkeley, CA, 94720-1900, United States of America, jguajardo@berkeley.edu

1 - Information Provision Policies in Developing Countries: Heterogeneous Farmers and Market Selection

Chen-Nan Liao, National Taiwan University, No.1, Sec. 4, Roosevelt Rd., Taipei City, Taiwan - ROC, chennan@berkeley.edu, Ying-ju Chen, Chris Tang

We examine the impact of information provision policies on farmer welfare in developing countries where heterogeneous farmers lack relevant information for making market (or crop) selection. We show that the optimal information provision policy may call for limited dissemination, and the government can implement it while overcoming perceived unfairness by providing information to all farmers at a nominal fee. We also examine issues including information dissemination via a for-profit company.

2 - Pay-as-You-go Business Models for Energy Technology Innovations in Developing Economies

Jose Guajardo, University of California Berkeley, 545 Student Services Bldg #1900, Berkeley, CA, 94720-1900, United States of America, jguajardo@berkeley.edu

Pay-As-You-Go business models have become widespread for the diffusion of energy technology innovations in developing economies, yet not much is known about this recent phenomenon. In this research, we analyze central aspects of consumer behavior and contract design in these novel markets.

3 - Selling Freemium Products to Loss Averse Consumers

Sami Najafi-Asadolahi, Santa Clara University, 500 El Camino Real, Santa Clara, CA, United States of America, snajafi@scu.edu, Nishant Mishra, Andy Tsay

We consider a firm selling two versions of a single product, a freemium for free and a premium at a regular price, to consumers who are loss-averse. Each consumer first uses the freemium, and after using it, decides whether to buy the premium. We find that when consumers become slightly dissatisfied from the freemium's valuation they, counter-intuitively, become more willing to purchase the premium, thereby increasing the firm's revenue.

4 - Product Recommendations via Geometric-based Adaptive Choice Conjoint Analysis

Denis Saure, University of Chile, Republica 701, Santiago, Chile dsauere@gmail.com, Juan Pablo Vielma

Aiming to obtain individualized estimates of consumer preferences in the context of product recommendations, we study the construction of adaptive conjoint choice designs under a Bayesian framework. By adopting a geometric interpretation of the problem, we construct near optimal designs when the number of questions is small, and also give a precise interpretation of efficiency criteria and design methods used in extant research, which we show result in suboptimal designs.

■ MD45

45-Room 103C, CC

Revenue Management and Learning II

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: John Birge, Professor, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu

1 - Learning to Compete Against Dynamic Pricing Strategies

Matthew Stern, University of Chicago - Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, stern@chicagobooth.edu, John Birge

We examine the impact of competition on the design and implementation of dynamic pricing strategies. Observing posted prices in each period, as well as their own private demand realizations, firms compete for revenues while learning the parameters of their underlying demand curves. We show that when firms remain willfully ignorant of their business environment, they can sustain collusive prices. We conclude that incomplete learning is a desired outcome of competing dynamic pricing strategies.

2 - Dynamic Pricing and Learning in Spread Betting

Adam Schultz, PhD Student, University of Chicago Booth School of Business, 5807 S Woodlawn Ave., Chicago, IL, 60637, United States of America, adam.schultz@chicagobooth.edu, John Birge, Bora Keskin

We develop a model in which a sportsbook dynamically prices the point spread for a sporting event. In our model, bettors maximize their expected profits by timing their bets, while the sportsbook follows an easily implementable policy to update the point spread. To analyze the decisions of the betting market, we introduce a mean-field approximation. Using data from online sportsbooks, we reveal insights about the betting market.

3 - Rental System Revenue Management Problem with Totally Unimodular Constraints

Ali Cem Randa, University of Chicago Booth School of Business, 5807 Woodlawn Ave., Chicago, IL, 60637, United States of America, randa@chicagobooth.edu, John Birge, Baris Ata

We analyze the example of a renter which has finite number of identical units that can be loaned for durations of days. The renter has to determine its booking limits for a planning horizon of finite duration which is considerably far in the future. We assume that all permutations of consecutive days in the planning horizon define a different product. The capacity constraints formed by these products are totally unimodular. We solve a multi-stage stochastic program exploiting this structure.

■ MD46

46-Room 104A, CC

Equilibrium Models and Pricing of Queues

Sponsor: Manufacturing & Service Oper Mgmt/Service Operations
Sponsored Session

Chair: Philipp Afeche, Associate Professor, University of Toronto, 105 St. George Street, Toronto, ON, M5S3E6, Canada, afeche@rotman.utoronto.ca

1 - An Equilibrium Analysis of a Multiclass Queue with Endogenous Abandonments

Xiaoshan Peng, The University of Chicago, Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, x-peng@chicagobooth.edu, Baris Ata, Peter Glynn

This paper studies a multiclass queueing system with endogenous abandonments where the congestion affects customers' abandonment behavior and vice versa. Our model captures this interaction by developing two closely related models: an abandonment model and a queueing model. Combining the results for the two models, we show that there exists a unique equilibrium in which the customers' abandonment time and the virtual waiting time for the various classes are consistent in the two models.

2 - Observational Learning and Abandonment

John Yao, Columbia University, 3022 Broadway, New York, NY, 10027, United States of America, JYao14@gsb.columbia.edu, Costis Maglaras, Assaf Zeevi

Demand models used in service operations often assume that users have accurate knowledge of the service system parameters needed to make decisions, such as whether to join a queue. What if instead, users must form estimates of these system parameters through their own observations or experiences in the system? I show the effect of observational learning on user behavior and equilibrium system performance in the context of abandonment in a queueing model.

3 - Strategic Open Routing in Queueing Networks

Andrew Frazelle, Fuqua School of Business, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, andrew.frazelle@duke.edu, Alessandro Arlotto, Yehua Wei

Motivated by self-interested routing, we propose a two-station queueing network with open routing in which agents require service at both stations and seek to minimize their individual total system times. Agents have no inherent preference over the sequence of stations that they visit apart from the impact of this sequence on their system times. We evaluate system performance and determine Nash or subgame perfect Nash equilibrium customer routing behavior in three different overloaded settings.

4 - Pricing and Prioritizing Time-sensitive Customers with Heterogeneous Demand Rates

Ricky Roet-Green, University of Toronto, 37 Zola Gate, Thornhill, L4J9A7, ON, Canada, rgricky@gmail.com, Opher Baron, Philipp Afeche, Joseph Milner

Providers often face time-sensitive customers that differ in their demand rates. Examples include amusement parks, museums, and ski resorts. However, the pricing literature for queues typically assumes unit demand for all customers. We study a revenue-maximizing provider that designs a price/lead-time menu for customers with heterogeneous demand rates and private information on their preferences. We show under what conditions it is optimal to prioritize customers based on their demand rates and transaction values, even if all are equally time-sensitive.

■ MD47

47-Room 104B, CC

Sustainability and Transportation

Sponsor: Manufacturing & Service Oper Mgmt/Sustainable Operations

Sponsored Session

Chair: Ruben Lobel, Operations and Information Management Department at The Wharton School of the University of Pennsylvania, Jon M. Huntsman Hall 3730 Walnut Street, Office 568, Philadelphia, PA, 19104, United States of America, rlobel@wharton.upenn.edu

1 - Compete vs. Cooperate? A Strategic Game Behind the EV Standards War

Ni Fang, HEC Paris, 1, Rue de la Liberation, HEC Paris, Jouy en Josas, DI, 78351, France, ni.fang@hec.edu, Marco Ceccagnoli

In the light of the standards war currently staged in electric vehicle (EV) industry, this paper examines the strategic choice facing the two EV manufacturers as to compete vs. cooperate for the development of an extensive charging infrastructure, a key complementary asset mitigating EV range anxiety. In doing so, this paper demonstrates EV manufacturers' incentives towards standardization and shows how standardization affects EV diffusion rate and firm's performance.

2 - Food, Energy and Environment Trilemma: Land use Configuration for Biofuel Industry Development

Michael Lim, University of Illinois, 1206 S. 6th Street, Champaign, IL, 61822, United States of America, mlim@illinois.edu, Yanfeng Ouyang, Xin Wang

We address the negative side effects of the rapid development of the biofuel industry, which has caused extensive competition among food, energy, and the environment in agricultural land use. Taking into account interactions among multiple stake-holders (e.g., farmers, bioenergy firms, food industry, government), we develop policy guidelines for coordinating subsidy and mandates to better achieve sustainable development of this emerging bio-economy.

3 - Socially Responsible Business Models for Off-grid Energy Access

Serguei Netessine, Professor, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, Serguei.Netessine@insead.edu, Bhavani Shanker Uppari, Ioana Popescu

One fifth of the humankind does not have access to electricity. They are mainly poor and rely on unhealthy solid fuels (kerosene etc.) for lighting. Even though cheaper rechargeable lighting technologies are available, their adoption is low and some consumers still use kerosene. We propose a model which explains this preference for kerosene and explore various business models which could alter this preference.

4 - Technology Sharing in Two-sided Markets

Ozge Yapar, Doctoral Candidate, University of Pennsylvania, Wharton School, Operations and Information Mgmt., Philadelphia, PA, 19104, United States of America, yapar@wharton.upenn.edu, Lorin Hitt, Ruben Lobel

This paper investigates the drivers behind Tesla's decision to make its patents freely available to other electric car manufacturers. The two sides of this market, car owners and potential charging stations, rely on each other to increase the value of their investment. We show under what conditions subsidizing the competitors can be profitable. By sharing technology, Tesla may be able to improve the charging station network and increase its own profit from car sales.

■ MD48

48-Room 105A, CC

Operations/Corporate Finance Interface

Sponsor: Manufacturing & Service Oper Mgmt/IFORM

Sponsored Session

Chair: Vishal Gaur, Cornell University, 321 Sage Hall, Ithaca, NY, 14850, United States of America, vg77@cornell.edu

1 - How Do Information Spillover and Debt Financing Affect Companies' Innovation Decisions?

Jie Ning, Assistant Professor, Case Western Reserve University, 11119 Bellflower Rd, Cleveland, OH, 44106, United States of America, jie.ning@case.edu, Volodymyr Babich

Information spillover alone leads to inefficient innovation equilibrium by inducing companies to free ride. Debt financing alone also leads to inefficient equilibrium by inducing companies to take excessive risks. This paper examines the interaction of these two economic forces and shows that the presence of both leads to either under-investment, over-investment, or social optimality.

2 - Systematic Risk and Mass Layoffs in the U.S. Manufacturing

Nikolay Osadchiy, Emory University, 1300 Clifton Rd NE, Atlanta, GA, 30322, United States of America, nikolay.osadchiy@emory.edu, Suresh Dasari, Peeyush Taoiri, Sridhar Seshadri

We study the role of systematic risk in jobs relocation decisions of manufacturers. Using the mass layoffs data in the U.S. manufacturing sector for the period from 2002 to 2010, we explore the view voiced by a number of manufacturers that in addition to cheap labor, systematic risk is also an important input in their production decisions.

3 - Risk or Margin: The Role of Trade Credit in Competition

Heikki Peura, London Business School, Regent's Park, London, United Kingdom, hpeura@london.edu, S. Alex Yang, Guoming Lai

We analyze horizontal competition with and without trade credit under the classic Bertrand framework. We find that when the competing firms are financially constrained, trade credit allows them to soften price competition. We further investigate the relationship between firms' financial strength and their physical production capacity, finding that with trade credit, financial constraints are a partial substitute for the role that physical capacity plays in price competition.

4 - Mental Cost Ratios and the Beer Game

Maximiliano Udenio, Technical University of Eindhoven, Eindhoven, Netherlands, M.Udenio@tue.nl, Vishal Gaur, Jan Fransoo

In this study we investigate the underlying behavior of beer-game players through a series of experiments. We argue that players make decisions based, partly, on a dynamic mental cost-ratio that fluctuates following multiple factors. We use a structural estimation model to quantify the mental weighing of underage and overage costs, and discuss several factors driving the decision making.

■ MD49

49-Room 105B, CC

Supply Chain Operations

Sponsor: Manufacturing & Service Oper Mgmt/Supply Chain

Sponsored Session

Chair: Alp Muharremoglu, Associate Professor, University of Texas at Dallas, 800 W Campbell Rd, Richardson, TX, United States of America, alp@utdallas.edu

1 - Using Retailer Order Commitments to Improve Supply Chain Performance

Nagesh Gavirneni, Cornell University, Ithaca, NY, United States of America, sg337@cornell.edu, Nagesh Gavirneni

We establish that retailer order commitment strategies improve the efficiency of decentralized distribution supply chains whenever the supplier's cost is at least 29.3% of the total supply chain cost. The effectiveness increases as the supplier's share of the total supply chain cost increases. We establish the robustness of these results for settings with non-normal demand distributions, backlogging at the supplier, and positive lead times between the supplier and the retailers.

2 - Can a Zero-margin Demand Stream Increase Profits?

Shaokuan Chen, The University of Texas at Dallas, 800 W. Campbell Road., Richardson, TX, 75080, United States of America, shaokuan.chen@utdallas.edu, Ganesh Janakiraman, Alp Muharremoglu

We consider a firm selling a non-perishable product in its primary market over time with uncertain demand. Suppose a new opportunity arises from a secondary market where the firm's product can only be sold at a zero-margin. Moreover, the firm is required to give priority to the demand from the secondary market. We explore the following question: Can such a zero-margin opportunity increase the firm's profit, and if so, when?

3 - Mitigating Supply Chain Disruptive Risks: A Two-stage Robust Optimization Approach

Peter Yun Zhang, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Building E40-261, Cambridge, MA, 02139, United States of America, pyzhang@mit.edu, Nikolaos Trichakis, David Simchi-levi

We present a model that captures two sets of decisions a supply chain risk manager faces: the placement of inventory in preparation for supply disruption and demand uncertainty, and the recourse decisions that coordinate capacity and inventory allocation after the uncertain events unfold. We take a worst-case perspective and analyze the problem via its Affinely Adjustable Robust Counterpart.

4 - Package Size and Pricing Decisions with a Bulk Sale Option

Ismail Kirci, PhD Student, University Of Texas at Dallas, 800 W. Campbell Road, Richardson, TX, 75080, United States of America, ixk130330@utdallas.edu, Alp Muharremoglu, Dorothee Honhon

In this study we investigate package size and pricing decisions of a retailer for a perishable product. The retailer has the option of bulk sale, which is defined as selling the product in a container that allows customers to buy as much or as little as they want.

MD50

50-Room 106A, CC

Procurement, Auction, and Pricing

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Zhixi Wan, Assistant Professor, University of Oregon, Eugene, OR, United States of America, zwan@uoregon.edu

1 - Optimal Descending Mechanisms for Constrained Procurement

Shivam Gupta, PhD Candidate, UT Dallas, NJ School of Management, 800 W. Campbell Rd., Richardson, TX, 75080, United States of America, sxg104920@utdallas.edu, Milind Dawande, Ganesh Janakiraman, Wei Chen

We propose optimal descending mechanisms for procurement under two practically-relevant feasibility constraints. We then show that both mechanisms belong to a larger class of descending mechanisms that are optimal for procurement under polymatroid feasibility constraints.

2 - Dual Sourcing Auctions for Unreliable Suppliers: with or Without Cost Distribution Information

He Huang, Professor, Chongqing University, School of Economics and Business Admin., Chongqing, China, huanghe@cqu.edu.cn, Zhipeng Li, Hongyan Xu

This paper examines dual-sourcing auctions for risk mitigation when a buyer faces uncertain demand and multiple unreliable suppliers with private cost information. Two scenarios involving three auction formats are considered, Generalized First-price Auction, Generalized English Auction and Optimal Auction with Learning. We separately design the above dual-sourcing auctions and then examine the buyer's strategic choice.

3 - Using Procurement Service Providers in Supplier Screening

Zhixi Wan, Assistant Professor, University of Oregon, Eugene, OR, United States of America, zwan@uoregon.edu, Sripad Devalkar

A buyer engages a procurement service provider (PSP) to short-list pre-screened suppliers for final selection. The PSP can exert costly effort to include promising candidates that have a higher probability to be deemed qualified by the buyer. We solve the buyer's joint optimization about the short-list size and the performance bonus.

4 - Dynamic Pricing with Product Returns

Xing Hu, Assistant Professor, University of Oregon, Eugene, OR, United States of America, xingh@uoregon.edu

We consider a monopolist's dynamic pricing problem when the customers may stochastically return the purchased products. We study how the customers' return speed and return probability affect the optimal pricing decisions.

MD51

51-Room 106B, CC

Applications of Operations Management to Pharmaceutical and Healthcare Industry

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Zhili Tian, Assistant Professor, Florida International University, 11200 S.W. 8th Street, Miami, FL, United States of America, ztian@fiu.edu

1 - Process Flexibility with Inventory

Yang Wang, UC Berkeley, IEOR Dept., Berkeley, CA, 48109, United States of America, yangwang0803@berkeley.edu, Philip Kaminsky

Motivated by a capacity planning project undertaken with a biopharmaceutical firm, we explore the benefits of combining process flexibility with inventory to better respond to demand uncertainty. We consider a multi-plant multi-product multi-period supply chain model in which each plant is capable of producing multiple products as well as holding inventory, and characterize conditions under which inventory, flexibility, or a combination of the two are most beneficial.

2 - Optimal Investment in Support of Existing Drug and Development of New Drug

Zhili Tian, Assistant Professor, Florida International University, 11200 S.W. 8th Street, Miami, FL, United States of America, ztian@fiu.edu

Firms invest in the support of existing drug and R&D of new drug. While the investment fund comes from the net sales of the existing drug, a firm has to balance the investment in the two types of competing projects. We determine the optimal resource allocation between the marketing support of the existing product and developing a new product. We estimate the demand as function of investment in marketing. We derive the optimal investment policy for the above two types of investment.

3 - Nurse Staffing Decision in Nursing Homes

Min Chen, Florida International University, 10200 SW 8th St, Miami, FL, 33199, United States of America, mchen2@fiu.edu

Staffing is the dominant input in the production of nursing home services. This paper examined how skilled nursing facilities responded to the minimum nursing hours per resident day regulations. Panel data analyses of facility-level nursing inputs and outputs revealed that nursing homes strategically reallocated their staffing levels and skill mix, which could have important implications for quality management.

MD53

53-Room 107B, CC

Behavioral Studies in Supply Chains and Revenue Management

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Jun Li, Assistant Professor, Ross School of Business, University of Michigan, 701 Tappan St, Ann Arbor, 48103, United States of America, junwli@umich.edu

Co-Chair: Xiaobo Zhao, Professor, Tsinghua University, Shunde Building, Beijing, China, xbzhao@mail.tsinghua.edu.cn, Beijing, China

1 - Does Elicitation Method Matter? Behavioral and Neuroimaging Evidence from Capacity Allocation Game

Yukun Zhao, Department of Industrial Engineering, Tsinghua University, Department of Industrial Engineering, Tsinghua University, Beijing, 100084, China, zhaoyk1989@gmail.com, Lihong Wang, Yefen Chen, Xiaobo Zhao

Based on the allocation game, we conduct a normative-behavioral experiment and a neuroimaging experiment by adopting fMRI technique to investigate the elicitation-method effect under the direct-response method and the strategy method. No significant difference is observed in either ordering behaviors or brain activities between the two elicitation methods. Our results indicate that in multi-round game experiments without emotion features, the elicitation-method effect is not likely to exhibit.

2 - Transparency and Indirect Reciprocity in Social Responsibility: An Incentivized Experiment

Leon Valdes, Massachusetts Institute of Technology, Cambridge, MA, United States of America, lvaldes@mit.edu, Tim Kraft, Karen Zheng

We design an incentivized experiment to study the impact of transparency on consumers' valuations of a firm's social responsibility practices. We investigate how much of consumers' valuations can be attributed to indirect reciprocity. We also analyze how heterogeneity in prosocial orientation impacts the roles of transparency and indirect reciprocity. Our results demonstrate that consumers are willing to pay a higher price under a higher level of transparency.

3 - Social Influence and Quality Competition: An Experimental Study

Dayoung Kim, Cornell University, 301A, 114 East Avenue, Ithaca, NY, 14850, United States of America, dk668@cornell.edu, Vishal Gaur, Andrew Davis

We investigate the impact that different types of social information have on the market share and demand uncertainty of firms competing through service quality. In particular, we conduct a lab experiment, where a consumer chooses to visit one of two firms, which differ in their average service quality. Our results suggest that the presence and type of social information can dramatically impact the consumers' decisions, a firm's market share and demand uncertainty.

4 - The Effect of Supply Base on Ordering Behavior

Haresh Gurnani, Professor, Wake Forest University, School of Business and Center for Retail, Winston Salem, NC, 27106, United States of America, gurnanih@wfu.edu, Karthik Ramachandran, Saibal Ray, Yusen Xia

Previous experimental research in newsvendor problem has mostly focused on ordering from a single supplier; we investigate how the availability of multiple suppliers would influence the order size and allocation decisions with uncertain demand. We also study how the supply base impacts behavioral insights developed under a single supplier setting.

■ MD54

54-Room 108A, CC

Computational Optimization and Statistical Methods for Big Data Analytics: Applications in Neuroimaging

Cluster: Tutorials

Invited Session

Chair: W. Art Chaovalitwongse, University of Washington - Seattle 3900 Northeast Stevens Way, Mechanical Engineering Building, Room G6, Seattle, WA, United States of America, artchao@uw.edu

1 - Computational Optimization and Statistical Methods for Big Data Analytics: Applications in Neuroimaging

W. Art Chaovalitwongse, University of Washington - Seattle, 3900 Northeast Stevens Way, Mechanical Engineering Building, Seattle, WA, United States of America, artchao@uw.edu, Shuai Huang

This tutorial describes recent advances in computational optimization and statistical methodologies in the emerging research area of Big Data analytics, with a focus on classification, regression and feature selection. We discuss the mathematical and statistical modeling of these problems and provide an application to brain imaging. Analytics of neuroimaging data can provide a unique and often complementary characterization of the underlying neurophysiological process that may be useful in clinical diagnosis of brain diseases.

■ MD55

55-Room 108B, CC

Environmental Application and Computational Aspects of Efficiency and Productivity Analysis

Cluster: Data Envelopment Analysis

Invited Session

Chair: Herbert Lewis, Associate Professor, Stony Brook University, College of Business, Stony Brook, NY, 11794-3775, United States of America, herbert.lewis@stonybrook.edu

1 - An Algebraic Modeling Language Package for Solving Large-Scale Data Envelopment Analysis Problems

Wen-Chih Chen, National Chiao Tung University, 1001 Ta Hsueh Rd., Hsinchu, Taiwan - ROC, wenchih@faculty.nctu.edu.tw, Yueh-shan Chung

Algebraic modeling languages for mathematical programming provide a flexible and powerful tool for DEA computation. This talk introduces an algebraic modeling language package for solving large-scale DEA problems. While taking the advantage of flexibility and powerful solvers from a modeling language, this package can solve larger-scale DEA problems without limitation on constraints and variables, and with better computational performance.

2 - Frontier Estimation via Penalized Concave Regression

Abolfazl Keshvari, Dr., Aalto University School of Business, Runeberginkatu 22-24, Helsinki, 00100, Finland, abolfazl.keshvari@aalto.fi

Concave regression is an important tool in estimating a productive efficiency frontier. However, computing this estimator is a very difficult and time consuming task. The computational burden rises very quickly with increasing numbers of observations. We develop an unconstrained quadratic programming (QP) problem to the (monotonic) concave regression, which outperforms the conventional constrained QP problem. Using our approach, we solve a problem with hundreds of observations in some seconds.

3 - Productivity Growth and Environmental Efficiency:**A Global Malmquist-Luenberger Index Analysis**

Jayanath Ananda, Dr, Central Queensland University, 120 Spencer Street, Melbourne, 3000, Australia, j.ananda@cqu.edu.au, Benjamin Hampf

The paper analyses the productivity of the urban water sector using the global Malmquist-Luenberger index while incorporating an undesirable output – greenhouse gas emissions. Findings indicate that the productivity growth of the sector has declined in cumulative terms. The water source, the level of wastewater treatment and production density showed a statistically significant influence on the relative efficiency of urban water utilities.

4 - Saving Water in California: using DEA to Allocate**Usage Reductions**

Herbert Lewis, Associate Professor, Stony Brook University, College of Business, Stony Brook, NY, 11794-3775, United States of America, herbert.lewis@stonybrook.edu, Diana Hagedorn, Thomas Sexton

Governor Brown of California has directed the State Water Resources Control Board to implement mandatory urban water reductions of 25%. In this paper, we use DEA in 5 of the 9 water use categories, comprising 95% of the state's water usage, to identify the reductions possible in each county through the elimination of inefficiency. Where the elimination of inefficiency is insufficient to meet the goal, we use a second linear programming model to allocate additional cuts in an equitable manner.

■ MD56

56-Room 109A, CC

Spatial Analysis

Sponsor: Location Analysis

Sponsored Session

Chair: Alan Murray, Professor, Drexel University, 3141 Chestnut Street, Philadelphia, PA, 19104, United States of America, amurray@drexel.edu

1 - Transmax 2: An Expanded Transit Route Covering Model

Richard Church, Professor, University of California, Santa Barbara, Santa Barbara, CA, 93106, United States of America, rick.church@ucsb.edu, Timothy Niblett

Current et al. (1984, 1985) were the first to suggest a routing problem to minimize distance and maximize demand coverage. This problem characterizes the principal goals of transit route design. Since that time there have been a number of formulations, involving elements like route extension and multiple route design. We discuss the TRANSMAX model of Curtin and Biba (2011) and based upon that propose a new, expanded formulation called TRANSMAX 2, which allows for greater flexibility.

2 - Max Flow with Buyout: Identifying The Minimum Number of Facilities/personnel Required to Meet Demand

Blair Sweigart, Operations Research Analyst, US Coast Guard, 216 Maryland Ave, Norfolk, VA, 23504, United States of America, dbsweigart@email.wm.edu

The USCG needs to ID deployability of personnel and mission impact. This reduces to a facility location problem: mission demands are demand nodes, personnel are potential facilities, arc capacities are time requirements. Objectives are: determine min. number of personnel needed to meet demand; ID if a person is critical. If not, ID the tradeoff cost. This is a modification of a max-flow algorithm that pushes excess out of the network intelligently to minimize the required number of personnel.

■ MD57

57-Room 109B, CC

Planning Models in Electric Power Systems

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Anya Castillo, Federal Energy Regulatory Commission, 888 1st Street NE, Washington DC, United States of America, anya.castillo@ferc.gov

1 - Optimal Portfolio Investment and Coordinated Scheduling of an Energy Storage Merchant in the Energy

Roderick Go, Johns Hopkins University, 3400 N. Charles St., Ames Hall 313, Baltimore, MD, 21218, United States of America, rgo1@jhu.edu, Anya Castillo, Dennice F. Gayme, Sonja Wogrin

We assess strategic behavior of a merchant energy storage provider in the bulk power market through a bilevel model to represent sequential decisions in investment and operations. We model optimal portfolio investments based on siting, sizing, and technology mix, and explore the effect of strategic operations, such as coordinated scheduling, on decisions. We transform this model into a math program with equilibrium constraints (MPEC), and approximate and solve as a mixed integer program (MIP).

2 - Proactive Transmission Planning: A Case Study of the Eastern Interconnection

Evangelia Spyrou, PhD Student, Johns Hopkins University, 3400 N Charles Street, Dept of Geography, Johns Hopkins University, Baltimore, MD, 21218, United States of America, elina.spyrou@gmail.com, Benjamin Hobbs, Jonathan Ho, Randell Johnson, James Mc Calley

Traditional transmission planning procedures are being challenged by renewable integration due to their reactive character. Meanwhile academic literature proposes the concept of proactive transmission planning. A mixed integer linear program is applied to estimate the benefits of proactively considering response by generation investments to transmission investments. We attempt to examine features of planning procedures that could impede or facilitate optimal planning.

3 - Unit Commitment Approximations in Generation and Transmission Planning: Efficiency & Accuracy

Benjamin Hobbs, Professor, The Johns Hopkins University, 3400 North Charles Street, Baltimore, MD, United States of America, bhobbs@jhu.edu, Saamrat Kasina, Jonathan Ho, Sonja Wogrin

Alternative tight relaxations of unit commitment problems that enable large planning models to be solved with operating subproblems that capture ramp, start-up, and pmin limits and costs. We examine their performance in the context of generation and transmission expansion models, including a stochastic programming analysis of the western interconnection of North America.

4 - Reserve Determination Methods for Variable Generation

Robert Entriken, EPRI, 3420 Hillview Avenue, Palo Alto, CA, United States of America, rentrike@epri.com

We present results of a survey of existing practices in certain power system operators for determining operating reserve requirements for system operators faced with growing penetrations of variable renewables, such as wind or solar generators. Building on existing practices, we review methods proposed in planning and integration studies, as well as in academia, which may become useful as renewable penetrations increase.

■ MD58

58-Room 110A, CC

Multi-Agent Decision-Making for Smart Grids Operation II

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Amin Kargarian, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15232, United States of America, amin.kargarian@gmail.com

1 - Distributed State Estimation and Energy Management in Smart Grids

Soumya Kar, Assistant Research Professor, Carnegie Mellon University, Electrical and Computer Engineering, CMU, Pittsburgh, PA, 15232, United States of America, soumyak@andrew.cmu.edu

Generally, it is expected that the grid of the future would differ from the current system by the increased integration of distributed generation, distributed storage, demand response, power electronics, and communications and sensing technologies. In this paper, we discuss distributed approaches, all based on

consensus+innovations, for two common energy management functions: state estimation and economic dispatch.

2 - Computational Look-ahead SCOPF via ADMM

Sambuddha Chakrabarti, Graduate Student, UT Austin, 1616 Guadalupe Street, Austin, TX, 78705, United States of America, sambuddha.chakrabarti@gmail.com, Matt Kraning, Ross Baldick, Eric Chu, Stephen Boyd

We present computational scheme and results of the ADMM based Proximal Message Passing as applied to solve the look ahead SCOPF to limit post fault line temperature and current to safe values wrt next set of outages.

3 - Adaptive Bidding Strategies of a Load Serving Entity with Distributed Energy Resources

Jhi-Young Joo, Assistant Professor, Missouri University of Science and Technology, 301 W. 16th St, 235 Emerson Electric Co. Hall, Rolla, MO, 65409, United States of America, joojh@mst.edu

This talk concerns two problems solved by an agent, a load serving entity (LSE), within a large-scale energy system. An LSE with different types of demand and energy resources optimizes energy schedule by mathematical programming. On the other hand, to optimize bids into the markets, a learning algorithm is used to adapt to the uncertain market conditions and rewards. The interdependencies between these two problems within an agent and among multiple agents are examined.

4 - Active Distribution Grid Operation: A System of Systems Framework

Amin Kargarian, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15232, United States of America, amin.kargarian@gmail.com

A system of systems framework is presented to operate an active distribution grid composing of several independent entities. The grid structure includes two layers where the distribution company is in upper layer and microgrids are in lower layer. A hierarchical optimization algorithm is presented to optimally operate the entire active distribution grid.

■ MD59

59-Room 110B, CC

Forest & Timber Management

Sponsor: ENRE – Environment II – Forestry

Sponsored Session

Chair: Nick Kullman, Masters Student, University of Washington, 360 Bloedel Hall, Seattle, WA, United States of America, nick.kullman@gmail.com

1 - A Joint Model of Strategic Forest Management, Capacity Expansion and Logistics

Eldon Gunn, Dalhousie University, Halifax, NS, B3H 4R2 Eldon.Gunn@Dal.Ca

This paper presents a mixed integer programming model that enables the integrated analysis of strategic forest management, forest industry capacity and the transport logistics that connect them. Some insights that arise from this model are discussed.

2 - Route Selection in Forest Transportation

Patrik Flisberg, Creative Optimization, Tokai, 7945 Cape Town, South Africa, pafli@mweb.co.za, Mikael Ronnqvist, Gunnar Svenson

Determining the best route for logging trucks is difficult as many road features need to be considered. We describe a system called Calibrated Route Finder that is used to invoice about 50% of all 2 million forest transports done annually in Sweden. This system has gradually been developed based on reporting and requests from the users. Recently, we have included detailed description on stops, acceleration and breaking to describe emissions and times. We report on detailed testing and analysis.

3 - Joint Production of Timber and Sitka Deer Habitat Capability on the Tongass National Forest

Michael Bevers, Dalhousie University, Halifax, NS, B3H 4R2 beversm@gmail.com, Curt Flather, Yu Wei, Greg Hayward, Mary Friberg, Thomas Hanley, Ben Case

The Tongass NF uses the FRESH model to estimate Sitka deer habitat capability measured in deer-days based on digestible dry matter and protein from hundreds of forage species occurring in dozens of vegetative communities potentially affected by timber harvests. Landscape effects on deer are accounted for using a moving window analysis. We developed a MILP formulation incorporating FRESH calculations into a whole-stand timber harvest scheduling model for spatially optimizing joint production of timber and deer habitat capability on management units of the Tongass NF.

■ MD60

60-Room 111A, CC

Panel Discussion: Encouraging Professionalism in the Classroom

Sponsor: INFORM-ED

Sponsored Session

Chair: Cliff Ragsdale, Bank of America Professor, Virginia Tech, Dept. of Business Information Technology, Pamplin Hall, Room 1007, Blacksburg, VA, 24061, United States of America, Cliff.Ragsdale@vt.edu

1 - Encouraging Professionalism in the Classroom

Moderator: Cliff Ragsdale, Bank of America Professor, Virginia Tech, Dept. of Business Information Technology, Pamplin Hall, Room 1007, Blacksburg, VA, 24061, United States of America, Cliff.Ragsdale@vt.edu, Panelists: James Cochran, Ronald Klimberg, Kevin Scheibe

One of a professor's roles as an educator is to prepare students for the professional workplace. The panelists in this session will share ideas related to how we might treat various aspects of our courses and classrooms as simulators of the professional workplace. Open discussion of these ideas with the audience is encouraged.

■ MD61

61-Room 111B, CC

Multilevel Optimization Problems in Energy

Sponsor: ENRE – Energy II – Other (e.g., Policy, Natural Gas, Climate Change)

Sponsored Session

Chair: Sauleh Siddiqui, Assistant Professor, Johns Hopkins University, 3400 N. Charles St. Latrobe 205, Baltimore, MD, 21218, United States of America, siddiqui@jhu.edu

1 - Strategic Bidding in Multi-unit Auctions with Storage of Electric Energy

Chiara Lo Prete, Assistant Professor Of Energy Economics, The Pennsylvania State University, 213 Hosler Building, University Park, PA, 16802, United States of America, chiaraloprete@psu.edu, Uday Shanbhag

Increased supply variability due to the integration of renewables has raised interest in energy storage resources providing flexibility in the operation of electricity systems. One of the key issues to be addressed by market operators relates to the participation of these resources in wholesale energy markets. We develop a theoretical framework to analyze how the inclusion of storage affects incentives and opportunities for strategic bidding behavior in electricity markets.

2 - An Exact Solution Method for Binary Equilibrium Problems and the Power Market Uplift Problem

Daniel Huppmann, Postdoctoral Fellow, Johns Hopkins University, German Institute for Economic Research (DIW Berlin), 3400 N. Charles St., Baltimore, MD, 21218, United States of America, dh@dergelbesalon.at, Sauleh Siddiqui

We propose a novel method to find Nash equilibria in games with binary decision variables by including compensation and incentive-compatibility directly into an optimization framework in lieu of using a linearization, or relaxation of integrality conditions. The method endogenizes the trade-off between efficiency and compensation payments necessary to align incentives of players. We provide existence results and conditions under which this problem can be solved as a mixed-binary linear program.

3 - How Proactive Transmission Investments Can Incentivize Social Welfare Improving Gencos Investments?

Enzo Sauma, Pontificia Universidad Catolica de Chile, Santiago, Chile, esauma@ing.puc.cl, David Pozo, Javier Contreras

We propose a proactive three-level equilibrium model for power transmission and generation expansion. The lower level models the market outcome; the intermediate level models the equilibrium in generation capacity expansion; and the upper level models the transmission expansion. The second and third levels are modeled as an Equilibrium Problem with Equilibrium Constraints. We study how proactive transmission investments can incentivize generation investments that improve social welfare.

4 - The Impact of Withholding Flexibility: An Application to Ramp Bidding in Electricity Markets

Ekaterina Moiseeva, KTH Royal Institute of Technology, SE-100 44, Stockholm, Sweden, moiseeva@kth.se, Mohammad Reza Hesamzadeh, Sonja Wogrin

We compare a one-level and a bilevel equilibrium game in which firms' flexibility is either: decided at the same time as their production decisions; or sequentially. We analyze the impact that different market structures have on the equilibrium outcomes. Our findings are applied to the ramp bidding game in electricity markets. It is observed that electricity producers may strategically declare a lower ramp rate if they expect such decision to maximize their profit in the production stage.

■ MD62

62-Room 112A, CC

Spatial Optimization and Conservation Reserve Design

Sponsor: ENRE – Environment I – Environment and Sustainability

Sponsored Session

Chair: Bistra Dilkina, Assistant Professor, Georgia Institute of Technology, Klaus Bldg 1304, Atlanta, GA, 30332-0765, United States of America, bdilkina@cc.gatech.edu

1 - Land Development Uncertainties in the Dynamic Reserve Network Design Problem

Nahid Jafari, Postdoctoral Research Associate, University of Georgia, 180 East Green St., Warnell School of Forestry and Natural R, Athens, GA, 30602, United States of America, nahid.jafari@uga.edu, Clinton Moore

The (conservation) reserve network design problem is a challenge to solve because of the spatial and temporal nature of the problem, stochastic action costs and dynamic land markets. To plan cost-effective conservation over time under stochastic uncertainties, we propose multi-period MIP models for the budget-constrained selection of fully connected sites. The objective is to maximize a summed conservation value for a subset of site availability scenarios at the end of the planning time horizon.

2 - Wildlife Corridors in Harvest Scheduling Models: A Case Study in Northern Sweden

Rachel St. John, University of Washington, Box 352650, Seattle, WA, 98195-2650, United States of America, rachelstjohn1@gmail.com, Sandor Toth

In northern Sweden, commercial forestry and reindeer husbandry compete for forest resources. The former relies on timber - the latter on lichen. We present a new model for maximizing net timber revenues while maintaining a high quality corridor system for reindeer. The model can control such geometric characteristics as corridor length and width by incorporating path finding technology in a mixed integer programming framework. We illustrate the model with a case study in Sweden.

3 - Spatial Considerations and Optimum Reserve Design for Multiple Species

Hayri Onal, University of Illinois, Urbana IL 61801, United States of America, h-onal@illinois.edu, Yicheng Wang

We present a linear MIP model for designing a conservation reserve system for multiple species where compactness and connectivity of the reserves are imposed at species level. We consider both structural connectivity and functional connectivity of the selected sites. An empirical application to the protection of ten state endangered bird species in Illinois will be presented.

4 - Optimal Design of Nature Reserves Considering Connectivity and Buffer Zones

Eduardo Alvarez-miranda, Universidad de Talca, Merced 437, Curicó, Chile, ealvarez@utalca.cl, Ivana Ljubic, Markus Sinnl, Marcos Goycoolea

In this talk we present general ILP models, which address two spatial requirements of nature reserves: connectivity, to avoid spatial fragmentation; and the presence of buffer zones surrounding so-called core areas. Extensive experimental results on synthetic and realistic instances show the effectiveness of a specially tailored algorithm in providing optimal solutions in short computing times. Other desired spatial properties, such as compactness, are also discussed.

■ MD63

63-Room 112B, CC

Daniel H. Wagner Prize Competition III

Cluster: Daniel H. Wagner Prize Competition

Invited Session

Chair: Allen Butler, President & CEO, Daniel H. Wagner Associates, Inc., 2 Eaton Street, Hampton VA 23669, United States of America, Allen.Butler@va.wagner.com

1 - Machine Learning Framework for Predicting Vaccines Immunogenicity

Eva Lee, Georgia Institute of Technology, Atlanta, GA, United States of America, eva.lee@gatech.edu

The ability to better predict how different individuals will respond to vaccination and to understand what best protects individuals from infection greatly facilitates developing next-generation vaccines. We present a general-purpose, machine-learning framework for discovering gene signatures that can predict vaccine immunity and efficacy. Our models offer unique features not found in other models simultaneously. We will describe the implemented results for yellow fever and influenza vaccines, and highlight their implications for public health and precision medicine.

■ MD64

64-Room 113A, CC

Decision Analysis Society Awards Session

Sponsor: Decision Analysis

Sponsored Session

Chair: Eric Bickel, Associate Professor & Director, OR&IE, U. of Texas at Austin, ETC 5.128C, Austin, TX, United States of America, ebickel@utexas.edu

1 - 2015 Decision Analysis Student Paper Award

Canan Ulu, Assistant Professor, Georgetown University, McDonough School of Business, Washington, DC, 20057, United States of America, Canan.Ulu@georgetown.edu, Robert Hammond

The Student Paper Award is given annually to the best decision analysis paper by a student author, as judged by a panel of the Decision Analysis Society of INFORMS. Students who did not complete their Ph.D. prior to May 1, 2014 are eligible for this year's competition.

2 - 2015 Decision Analysis Publication Award

Kevin Mccardle, Professor, UCLA, Los Angeles, CA, kevin.mccardle@anderson.ucla.edu

This award is given annually to the best decision analysis article or book published in the second preceding calendar year (i.e. calendar year 2013 for consideration in 2015). The intent of the award is to recognize the best publication in "decision analysis, broadly defined." This includes, but is not limited to, theoretical work on decision analysis methodology (including behavioral decision making and non-expected utility theory), descriptions of applications, and experimental studies.

3 - Practice Award

Frank Koch, Consultant, 2510 Cleveland St, Eugene, OR, 97405, United States of America, Frank@kochdecisions.com

The Decision Analysis Practice Award is awarded to the best example of decision analysis practice as judged by the Decision Analysis Practice Award Committee. The purpose of the award is to publicize and encourage outstanding applications of decision analysis practice. We will present the finalists and this year's winner.

4 - 2015 Ramsey Medal Award

Eric Bickel, Associate Professor & Director, OR&IE, U. of Texas at Austin, ETC 5.128C, Austin, TX, United States of America, ebickel@utexas.edu

The Ramsey Medal of the Decision Analysis Society is awarded for distinguished contributions in decision analysis. Distinguished contributions can be internal, such as theoretical and procedural advances in decision analysis, or external, such as developing or spreading decision analysis in new fields. We will introduce the 2015 Ramsey Medal winner, followed by a presentation by the winner.

■ MD65

65-Room 113B, CC

Freight Transportation

Contributed Session

Mohammad Torkjazi, PhD Student, University of South Carolina, 620 Heidt St Apt 1, Columbia SC 29205, United States of America, torkjazi@email.sc.edu

1 - An Optimization Model to Assess Freight Movement between Rail and Road

Lokesh Kalahasthi, Research Assistant, Rensselaer Polytechnic Institute, 110 8th Street, Room JEC 4027, Troy, NY, 12180, United States of America, kalahl@rpi.edu, Trilce Encarnacion

The goal of the paper is to obtain an optimization model that gives a freight traffic assignment on a combined network of road and rail; that could be used to assess the freight modal split including vehicle types and intermodal transfers. The challenge is to incorporate various constraints shippers, carriers and receivers face in using rail and truck; such as shipment size restrictions, transfer time restrictions, variations in the costs, etc. The goal is to obtain insights into methodologies.

2 - A Routing Model for Multicommodity Multimodal Freight Shipment under Network Disruptions

Md Majbah Uddin, Graduate Research Assistant, University of South Carolina, 300 Main Street, Civil and Environmental Engineering, Columbia, SC, 29208, United States of America, muddin@cec.sc.edu, Nathan Huynh

This study proposes a model to route multicommodity shipments on an intermodal freight transport network, where network elements are subject to unexpected disruptions. A stochastic mixed integer program is formulated which minimizes not only operational costs but also penalty cost of unmet demand. To solve this model, sample average approximation algorithm is utilized. Numerical tests reveal that the model is capable of finding high quality solutions for a large-scale, real-world network.

3 - Container Shipping Alliances: A Cooperative Game Theory Simulation

Philipp Rau, WHU - Otto Beisheim School of Management, In den Hüfen 5, Wehr, 79664, Germany, philipp.rau@whu.edu, Stefan Spinler

Overcapacity and pressure on margins are keeping the container shipping industry's environment challenging. This has led carriers to enter vessel sharing agreements and alliances, resulting in a quasi-consolidation. To address the investment problem in an industry that has moved to a more cooperative setting, we develop a cooperative game theory simulation model. We assess impact of competitive intensity and investment heuristics on industry capacity, alliance stability, and carrier financials.

4 - How Drayage Schedule Affect the Gate Appointment System at Container Terminals

Mohammad Torkjazi, PhD Student, University of South Carolina, 620 Heidt St. Apt. 1, Columbia, SC, 29205, United States of America, torkjazi@email.sc.edu, Nathan Huynh

The lack of good communication between drayage companies and container terminals is one of the contributing causes for long queues at the terminal gates. To improve the communication process, a comprehensive model of this process is required. This study proposes a mathematical formulation which reflects the process of communication from the view of both sides in detail. Also, a three-step algorithm is proposed to solve the model and tested on hypothetical problems of different sizes.

■ MD66

66-Room 113C, CC

Aviation Applications Section: Keynote Presentation

Sponsor: Aviation Applications

Sponsored Session

Chair: Senay Solak, University of Massachusetts Amherst, Isenberg School of Management, Amherst, MA, 01003, United States of America, solak@isenberg.umass.edu

1 - FAA's Modernized Terminal Area Forecast

Dipasis Bhadra, Economist, FAA, 800 Independence Avenue, SW, Washington, DC, 20591, United States of America, dipasis.bhadra@faa.gov

The Terminal Area Forecast tool is designed to integrate views of local, national and international flow of activities and capture effects of socioeconomic and technological factors on aviation. The tool is used to understand airports, passenger routing, and aircraft network impact of NEXTGEN development. It also provides projections for future air transport activity through time using future passengers by origin and destination (O&D) market routes and networks (i.e., segment flows); aircraft operations by markets and network routes; and integrates operations and passenger flows through the National Airspace System (NAS) network. The forecasting tool is used to help understand the policies, procedures, and environmental regulations.

■ MD67

67-Room 201A, CC

Integrated Vehicle Routing Problems II

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Weihong Hu, Georgia Tech, Atlanta, GA, United States of America, weihongh@gatech.edu

1 - Heuristics for an Integrated Inventory Routing and Freight Consolidation Problem of Perishable Goods

Weihong Hu, Georgia Tech, Atlanta, GA, United States of America, weihongh@gatech.edu, Alejandro Toriello, Maged Dessouky

We study a novel mixed integer programming model that integrates freight consolidation and inventory routing of perishable goods. We propose an iterative framework that combines a decomposition procedure involving three subproblems and an optimization-based local search scheme. Experiments based on empirical distributions of real data demonstrate the effectiveness of both solution approaches for small to medium size problem instances. We further extend the approach for larger problem instances.

2 - Reoptimization Capabilities of Benders Decomposition for the Stochastic Production Routing Problem

Yossiri Adulyasak, HEC, Canada, yossiri.adulyasak@hec.ca, Jean-Francois Cordeau, Raf Jans

We present two approaches that exploit the reoptimization capabilities to speed up the Benders decomposition algorithms for the the production routing problem (PRP), which is a generalization of the inventory routing problem (IRP), under demand uncertainty. The first approach is applied to the two-stage stochastic PRP in the context of a sample average approximation (SAA) method. The second approach is embedded into a rollout algorithm for the multi-period stochastic PRP. Computational results are presented.

3 - Resource-Constrained Dynamic Programming with "Hot-Starting" for the Elementary Shortest

Ahmad Jarrah, George Washington University, Washington, DC, United States of America, jarrah@gwu.edu, Luis Novoa, Xinhui Zhang, Jonathan Bard

We develop the complete theory for designing a dynamic program (DP) for solving elementary shortest path problems with idle time cost. This is integrated with bidirectional extensions, decremental state-space relaxation, 2-cycle elimination and sharpest-to-date restricted sets of unreachable nodes. We describe new hot-starting procedures to significantly improve the DP's run time. The approach can be used in solution algorithms for the capacitated VRPTW problem with idle time cost.

■ MD68

68-Room 201B, CC

Joint Session TSL/Public Sector: Resilience in Transportation Infrastructure Systems

Sponsor: Transportation, Science and Logistics

Sponsored Session

Chair: Lili Du, Assistant Professor, Illinois Institute of Technology, 3201 S. Dearborn Street, Chicago, IL, United States of America, ldu3@iit.edu

1 - A System-of-Systems Approach toward a Resilient, Dynamically Interdependent Transportation Network

Elise Miller-Hooks, Professor, University of Maryland, College Park, MD, elisemh@umd.edu, Neza Vodopivec

A transportation network's vulnerability to damage depends on the vulnerabilities of other critical systems (i.e. energy, telecommunications, building infrastructure). In a disaster, interdependencies both within a system and between different systems are reshaped dynamically as people take adaptive actions to mitigate impact and repair networks. We explore the interactions between changes in network structures and the evolution of interdependencies between systems.

2 - Infrastructure Investment Decisions in Multimodal Intercity Transportation Networks

Bo Zou, University of Illinois at Chicago, 2095 Engineering Research Facility, 842 W. Taylor Street (M/C 246), Chicago, IL, 60607-7023, United States of America, bzou@uic.edu, Lili Du, Mohamadhosssein Noruzoliaee

Infrastructure investment in multimodal intercity transportation networks involves maintaining existing capacity and adding new capacity to infrastructure facilities. To achieve maximum returns, the infrastructure planner should understand the behavior of players in the network, especially their responses to investment. We develop a bi-level framework to model the decision process, where the upper level pursues social welfare maximization subject to lower-level supply-demand equilibrium.

3 - Optimal Location and Operation of Railroad First-response Resources

Siyang Xie, PhD Student, University of Illinois at Urbana-Champaign, Urbana, IL, United States of America, sxie13@illinois.edu, Yanfeng Ouyang

Railroad incidents such as derailments often seriously impact a large region and block traffic in nearby highway networks, which in turn hinders efficiency of first response efforts. In this paper, we develop a reliable optimization model to characterize and guide positioning and utilization of railroad first-responder resources. Customized solution techniques are employed to effectively solve the model and to provide decision support.

4 - Hazmat Network Design using Time-dependent Consecutive Road Closures Considering Intermediate Stops

Tolou Esfandeh, University at Buffalo, SUNY, Department of Industrial & Systems Eng., 339A Bell Hall, Buffalo, NY, 14260, United States of America, tolouesf@buffalo.edu, Changhyun Kwon, Rajan Batta

We analyze the regulator's problem of identifying the sections of the network and their corresponding times that should be closed to hazmat transportation in a time varying network. We assume that the closure of a section is consecutive in time and the hazmat carriers are allowed to stop in the middle of their trip. We develop a column generation algorithm that accounts for routing and scheduling alternatives which not only reduce the risk but also accounts for drivers' cost perspectives.

■ MD69

69-Room 201C, CC

Arc Routing Problems and Applications

Sponsor: Transportation, Science and Logistics

Sponsored Session

Chair: Mehmet Basdere, Northwestern University, 2145 Sheridan Road, Tech Institute C210, Evanston, IL, 60208, United States of America, mehmetbasdere2016@u.northwestern.edu

1 - The Windy Rural Postman Problem with a Time-dependent Zigzag Option

Rui Zhang, University of Maryland, College Park, MD, ruizhang@rhsmith.umd.edu, Erwin Pesch, Jenny Nossack, Bruce Golden

We focus on the windy rural postman problem with an additional zigzag option. It combines two classes of arc routing problems known before: those with zigzag options and those with time dependencies. We present two MIP formulations and suggest exact solution approaches. Furthermore, we analyze the effects of zigzag and time window options on the objective value.

2 - Arc Routing Problems to Restore Connectivity of a Road Network after a Disaster

Vahid Akbari, Koc University, College of Engineering, Sariyer, Istanbul, 34450, Turkey, vakbarighadkolaei@ku.edu.tr, Sibel Salman

Routes should be generated to reconnect a disconnected road network in the shortest time by opening blocked roads. We study two versions: 1) minimize the time to reconnect the network, 2) maximize the total prize of components reconnected within a time limit. We develop MIP formulations and heuristic algorithms.

3 - Arc Routing, Vehicle Routing and Turn Penalties

Thibaut Vidal, Professor, Pontifícia Universidade Católica do Rio de Janeiro, R. Marquês de São Vicente, 225 - Gávea, Rio de Janeiro, 22451-900, Brazil, vidalt@inf.puc-rio.br

We introduce a structural decomposition for arc routing problems, in which all decisions about driving lanes, turns, edge traversal and service orientations are addressed via dynamic programming. We show that a neighborhood based on moves on the sequences of services with optimal traversal decisions can be explored in $O(1)$ per move. The approach is integrated into two classical metaheuristic frameworks, leading to remarkable results for many arc routing variants, with possible turn penalties.

4 - The Lock Free Arc Touring Problem with an Application to Marathon Course Design

Mehmet Basdere, Northwestern University, 2145 Sheridan Road, Tech Institute C210, Evanston, IL, 60208, United States of America, mehmetbasdere2016@u.northwestern.edu, Karen Smilowitz, Sanjay Mehrotra

In this talk, we present a new type of arc routing problem in the marathon course design setting. The aim is to find a valid marathon course that minimizes the average distance to the medical facilities within the region of interest without preventing the public access to those facilities while visiting a predetermined subset of landmark streets. A novel solution approach which utilizes visit restrictions and new valid inequalities are introduced.

■ MD70

70-Room 202A, CC

Railway Analytics

Sponsor: Railway Applications

Sponsored Session

Chair: Qing He, Assistant Professor, SUNY Buffalo, 313 Bell Hall, Buffalo, NY, 14051, United States of America, qinghe@buffalo.edu

1 - Multi-task Learning for Joint Prediction of Failure Time and Failure Types of Train Wheels

Weixin Wang, University at Buffalo, 1357 Millersport Hwy Apt 8, Buffalo, NY, 14221, United States of America, weixinwa@buffalo.edu, Zhiguo Li, Qing He

The failures of train wheels account for half of all train derailments. Both failure time and failure types of wheels are critical for wheel maintenance. Failure time prediction is a regression task, whereas failure type is a classification task. In this work, we propose a multi-task learning approach to jointly predict these two tasks by using a common input space to achieve more desirable results.

2 - Diagnostic Method to Measure the Impact of Railway Traffic Heterogeneity from Field Operations Data

Mei-Cheng Shih, University of Illinois, U-C, 205 North Mathew Ave, Urbana, IL, 61801, United States of America, mshih2@illinois.edu, C. Tyler Dick

Growing demand for freight rail transportation of crude oil and domestic intermodal traffic has increased both the volume and disparity in types of trains operated on many mainlines. Differences in train characteristics and priority, has become one of the major causes of congestion. Based on actual train operations data from a Class 1 railroad, this study develops two indices that help railroads measure the degree to which traffic heterogeneity impacts observed operating performance.

3 - Evaluating Track Maintenance Aggregation in Extended Work Windows on Freight Railroad Lines

Alexander Lovett, Graduate Research Assistant, University of Illinois at Urbana-Champaign, 205 N Mathews Ave, B118 Newmark Lab, Urbana, IL, 61801, United States of America, alovett2@illinois.edu, Christopher Barkan, C. Tyler Dick

Combining track maintenance activities into extended work windows can improve maintenance efficiency. Efficiencies come from reduced set-up time and efforts common to multiple activities at the cost of being more disruptive to train operations. Aggregating activities requires adjusting maintenance cycles which may increase accident risk or maintenance frequency. A methodology for evaluating the costs of aggregating track maintenance into an extended work window is presented.

■ MD71

71-Room 202B, CC

Transportation Network Modeling and Design

Sponsor: TSL/Urban Transportation

Sponsored Session

Chair: Antoine Petit, UIUC, Urbana, IL, United States of America, apetit@illinois.edu

1 - Generalized Statistical Traffic Assignment: Methodology, Properties and Variance Analysis

Sean Qian, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, seanqian@cmu.edu, Wei Ma

The traffic assignment problem has been typically used to estimate deterministic network traffic volumes. Day-to-day variations of link and path flow are unfortunately overlooked, but often times they are required for modeling network uncertainty and resilience. We propose a generalized statistical traffic assignment model where variance of demand, route choices and individual perception are considered. We show some statistical properties of this model and discuss the variance analysis.

2 - Construction Schedule Design Considering Cost, Traffic Delay and Energy Consumption

Laura E. Ghosh, UIUC, Urbana, IL, United States of America, vingerh1@illinois.edu, Khaled El-Rayes, Ahmed Z. Abdelmohsen, Yanfeng Ouyang

A model that determines the optimal freeway maintenance schedule over a construction season is presented. It optimally selects work-zone length, workday start time and duration, lane and shoulder widths, temporary lane construction and access strategy in order to (i) minimize the costs of construction-related traffic delay and corresponding mitigation measures and (ii) minimize construction related energy consumption.

3 - Flexible Transit Network Design with and Without Branching under Spatially Heterogeneous Demand

Antoine Petit, UIUC, Urbana, IL, United States of America, apetit@illinois.edu, Yanfeng Ouyang

While public transportation systems are usually designed with fixed routes, this work presents an alternative flexible-route transit system where vehicles travel within predetermined areas in response to trip demand to provide door-to-door service. Two additional features will be considered in the network design, hybrid structure and local branching.

4 - Generalized Bounded Rationality and Robust Multi-Commodity Network Design

Changhyun Kwon, Associate Professor, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, chkwon@usf.edu, Longsheng Sun, Mark Karwan

When the route-choice behavior of network users are uncertain, the notion of bounded rationality has been used to allow users to choose sub-optimal routes whose length is within a certain bound. In this paper, we provide another framework to explain such bounded rationality assuming that network users make perfectly rational route decisions, but with perception error in link costs. By showing that some cases of the perception error model are equivalent to the bounded rationality models, we establish the notion of generalized bounded rationality. We demonstrate how the notion of generalized bounded rationality can be used for robust multi-commodity network design problems and provide computable optimization frameworks based on both links and paths. We illustrate our approaches in the context of hazardous materials transportation.

■ MD72

72-Room 203A, CC

Panel Discussion on Big Data Science – Opportunities and Challenges

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Hui Yang, Associate Professor, Pennsylvania State University, 310 Leonhard Building, Industrial and Manufacturing Eng., State College, PA, 16801, United States of America, huy25@psu.edu

1 - Panel Discussion on Big Data Science - Opportunities and Challenges

Moderator: Hui Yang, Associate Professor, Pennsylvania State University, 310 Leonhard Building, Industrial and Manufacturing Eng., State College, PA, 16801, United States of America, huy25@psu.edu, Panelists: Soundar Kumara, Liying Cui, Yan Xu, Andrew Kusiak

This panel brings experts from academia and industry to discuss the opportunities and challenges in big data science. The panelists are: Dr. Andrew Kusiak, Professor and Chair, The University of Iowa; Dr. Soundar Kumara, Professor, The Pennsylvania State University; Dr. Yan Xu, Senior Manager, Big data optimization group, SAS Institute; Dr. Liying Cui, network improvement manager, Starbucks: ...

■ MD73

73-Room 203B, CC

Data Analytics in Manufacturing and Service Industries

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Nan Chen, National University of Singapore, 117576, Singapore, isecn@nus.edu.sg

Co-Chair: Kaibo Wang, Associate Professor, Tsinghua University, Department of Industrial Engineering, Beijing, China, kbwang@tsinghua.edu.cn

1 - Modeling Air Quality Data based on Physical Dispersion Processes

Xiao Liu, IBM, Singapore, liuxiao@sg.ibm.com

In this paper, we investigate a statistical modeling approach based on a commonly used physical dispersion model, called the scalar transport equation. The relationship between the proposed spatial-temporal model and the physical model is well established. The model describes the pollutant concentration by a non-stationary random field with a space-time non-separable and anisotropic covariance structure.

2 - Remaining Useful Life Prediction using Mixed Effects Model with Mixture Prior Distributions

Raed Al Kontar, UW Madison, Eagle Heights 301J, Madison, WI, United States of America, alkantar@wisc.edu, Junbo Son, Shiyu Zhou

In Modern engineering systems, pre-mature failure has become quite rare. Thus, degradation signals used for prognosis are often imbalanced. Such imbalanced data may hinder accurate remaining useful life prediction especially in terms of detecting pre-mature failures as early as possible. We propose a degradation signal based RUL prediction method to address the imbalance in data. This method captures the characteristics of different groups and provides real time updating of an in-service unit

3 - An OSA Detection Approach using a Discriminative Hidden Markov Model

Xi Zhang, Assistant Professor, Peking University, 5 Yiheyuan Rd., Beijing, 100871, China, xi.zhang@pku.edu.cn, Changyue Song, Kaibo Liu

We proposed a novel detection approach for obstructive sleep apnea (OSA) based on ECG signals by considering the temporal dependency. A discriminative hidden Markov model (HMM) and corresponding parameter estimation algorithms are provided, and a real case study shows that a competitive performance including accuracies of 94.3% for per-recording classification and 86.2% for per-segment OSA detection with satisfactory sensitivity and specificity were achieved.

4 - Quantification and Monitoring on Ecommerce Reviews Dataset

Suoyuan Song, HKUST, Dept. of IELM, HKUST, Clear Water Bay, Kowloon, Hong Kong - PRC, songsuoyuan@gmail.com, Fugee Tsung

Recently, the boom of e-merchants have attracted researchers on analyzing those text-rich data. Unfortunately, these technologies have drawn little attention in statistics and quality area. In this article, we aim to (1) use text mining technologies to first quantify customer reviews, and (2) build statistical model to monitor those text-rich reviews data.

■ MD74

74-Room 204A, CC

Advanced Maintenance Modeling

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Yisha Xiang, Assistant Professor, Lamar University, 2626 Cherry Engineering Building, Beaumont, TX, 77710, United States of America, yxiang@lamar.edu

Co-Chair: David Coit, Professor, Rutgers University, Piscataway, NJ, United States of America, coit@rci.rutgers.edu

1 - A Gaming Model for Outsourcing Maintenance under Uncertain Fleet Expansion

Tongdan Jin, Texas State University, 601 University Drive, San Marcos, TX, United States of America, tj17@txstate.edu, Shuying Li, Hong-zhong Huang

We propose a multi-criteria, performance-based maintenance contract to maximize the utilities of the customer and the supplier under principal-agent model. We prove that supplier's decision on maintenance time, spares stocking and repair capacity are fully observable to the customer, hence ensuring fully efficient service delivery with no moral hazards. We further show that customers are incentivized to share advance demand information with the supplier for new product acquisition.

2 - A Survey of Condition-based Maintenance Policies for Deteriorating Systems

Suzan Alaswad, Assistant Professor, Zayed University, Kalifa City B, Abu Dhabi, United Arab Emirates, Suzan.Alaswad@zu.ac.ae, Yisha Xiang

This paper reviews CBM literature highlighting the various stochastic modeling approaches. This paper classifies the CBM models based on the system stochastic degradation model (i.e. whether the degradation state is discrete or continuous) into three deterioration models: discrete, proportional hazard model (PHM), and continuous, and surveys existing CBM models based on this classification for both single and multi unit systems.

3 - Markov Additive Processes for Degradation with Jumps under Dynamic Environments

Yin Shu, University of Houston, E206 Engineering Bldg.2, Houston, TX, 77204, United States of America, yinshulx@gmail.com, Qianmei Feng, Edward Kao, Hao Liu, David Coit

We use Markov additive processes to integrally handle the complexity of degradation including internally- and externally-induced stochastic properties with complex jump mechanisms. We derive the Fokker-Planck equations for such processes, based on which we derive explicit results for life characteristics represented by infinitesimal generator matrices and Levy measures. The superiority of our models is their flexibility in modeling degradation data with fluctuation under dynamic environments.

4 - Joint Burn-in and Imperfect Condition-based Maintenance for N-subpopulations

Yisha Xiang, Assistant Professor, Lamar University,
2626 Cherry Engineering Building, Beaumont, TX, 77710, United States of America, yxiang@lamar.edu, David Coit

For some engineering design and manufacturing applications, particularly for evolving and new technologies, some populations of manufactured parts or devices are heterogeneous and consist of a small number of different subpopulations. In this study, we propose a joint burn-in and imperfect condition-based maintenance model with consideration of random effects within subpopulations. Numerical examples are provided to illustrate the proposed procedure.

■ MD75

75-Room 204B, CC

Deep Dive on Open Innovation – Papers and Discussants

Cluster: New Product Development
Invited Session

Chair: Jeremy Hutchison-Krupat, Professor, University of Virginia, Charlottesville, VA 22901, United States of America, KrupatJ@arden.virginia.edu

1 - Optimal Shapes of Innovation Pipelines

Joel Wooten, University of South Carolina, Columbia, SC, United States of America, joel.wooten@moore.sc.edu, Sriram Venkataraman

New product introductions often occur via R&D pipelines. We explore the optimal number of innovation options to pursue in this complex managerial process. A stylized game simulation of the pharma industry provides additional evidence for our problem.

2 - Discussant

Sanjiv Erat, UCSD, Gilman Drive, La Jolla, CA, United States of America, serat@ucsd.edu

This talk will offer a discussion/critique of the paper titled “Optimal Shapes Of Innovation Pipelines.

3 - How Much Better is Open Innovation?

Sebastian Fixson, Babson College, Tomasso Hall 226, Babson Park, MA, 02457, United States of America, sfixson@babson.edu, Tucker Marion

Over the past 15 years research has emerged that describes many advantages of open innovation, such as unearthing ideas that better match customer needs and/or problem specifications. In this paper, we study in detail the new product development process of a single organization that makes extensive use of external actors throughout its process, and explore the corresponding performance implications.

4 - Discussant

Yi Xu, Associate Professor, Smith School of Business, University of Maryland, College Park, MD, 20742, United States of America, yxu@rhsmith.umd.edu

This talk will offer a discussion/critique of the paper titled “How Much Better Is Open Innovation?

■ MD76

76-Room 204C, CC

Simulation in Healthcare

Sponsor: Simulation
Sponsored Session

Chair: Tahir Ekin, Assistant Professor, Texas State University, 01 University Dr. McCoy Hall 411, San Marcos, TX, 78666, United States of America, t_e18@txstate.edu

1 - Simulation of Hospital Outpatient Clinics

Lawrence Fulton, Assistant Professor, Texas Tech University, 703 Flint Ave, Lubbock, TX, United States of America, larry.fulton@ttu.edu, Nathaniel Bastian

MedModel was used to provide decision support for a hospital's outpatient clinic organization. Variables of interest included cost, capitation rate, utilization, and throughput. Outpatient areas evaluated included primary care clinics, OB/GYN, pediatrics, internal medicine, same-day surgery, orthopedics, psychology / psychiatry, social work service, and physical therapy / occupational therapy. The modeling demonstrates the usefulness of healthcare simulation for organizational change.

2 - The Use of Lindley's Entropy in Dynamic Sampling Decisions

Rasim Muzaffer Musal, Associate Professor, Texas State University, 601 University Dr., McCoy Hall 411, San Marcos, TX, 78666, United States of America, rm84@txstate.edu, Tahir Ekin

Neyman Allocation (NA) is used to stratify Medicare payments to create relatively homogeneous strata. These strata are assumed to provide a relatively more homogeneous over-payment sub-populations. We suggest an extension to NA by the use of Lindley's expected information gain measure to make efficient sampling decisions. In doing so a novel application is presented under simulated scenarios. A comparison between alternative methods is illustrated.

3 - Using Markov Chain Monte Carlo for Input Models of Surgery Duration in a Multi-specialty Department

Louis Luangkesorn, Research Assistant Professor, University of Pittsburgh, 1048 Benedum Hall, Department of Industrial Engineering, Pittsburgh, PA, 15261, United States of America, lol11@pitt.edu, Zeynep Filiz Eren Dogu

The variety of procedures in a surgery suite means that even with several years of data many surgical cases will have little or no historical data for use in predicting case duration. Parameterizing duration is needed for other procedures such as stochastic optimization. We combine expert judgement, expert classification of procedures by complexity category and historical data in a Markov Chain Monte Carlo (MCMC) model to parameterize cases and test the result against other methods.

4 - Medicare Fraud Analytics using Cluster Analysis

Babak Zafari, The George Washington University School of Business, 2201 G Street NW, Fungler Hall, Suite 415, Washington, DC, United States of America, zafari@gwu.edu, Paulo Macedo, Sewit Araia

In this work, we use of cluster analysis to group healthcare providers based on similar billing patterns. In detecting outliers, comparing providers based on self-reported specialty can cause false positives due to specialization. We use BETOS codes to categorize procedure codes in addressing the issue of aberrant billing behavior. This establishes a representative peer comparison group that minimizes false positives. The efficacy of the proposed method is illustrated through data simulation.

■ MD77

77-Room 300, CC

Supply Chain Management VIII

Contributed Session

Chair: Marcus Bellamy, Assistant Professor, Boston University Questrom School of Business, 595 Commonwealth Avenue, Boston, MA, 02215, United States of America, bellamym@bu.edu

1 - R and D Modes of Manufacturers' Cost Reduction: How to Invest in Supply Chains

Jing Hu, PhD Student, Fudan University, 670 Guoshun Road, Yangpu District, Shanghai, China, jinghu13@fudan.edu.cn, Qiying Hu

Inspired by the Chinese mobile phone industry, we find four R&D modes between vertical firms: two collaborative modes (R&D cartel and R&D joint venture) and two non-collaborative modes (manufacturer-R&D and retailer-R&D). A three-stage game model is considered to explain why these modes coexist. We find that firms prefer the R&D cartel if and only if they have comparable channel powers. When collaboration is impossible, only the firm with sufficiently smaller cost factor prefers R&D by itself.

2 - The Role of Customer Flexibility in Achieving Supply Chain Agility

Vahid Ghomi, PhD Student, University of Mississippi, Marketing Department, School of Business Administration, Oxford, MS, 38655, United States of America, vghomi@bus.olemiss.edu, Bahram Alidaee

A firm's supply chain agility (SCA) is a critical factor affecting its overall competitiveness. To create SCA, most research concentrate on exploring manufacturing flexibility, supply side flexibility, and logistics capabilities. However, there are variety of settings where demand side flexibility (DSF) can be achieved. The purpose of this research is to present, (1) a comprehensive literature review of DSF, (2) research directions as how SCA can be achieved by exploring DSF.

3 - Purchasing Postponement and SC Coordination in a Decentralized N-V Model with Stochastic Demand

Sourabh Bhattacharya, Professor, Institute of Management Technology, Hyderabad, India, 38, Cherlaguda Village Shamshabad, Hyderabad, TS, 500048, India, sbhattacharya@imthyderabad.edu.in

We determine the buyback price for a seller in a purchasing postponement environment. Under stochastic demand a buyer postpones its purchasing decision to reduce inventory cost. The seller on the other, offers a buy back rate to induce higher orders from the buyer. Our model suggests that in a decentralized SC under purchasing postponement, a buy back rate can be arrived at such that the SC profits are maximized and SC coordination is established.

4 - Impact of Supply Relationship Dynamics on Firm Performance: A Multilevel Empirical Analysis

Marcus Bellamy, Assistant Professor, Boston University Questrom School of Business, 595 Commonwealth Avenue, Boston, MA, 02215, United States of America, bellamym@bu.edu, Soumen Ghosh, Manpreet Hora

We develop an empirical model to examine supply relationship dynamics as drivers of firm performance. We use supply chain relationship and financial data from the Bloomberg database. Our unique dataset allows us to investigate manufacturing firms both as customers and suppliers. We use a multilevel mixed-effects model combining firm and dyad level effects.

5 - Logistics Performance Improvement from Information Integration

Sung-tae Kim, Assistant Professor, SolBridge International School of Business, 128 Uam-ro, Dong-gu, Daejeon, 300-814, Korea, Republic of, stkim1@solbridge.ac.kr, Gi-eyun Seo

This study examines the moderating effects of strategic and operational information integration on the relationships between logistics performance and organizational performance. This study measures logistics performance, in terms of effectiveness, efficiency, and differentiation. Organizational performances are classified as operational, financial, and market performances. The data from 321 manufacturing firms are evaluated using moderated hierarchical regression analysis.

■ MD78

78-Room 301, CC

Optimization under Uncertainty with Energy Applications

Contributed Session

Chair: Yu Zhang, University of Minnesota, 1033 29th Ave SE, Apt B, Minneapolis, MN, 55414, United States of America, zhan1220@umn.edu

1 - Predicting and Mitigating Congestion for an Electric Power System under Uncertainty

Dzung Phan, IBM T.J. Watson Research Center, 1101 Kitchawan Road, P.O. Box 218, Yorktown Heights, NY, 10598, United States of America, phandu@us.ibm.com, Soumyadip Ghosh

Operation of a transmission grid has to handle increasing renewables uncertainty. This necessitates probabilistic modeling of the impact of uncertainty over the near-future state of the grid. We propose a multi-period optimization model to estimate the probability of the occurrence of a transmission line congestion event. The model also helps to choose the best mitigation decisions to minimize the chances of experiencing a congestion. A distributed algorithm is presented to efficiently solve it.

2 - Optimal Operation and Services Scheduling for AA Electric Vehicle Battery Swapping Station

Hrvoje Pandzic, Faculty of Electrical Engineering and Computing University of Zagreb, Unska 3, Zagreb, Croatia, Hrvoje.Pandzic@fer.hr, Mushfiqur Sarker, Miguel Ortega-vazquez

For a successful rollout of electric vehicles (EVs), it is required to establish an adequate charging infrastructure. Battery swapping stations are poised as effective means of eliminating the long waiting times associated with charging the EV batteries. These stations are mediators between the power system and their customers. This presentation describes an optimization framework for the operating model of battery swapping stations.

3 - A Multi-period Energy-Aware Inventory Model with CVAR Constraints

Niloofer Salahi, Graduate Research Assistant, Rutgers The State University of New Jersey, 96 Frelinghuysen Road, Piscataway, NJ, 08854, United States of America, niloofer.salahi@gmail.com, Mohsen Jafari

A risk-averse production planning with energy efficiency consideration is introduced for an industrial process subject to stochastic demand. We present an inventory model that minimizes expected costs while maintaining performance requirements. The energy consumption is calculated using energy-performance curves specific to the type of industrial process. We show that significant cost saving is expected when adjusting the production plan according to time dependent electricity pricing schemes.

4 - Robust Optimization vs. Stochastic Programming for Electricity Generating Unit Commitment

Narges Kazemzadeh, Graduate Research Assistant, Iowa State University, Industrial & Mfg. Sys. Engg., Ames, IA, United States of America, kazemzad@iastate.edu, Sarah Ryan

Unit commitment seeks the most cost effective generator commitment decisions to meet net load while satisfying operational constraints. Stochastic programming and robust optimization are the most widely studied approaches under uncertainty in the load less variable generation. We investigate and compare the performance of these approaches for a multi-bus power system in different aspects including economic efficiency as well as the risk associated with the decisions.

5 - Real-time Energy Disaggregation using Online Convex Optimization

Yu Zhang, University of Minnesota, 1033 29th Ave SE, Apt B, Minneapolis, MN, 55414, United States of America, zhan1220@umn.edu, Georgios Giannakis

By decomposing a whole electricity consumption into appliance-level signals, energy disaggregation can induce end users' saving behavior and significantly improve energy efficiency. Capitalizing on underlying features of the sparse and low-rank signals, an online convex optimization problem is formulated for the real-time disaggregation task. An efficient online algorithm is developed with provably sublinear regret. Numerical results corroborate the merits of the proposed approach.

■ MD79

79-Room 302, CC

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - LINDO Systems, Inc. - Optimization Modeling Made Easy

Mark Wiley, VP Marketing, LINDO Systems, Inc.

Come and learn how easy it is to: • Quickly build linear, nonlinear, quadratic, conic and integer optimization models, • Incorporate uncertainty into optimization models, • Easily access data from Excel and databases, • Seamlessly embed a solver into your own application. Come and see a demonstration of the power and flexibility of the new releases of: • LINDO API – a callable solver engine, • LINGO – an integrated modeling language and solvers, • What's Best! – a large-scale solver for Excel.

2 - DO ANALYTICS - OPTEX Mathematical Modeling System: The New Paradigm

Jesus Maria Velasquez, Chief Scientist, Do Analytics LLC

DO ANALYTICS presents OPTEX Mathematical Modeling System, a powerful expert system that is changing the way to make large scale mathematical programming models. OPTEX: * Generates programming codes in the most powerful optimization technologies, including the SQL statements to connect any DBMS. * Mixes the power of an optimization technology with the easiness of EXCEL. * Works as a client & as an optimization server in the cloud. * Easy and Fast, OPTEX represents the new generation to DO ANALYTICS

Tuesday, 8:00am - 9:30am

■ TA01

01-Room 301, Marriott

Military Manpower and Force Management

Sponsor: Military Applications

Sponsored Session

Chair: Andrew Hall, COL, U.S. Army, 4760 40th St N, Arlington, VA, United States of America, AndrewOscarH@aol.com

1 - Air Force Officer Accession Planning: Addressing Key Gaps in Meeting Career Field Academic Degree Requirements

Tara Terry, Operations Researcher, RAND Corporation, 1200 S. Hayes St., Arlington, VA, 22202, United States of America, tterry@rand.org

The goal of the Air Force officer accession process is to ensure the USAF accesses officers with the knowledge, skills and attributes to perform missions in particular career fields. Key to this goal for non-rated officers is establishing and enforcing academic degree requirements. We uncovered gaps in accession processes that undermine meeting career field education requirements. We introduced recommendations toward correcting the accession process and meeting career fields academic needs.

2 - A Methodology for Estimating Caseload in the U.S. Army's Disability Rating Process

James Broyles, Operations Researcher, RAND Corporation, 1776 Main Street, Santa Monica, CA, 90401, United States of America, jbroyles@rand.org, Mustafa Oguz

As U.S. Army soldiers separate from service, a portion of them enter the disability rating process to obtain a rating that determines their level of benefits and compensation. The process involves several evaluation steps and appeal processes that cause highly variable and sometimes long processing durations. This research presents a methodology that uses a non-Markovian probability model for estimating disability rating caseload given forecasted future soldier separations.

3 - Aligning Officer Personnel Requirements with a Sustainable Career Lifecycle Model

Michael Needham, DCS G-1, HQDA, 300 Army Pentagon, Washington, DC, United States of America, michael.p.needham2.mil@mail.mil

The U.S. Army is at a critical juncture in determining a supportable military personnel structure that is limited by mandated force structures. Personnel structure adjustments drive near-term force-shaping personnel policies, such as accessions, promotions, and separations. We identify sustainable standards of grade using historical data while accounting for future personnel management policies. The model uses sixteen years of historical data as a foundation to determine future behavior.

4 - Army Officer Grade Distribution for the Army Competitive Category

Francisco Baez, DCS G-1, HQDA, 300 Army Pentagon, Washington, DC, United States of America, francisco.r.baez.mil@mail.mil

The Army's Grade Structure has become significantly senior impacting the potential health of the current and future force by reducing selectivity and competition rates, and forcing early promotions. The propose distribution of officers focuses on re-balancing grade structure for each career management field to ensure balance and health of the force by ensuring leader-to-led ratios, quality, and viable career paths for all soldiers.

■ TA02

02-Room 302, Marriott

Optimization Applications in Homeland Security

Cluster: Homeland Security

Invited Session

Chair: Daniel Faissol, Lawrence Livermore National Laboratory, Livermore, CA, United States of America, faissol1@llnl.gov

1 - Modeling the Global Spread and Impact of Diseases at Various Levels of Aggregation

Daniel Skorski, Operations Research Scientist, Pacific Northwest National Laboratory, 301 Hills Street, Richland, WA, 99352, United States of America, Daniel.Skorski@pnnl.gov, Robert Brigantic, Brent Daniel, Matthew Oster

Diseases spread by various modes of transportation is a never-ending modeling and analysis need. GlobalCURE provides a framework to study the interplay

between global infrastructure, epidemiology, economics, government policy, and regional and/or international populations. This presentation summarizes the development (web and desktop) and use of the GlobalCURE tool. In our analysis, we specifically focus on the interplay of factors across levels of aggregation (e.g., tract through country).

2 - Optimization Planning Tool for Urban Search Missions

Daniel Faissol, Lawrence Livermore National Laboratory, Livermore, CA, United States of America, faissol1@llnl.gov, Claudio Santiago, Richard Wheeler, Thomas Edmunds

We present a prototype tool to support planning of radiological and nuclear search missions in an urban environment using mobile detectors. Two distinct problems are considered with proposed solutions: (1) a nonconvex optimization problem that solves for detector dwell times and locations that maximize the probability of detection for building interiors, and (2) a multiple vehicle routing problem on a directed multigraph that solves for the maximum net benefit given a fixed total search time.

3 - Optimal Sonar Deployment in a Maritime Environment: A Fortification Approach

Taofeek Biobaku, University of Houston, Houston, TX, United States of America, tobiobaku@uh.edu, Gino Lim, Jaeyoung Cho, Hamid Parsaei, Seon Jin Kim

The safety and integrity of maritime assets continue to be of paramount importance in world trade and economy. The marine-based trilevel problem remains computationally challenging. The inherent challenges increase with the risk analysis approach we adopt. We propose algorithms based on modifications of Benders' decomposition; and column-and- constraint general algorithms to attempt an optimal solution. Thereafter, we compare solutions on these two algorithms using a case study.

4 - A Mothership-based UAV Routing Problem in Support of Counterfire Operations

Jaeyoung Cho, University of Houston, 333 Dominion Dr., #1021, Katy, TX, 77450, United States of America, uncmac.rokag@gmail.com, Taofeek Biobaku, Seon Jin Kim, Gino Lim

We describe a model for routing UAVs which are launched and recovered from airborne drone carriers. We formulate and solve this problem with a given fleet of UAVs subject to technical and operational constraints. The spatio-temporal model captures important aspects of a UAV deployment in counterfire operations including collaboration tactics and overlapping observation. The model is designed to provide an insight into issues associated with operating UAVs aided counterfire operations system.

■ TA03

03-Room 303, Marriott

Scheduling in Practice

Cluster: Scheduling and Project Management

Invited Session

Chair: Emrah Cimren, Nike, 1 SW Bowerman Dr., Beaverton, OR, 97005, United States of America, Emrah.Cimren@nike.com

1 - A Sample-Gradient-Based Algorithm for Multiple-OR and PACU Surgery Scheduling

Miao Bai, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, mib411@lehigh.edu, Gregory Tonkay, Robert Storer

We address a multiple-OR surgery scheduling problem constrained by shared PACU capacity within the block-booking framework. Given the surgery sequence, a Discrete Event Dynamic System-based stochastic optimization model is formulated in order to minimize the cost incurred by patient waiting time, surgeon idle time, OR blocking time, OR overtime and PACU overtime. A sample-gradient-based algorithm is proposed to solve the sample average approximation of our formulation.

2 - Leveraging Predictive Analytics for HPC Scheduling in Dynamic Environments

Sarah Powers, Oak Ridge National Laboratory, One Bethel Valley Road, Oak Ridge, TN, United States of America, powersss@ornl.gov

Improvements in heterogeneous HPC scheduling can be obtained by leveraging predictive analytics of job submissions. Development of the necessary workflow models requires historical data and is costly due to the potential high diversity of job types and their evolving patterns over time. We propose a method which learns these patterns dynamically, allowing for unknown jobs types and changing arrival patterns. Prediction gains are thus automated and utilizable in dynamic environments.

3 - Driver Scheduling Optimization Method Proposal for the J.B. Hunt Intermodal Division

Luisa Janer, Graduate Student, University of Arkansas, 759 S Royal Oak Pkwy #201, Fayetteville, AR, 72701, United States of America, mjanerru@uark.edu, Valeria A. Remon Perez, Nicole Taborga Delius, Nakia Lynn Lee

A scheduling tool based on optimization was developed in order to improve the driver and truck scheduling process of the J.B. Hunt Intermodal Division. After having developed six prototypes of an optimization model, the tool manages to effectively lower the outsourcing percentage to ten percent and increases the driver-truck ratio to 1.8.

■ TA04

04-Room 304, Marriott

Panel Discussion: Journal Publication Tips

Sponsor: Junior Faculty Interest Group

Sponsored Session

Chair: Cameron MacKenzie, Assistant Professor, Iowa State University, 3004 Black Engineering, Ames, IA, 50011, United States of America, camacken@iastate.edu

1 - Panel Discussion: Successful Journal Publication Tips

Moderator: Cameron MacKenzie, Assistant Professor, Iowa State University, 3004 Black Engineering, Ames, IA, 50011, United States of America, camacken@iastate.edu, Panelists: Chris Tang, Martin Savelsbergh, Serguei Netessine, Stefanos Zenios, Jay Simon

Panel discussion will include editors and associate editors from Management Science, Operations Research, Decision Analysis, Manufacturing & Service Operations Management, and Transportation Science.

■ TA05

05-Room 305, Marriott

Social Media and Networks in Business

Cluster: Social Media Analytics

Invited Session

Chair: Xiaojing Dong, Associate Professor, Santa Clara University, 500 El Camino Real, Lucas Hall, Marketing, Santa Clara, CA, 95053, United States of America, xdong1@scu.edu

1 - Predicting Social Influence Based on Dynamic Network Structures

Mandy Hu, Assistant Professor, The Chinese University of Hong Kong, CUHK Business School, Marketing, Shatin, Hong Kong - PRC, mandyhu@baf.cuhk.edu.hk

This study examines how network structure and dynamics interplay with the effect of social influence to facilitate diffusion. The context we consider is the diffusion of a new smartphone from a major wireless carrier in two medium-sized cities in China. We are able to identify the two most significant network measures related to social influence are diversity of connection and time variation of edge numbers. Our findings provide foundation on the network-based targeting strategy.

2 - Matrix Metrics: Network-based Systemic Risk Scoring

Sanjiv Das, William And Janice Terry Professor Of Finance, Santa Clara University, Leavey School of Business, 500 El Camino Real, Santa Clara, CA, 95053, United States of America, srdas@scu.edu

I develop a network-based systemic risk score that depends on individual risk at each financial institution and interconnectedness across institutions. This risk metric is decomposable into risk contributions from each entity, forming a basis for taxing each entity appropriately. Spillover risk determines the scale of externalities that one institution might impose on the system. Splitting up too-big-to-fail banks from the system does not lower systemic risk.

3 - Motivation of User-Generated Content in a Social Network

Xiaojing Dong, Associate Professor, Santa Clara University, 500 El Camino Real, Lucas Hall, Marketing, Santa Clara, CA, 95053, United States of America, xdong1@scu.edu

This study focuses on understanding the motivation of user-generated content in open-source environments and online social networks. In our data, to encourage members to contribute more reviews on the site, the community introduced cash payment to those who offered reviews. We find the effect of such reward actually depends on the level of social connectedness. Those with fewer connections responded positively to the reward, and those with more connections responded negatively.

4 - Within and Cross-channel Effects of Brand Advertising on Word-of-Mouth

Linli Xu, Carlson School of Management, University of Minnesota, 321 19th Ave S, Suite 3-150, Minneapolis, MN, United States of America, linlixu@umn.edu, Mitchell Lovett, Renana Peres

The central theme of this paper is to examine the relationship between advertising and WOM. We study the influence of advertising on word-of-mouth within channel and across channels. Preliminary evidence suggests significant relationships both within and cross-channels. For example, both TV and Internet display advertising appear to be significantly related to offline word-of-mouth with TV having a stronger direct effect than Internet, whereas Internet advertising is stronger online than TV.

5 - Mobile Big Data Analytics

Xueming Luo, Temple Univ, 1801 Liacouras, Philadelphia, PA, 19076, United States of America, luoxm@temple.edu

Over 3.6 billion people worldwide are deeply engaged with smartphone devices. This reach potential proffers unprecedented marketing opportunity. As marketers can send ads to smartphone users anywhere they are, marketing discipline now faces tremendous opportunities of coming up with new theory and industry practices for manager and consumer insights. Xueming will present some recent research findings from his Global center for big data in mobile analytics.

■ TA06

06-Room 306, Marriott

Systemic Risk

Sponsor: Financial Services

Sponsored Session

Chair: Stathis Tompaidis, Professor, University of Texas at Austin, Office of Financial Research, Austin, TX, 78712, United States of America, Stathis.Tompaidis@mcombs.utexas.edu

1 - Gauging form PF: Data Tolerances in Regulatory Reporting on Hedge Fund Risk Exposures

Phillip Monin, Researcher, Office of Financial Research, 717 14th St. NW, Washington, DC, 20005, United States of America, Phillip.Monin@treasury.gov, Mark Flood, Lina Bandyopadhyay

We examine the precision of Form PF as an instrument for measuring risk exposures in the hedge fund industry. Using a novel simulation methodology, we assess the measurement tolerances of Form PF by examining the distribution of actual portfolio risk exposures that are consistent with a fixed presentation on Form PF. We find that Form PF's measurement tolerances are sufficiently large to allow private funds with dissimilar actual risk profiles to report similar risks to regulators.

2 - Systemic Risk: The Dynamics under Central Clearing

Agostino Capponi, Columbia, Mudd 313, New York, NY, 10027, United States of America, ac3827@columbia.edu

We develop a tractable model for asset value processes of financial institutions trading with one central clearinghouse. Each institution allocates assets between his loan book and his clearinghouse account. We show that a unique equilibrium allocation profile arises when institutions adjust trading positions to hedge risks stemming from their loan books. The stochastic dynamic equilibrium path shows a buildup of systemic risk manifested through the increase of market concentration.

3 - Hidden Illiquidity with Multiple Central Counterparties

Kai Yuan, Columbia Business School, 3022 Broadway, 4J, Uris Hall, New York, United States of America, kyuan17@mail.gsb.columbia.edu, Paul Glasserman, Ciamac Moallemi

Convex margin requirements from CCPs create an incentive for a swaps dealer to split its positions across multiple CCPs, effectively "hiding" potential liquidation costs. To compensate, each CCP needs to set higher margin requirements than it would in isolation. In the case of linear price impact, we show that a necessary and sufficient condition for the existence of an equilibrium is that the two CCPs agree on liquidity costs and a difference in views can lead to a race to the bottom.

■ TA07

07-Room 307, Marriott

Pricing and Risk Modeling in Financial Engineering, Operations Research

Cluster: Risk Management

Invited Session

Chair: Hongzhong Zhang, Assistant Professor, Columbia University, 1255 Amsterdam Ave, New York, NY, 10027, United States of America, hz2244@columbia.edu

1 - Counterparty Risk in a Heterogenous Random Network Model

Stephan Sturm, Worcester Polytechnic Institute, ssturm@wpi.edu, Eric Schaanning

We discuss the consequences of the central clearing mandate for OTC derivatives. Analysing the expected total and potential future counterparty exposure in a heterogeneous random graph network allows us to analyse the consequences of central clearing in a realistic model calibrated to actual market data.

2 - On Minimizing Drawdown Risks of Lifetime Investments

Bin Li, University of Waterloo, 200 University Avenue West, M3 Building, Waterloo, Canada, b226li@uwaterloo.ca, David Landriault, Dongchen Li, Xinfu Chen

We study a lifetime investment problem to minimize the risk of occurrence of significant drawdowns. We examine two financial market models and closed-form optimal strategies are obtained. Our results show that it is optimal to minimize the portfolio variance when the fund value is at its historic high-water mark. When the fund value drops, the fund manager should increase the proportion invested in the asset with a higher instantaneous rate of return.

3 - Beating the Omega Clock: An Optimal Stopping Problem with Random Time-horizon

Hongzhong Zhang, Assistant Professor, Columbia University, 1255 Amsterdam Ave, New York, NY, 10027, United States of America, hz2244@columbia.edu, Neofytos Rodosthenous

We study the optimal stopping of a perpetual call option in a random time-horizon under exponential spectrally negative Levy models. The time-horizon is modeled as the so-called Omega default clock, which is the first time the occupation time of the underlying process below a level exceeds an independent exponential random variable. We show that the shape of the value function varies qualitatively with model parameters. In particular, we show the possibility of two disjoint continuation regions.

4 - Impact of Bayesian Learning and Externalities on Strategic Investment

Wenxin Xu, University of Illinois, Urbana IL 61801, United States of America, wxu9@illinois.edu

We investigate the interplay between learning effects and externalities in the problem of competitive investments with uncertain returns. We find a region of a war of attrition between the two firms in which the interplay between externalities and learning gives rise to counterintuitive effects on investment strategies and payoffs.

■ TA08

08-Room 308, Marriott

e-Business Models

Cluster: Business Model Innovation

Invited Session

Chair: Simone Marinesi, Wharton, 562 Jon M. Huntsman Hall, 3730 Walnut St, Philadelphia, PA, 19104, United States of America, marinesi@wharton.upenn.edu

1 - Online Grocery Retailing

Elena Belavina, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, United States of America, elena.belavina@chicagobooth.edu

Grocery delivery is a market that many try to conquer. Appropriate pricing is key for success. There is little consensus among different players (at times even within one firm operating in different locations) on what is the best pricing scheme. For example, Amazon Fresh in Seattle is using per order pricing while in San Francisco - subscription fee. We provide recommendation for the preferred pricing scheme based on various characteristics (delivery logistics, demand variability etc.).

2 - "If at First You Don't Succeed": Understanding Serial Entrepreneurs on Kickstarter

Hallie Cho, INSEAD, 1 Ayer Rajah Avenue, Singapore, Singapore, hallie.cho@insead.edu, David Clough

From the crowdfunding platform Kickstarter, we have data on 27,399 technology and design projects created by 6960 entrepreneurs—1376 of whom are serial entrepreneurs. We examine characteristics of the projects and the entrepreneurs to understand what distinguishes a serial entrepreneur from a one timer. For 779 of the serial entrepreneurs, their first projects were failures. We investigate how serial entrepreneurs respond to setbacks and how their resource gathering strategy changes over time.

3 - Wisdom or Madness? Comparing Crowds with Expert Evaluation in Funding the Arts

Ethan Mollick, Assistant Professor, U. Penn, 2000 Steinberg Hall-Dietrich Hall, 3620 Locust Walk, Philadelphia, PA, 19004, United States of America, emollick@wharton.upenn.edu, Ramana Nanda

Drawing on a panel of experts and data from the largest crowdfunding site, we examine funding decisions for proposed theater projects. We find significant agreement between the funding decisions of crowds and experts. Our findings suggest that crowdfunding can play a role in complementing expert decisions by allowing projects the option to receive multiple evaluations and thereby lowering the incidence of false negatives.

4 - Crowdsourcing Exploration

Yiangos Papanastasiou, Haas School of Business, UC Berkeley, Berkeley, CA, 94720, United States of America, yiangos@haas.berkeley.edu, Nicos Savva, Kostas Bimpikis

In an online review platform, information on the quality of alternative service providers is both generated and utilized by the consumer population. Inefficiencies arise from the fact that information is generated as a byproduct of self-interested consumer choices, rather than with the benefit of future consumers in mind. Within a multi-armed bandit framework, we study how such inefficiencies relate to alternative policies of information-disclosure to the platform's users.

■ TA09

09-Room 309, Marriott

Using Big Data Analytics for Technology Intelligence: Methods and Cases to Gather Intelligence on Technological Innovations

Sponsor: Technology, Innovation Management & Entrepreneurship
Sponsored Session

Chair: Tugrul Daim, Professor, Portland State University, P.O. Box 751, Portland, OR, 97201, United States of America, ji2td@pdx.edu

1 - Business Partner Recommendation Based on Machine Learning of Customer-Supplier Relationships

Yuya Kajikawa, Tokyo Institute of Technology, 3-3-6 Shibaura, Minato-ku, Tokyo, Japan, kajikawa@mot.titech.ac.jp, Naoko Matsuda, Yi Zuo

Business partnership is vital not only for business development but also information sharing and collaboration for innovation. In this work, we modeled customer-supplier relationships among firms using statistical learning model by support vector machine to support firms to find plausible business partners. The result showed prediction accuracy over 80% in average, but a variance was found between different sizes of firms. We discuss the mechanism determining the relationships.

2 - The Circle of Innovation

Fred Phillips, Distinguished Professor, Yuan Ze University, R60401, Building 6, No.135, Yuan-Tung Rd, Taoyuan, Taiwan - ROC, fred.phillips@stonybrook.edu

There is a high-level feedback between technological innovation and social change. Innovation brings about new products and services, and new ways of using them. These in turn lead to new ways to interact and organize. The new structures generate new unfilled needs, which are opportunities for still more innovation. This changes how we classify innovations, how we should analyze statistics, and our views of technology assessment, market segmentation, and product development for sustainability.

3 - Technology Assessment: Case of Robotics for Power Applications

Tugrul Daim, Professor, Portland State University, P.O. Box 751, Portland, OR, 97201, United States of America, ji2td@pdx.edu, Judith Estep

This paper presents an integration of data analytics methods and expert judgment quantification to evaluate multiple robotics technologies for the power utilities.

4 - Evaluating Technology Adoption in Emerging Regions: Case of Smart Phone in Saudi Arabia

Fahad Aldhaban, Portland State University, P.O. Box 751,
Portland, United States of America, aldhaban@gmail.com,
Tugrul Daim

This paper reviews the adoption factors of smart phones in emerging regions. Saudi Arabia is studied as a case study. This presentation will cover the qualitative part of the work. This part helped filter factors and finalize the survey instrument

■ TA10

10-Room 310, Marriott

Contextual Factors Affecting eBusiness Initiatives

Sponsor: E-Business

Sponsored Session

Chair: Frank MacCrory, Massachusetts Institute of Technology, MIT Initiative on the Digital Economy, 355 Main Street - NE25-768D, Cambridge, MA, 02142, United States of America, maccrory@mit.edu

1 - Social Media Usage Implications for Project Success, Political Preferences, and Leisure Activities

Joseph Vithayathil, Assistant Professor, Washington State University, Carson College of Business, Pullman, WA, 99164, United States of America, joseph.vithayathil@wsu.edu,
John Kalu Osiri, Majid Dadgar

We use a survey to empirically analyze the effect of social media usage on workplace project success, political preferences, and leisure activities such as shopping and television viewing behavior. This work adds to the emerging literature on the impact of social media. We find weak association of social media usage with project success, political preferences and leisure activities. Results are interpreted using social presence and media richness theories, and implications are discussed.

2 - Content Pricing Strategies under Dual Medium Access

Ran Zhang, UC Irvine, CA, ranz2@uci.edu, Shivendu Shivendu

Pricing information goods on physical and digital medium is a challenging question for content providers. We develop an analytical model where consumers are heterogeneous in both valuation for content and preference for medium. We show that while offering both bundle of mediums and digital medium is optimal under some market conditions, offering digital medium only is optimal under other conditions. The optimal price for digital medium can decrease with marginal cost of physical medium.

3 - Incentives for Selective Information Sharing

Aditya Saharia, Associate Professor, Gabelli School of Business - Fordham University, 113 W. 60th Street, New York, NY, 10023, United States of America, saharia@fordham.edu

An increased transparency in inter-organizational systems does not make members of a value chain equally better off. Individual members may then try to influence other members' decisions by introducing strategic ambiguity by not collect demand information or by selectively share information with only some downstream members.

■ TA11

11-Franklin 1, Marriott

Online Optimization with Integer Applications

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Virgile Galle, PhD Candidate, MIT, vgalle@mit.edu

1 - Real-time Revenue Management under Partially Learnable Demand

Dawson Hwang, PhD Candidate, MIT, 77 Massachusetts Avenue, 32-D678, Cambridge, MA, 02139, United States of America, dawson@mit.edu, Le Nguyen Hoang, Vahideh Manshadi, Patrick Jaillet

We study a real-time revenue management problem where stochastic information about the future demand is unknown a priori and can only be partially learned. We develop adaptive and non-adaptive booking-limit policies parameterized by predictability of the demand. In the two extreme cases of fully learnable and fully unpredictable demand, we recover the known performance guarantees. Our work bridges the gap between classical adversarial and stochastic demand models, and defines value of learning.

2 - Container Relocation Problem with Partial Information

Virgile Galle, PhD Candidate, MIT, Cambridge, MA, vgalle@mit.edu, Cynthia Barnhart, Setareh Borjian, Patrick Jaillet, Vahideh Manshadi

We introduce two new versions of the container relocation problem. First we suppose that container departure times are only partially known and propose an efficient branching algorithm using sampling and pruning to solve this problem. Moreover, the second variation assumes that none of the departure times are known in advance. In that case, we provide lower bounds to support the intuition that the "lowest-height" policy is optimal in both static and dynamic case

3 - Taxi Assignment: Offline and Data-driven Online Optimization

Sebastien Martin, PhD Candidate, MIT, Operations Research Center, MIT, 77 Mass Ave, Bldg E40-130, Cambridge, MA, United States of America, semartin@mit.edu, Dimitris Bertsimas, Patrick Jaillet

This research focuses on taxi routing and assignment to customers: we optimize the actions and revenues of a taxi fleet. We use MILPs and randomized algorithms to solve to optimality the full-information version of the problem where demand is known beforehand. Then, we extend these methods to make data-driven online decisions. We apply our methods on the Manhattan network using actual 2013 yellow cabs demand data.

4 - Online Packing in the Random Time Arrival Model

Le Nguyen Hoang, Postdoctoral Associate, MIT, 77 Massachusetts Ave, Cambridge, MA, 02139, United States of America, lenhoang@mit.edu, Dawson Hwang, Patrick Jaillet

Much interest has recently been given to online packing under a uniformly random permutation of request arrivals. We propose a more general and realistic setting, where, instead, requests arrive at random times. In particular, we do not assume the number of requests to be known ahead of time, and we allow for heterogeneity in the probability distributions of the random arrival times. We present different online algorithms and discuss their respective competitive ratios.

■ TA12

12-Franklin 2, Marriott

Convexification-based Algorithms for Solving Quadratic and Polynomial Programs

Sponsor: Optimization/Mixed Integer Nonlinear Optimization and Global Optimization

Sponsored Session

Chair: Jitamitra Desai, Professor, Nanyang Technological University, 50 Nanyang Avenue, Singapore, Singapore, jdesai@ntu.edu.sg

1 - Minimum Triangle Inequalities and Algorithms for 0-1 QCQPs

Jitamitra Desai, Professor, Nanyang Technological University, 50 Nanyang Avenue, Singapore, Singapore, jdesai@ntu.edu.sg, Xiaofei Qi, Rupaj Nayak

We present a new class of minimum triangle inequalities (MINTI) for 0-1 QCQPs. We prove that these inequalities are superior to the traditionally used triangle inequalities, and offer several variations of these new cutting planes. We also present an improved branch-and-bound algorithm that incorporates certain properties from the MINTI cuts, and prove the efficacy of these cuts via our computational results.

2 - Non-negative Polynomial and Moment Conic Optimization

Mohammad Mehdi Ranjbar, Rutgers, 100 Rockefeller Rd, Rutgers Business School, Piscataway, NJ, 08854, United States of America, 59ranjbar@gmail.com, Farid Alizadeh

Non-negative polynomial cone and its dual, moment cone, are non-symmetric cones and extremely bad scaled. Then common primal-dual method will not be a good algorithm to be used. Recently Nesterov has proposed a new predictor-corrector path-following method. Skajaa-Ye have proposed a Homogeneous interior point method using Nesterov's predictor-corrector path-following method for some non-symmetric conic problem. We will extend that to non-negative polynomial and moment conic programming.

3 - Robust Sensitivity Analysis of the Optimal Value of Linear Programming

Guanglin Xu, PhD Student, University of Iowa, 321 Finkbine Ln Apt. 11, Iowa City, IA, United States of America, guanglin-xu@uiowa.edu, Samuel Burer

We study sensitivity analysis in linear programming problems where general perturbations in the objective coefficients and right-hand sides are considered. This generality leads to non-convex quadratic programs (QPs) that are difficult to solve in general. We investigate copositive formulations and tight semi-definite relaxations of these QPs and validate our approach on examples existing in the literature, as well as our own examples.

4 - Higher Rank-Order Semidefinite Cutting Planes for Nonconvex QCQPs

Xiaofei Qi, PhD Student, Nanyang Technological University,
50 Nanyang Ave, Singapore, Singapore, xqi001@e.ntu.edu.sg,
Jitamitra Desai, Rupaj Nayak

We introduce a polynomial-time scheme to generate higher rank-order semidefinite cutting planes that serve to tighten convex relaxations of nonconvex quadratically constrained quadratic programs (QCQPs) and significantly improve lower bounds. Suitably defined row-and-column based operations are used to speed up the process of generating these cuts, and computational comparisons across different types of relaxations shows the efficacy of these new cutting plane strategies.

■ TA13

13-Franklin 3, Marriott

Optimizing Sharing Service/Economy Under Uncertainty

Sponsor: Optimization/Optimization Under Uncertainty
Sponsored Session

Chair: Siqian Shen, Assistant Professor, University of Michigan,
1205 Beal Avenue, Ann Arbor, MI, 48105, United States of America,
siqian@umich.edu

1 - Optimal Location Design of Carsharing Fleet under Uncertain One-way and Round-trip Demands

Zhihao Chen, czhihao@umich.edu, Siqian Shen

We allocate vehicles in a homogeneous carshare fleet to contracted locations, to maximize the expected revenue from random demand for one-way and round trip rentals. We use a spatial-temporal network and optimize both risk-neutral and CVaR-based risk-averse two-stage stochastic programs with high demand satisfaction rates. The two-stage problems are solved via branch-and-cut with mixed integer rounding and we give insights on carsharing location design from data reported by Zipcar in Boston.

2 - Online Resource Allocation with Limited Flexibility

Xuan Wang, New York University, 44 West 4th Street,
Suite 8-154, New York, NY, 10012, United States of America,
xwang3@stern.nyu.edu, Jiawei Zhang, Arash Asadpour

We consider a general class of online resource allocation problems with limited flexibility, where a type j request can be fulfilled by resource j or resource $j+1$, and we call this limited flexibility the long chain pattern. The long chain has been studied in process flexibility and has been shown to be very effective in coping with demand uncertainty under offline arrivals. We provide preliminary results that show the effectiveness of the long chain when the arrivals are online.

3 - On-demand Staffing: Incentive Wage Contracts with Guaranteed Fill Rates

Zhichao Zheng, Singapore Management University, Lee Kong
China School of Business, 50 Stamford Road, Singapore, 178899,
Singapore, danielzheng@smu.edu.sg, Tao Lu, Yuanguang Zhong

We study the on-demand economy and its impact on labor market efficiency. We consider n employers with uncertain and time-varying demands, and a platform operator providing on-demand staffing services. We propose a novel fill rate-based allocation policy enabling the on-demand workforce to be shared efficiently among employers. We propose a form of incentive contracts based on fill rate guarantees, and show that our contracts can induce the system-wise optimality in decentralized systems.

■ TA14

14-Franklin 4, Marriott

Data-driven Optimization

Sponsor: Optimization/Optimization Under Uncertainty
Sponsored Session

Chair: Gah-Yi Vahn, Assistant Professor, London Business School,
Sussex Place, Regent's Park, London, NW1 4SA, United Kingdom,
gvahn@london.edu

1 - Data-driven Estimation of (s, S) Policy

Gah-Yi Vahn, Assistant Professor, London Business School,
Sussex Place, Regent's Park, London, NW1 4SA, United Kingdom,
gvahn@london.edu

I derive a tractable algorithm for computing the optimal (s,S) policy when the decision maker has access to historical demand data. I show that this scheme yields asymptotically optimal (s, S) policy and derive analytical characterisations of confidence intervals, which is useful for operational decision-making.

2 - Near Optimal Ambiguity Sets in Distributionally Robust Optimization

Vishal Gupta, Assistant Professor, USC Marshall School of
Business, 3670 Trousdale Parkway, Bridge Hall 401 G,
Los Angeles, CA, 90089-0809, United States of America,
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We assess the strengths of data-driven ambiguity sets in distributionally robust optimization (DRO) by bounding the relative size of a candidate set to a specific, asymptotically optimal set. We find popular ambiguity sets are much larger than this asymptotically optimal set, suggesting current DRO models are overly conservative. We propose new “near-optimal” sets that are only a constant factor larger than the optimal set and satisfy the usual robustness properties.

3 - A Time Based Choice Model

Tauhid Zaman, MIT Sloan School of Management, 50 Memorial
Drive, Cambridge, MA, 02139, United States of America,
zlisto@mit.edu

We present a choice model which incorporates the time it takes the user to make a decision. Our model assumes that the further apart two items are in terms of user preference, the faster a decision is made. We conduct a set of online polls and find that this model captures actual human behavior. We also show that using this time based choice model can learn user preferences with high accuracy than standard choice models for a fixed sample size.

■ TA15

15-Franklin 5, Marriott

Patient Scheduling in Health Care

Sponsor: Optimization in Healthcare
Sponsored Session

Chair: Joseph Milner, Associate Professor Of Operations Management,
Rotman School of Management, University of Toronto,
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Joseph.Milner@Rotman.Utoronto.Ca

1 - Dynamic Patient Scheduling for Multi-Appointment Health Care Programs

Adam Diamant, Assistant Professor Of Operations Management,
Schulich School of Business, York University,
111 Ian Macdonald Boulevard, Toronto, ON, M3J1P3, Canada,
adiamant@schulich.yorku.ca, Faye Quereshey, Joseph Milner

We investigate the scheduling practices of a multidisciplinary, multistage, outpatient health care program with no-shows. We formulate the problem as a Markov Decision Process and use approximate dynamic programming to find policies to schedule patients to appointments. We examine the quality of our solutions via structural results and compare them to a simulation of the clinic. Our results applied to the operation of a bariatric surgery program at a large tertiary hospital in Toronto, Canada.

2 - Flexible Hospital-wide Patient Scheduling

Daniel Gartner, Carnegie Mellon University, 5000 Forbes Avenue,
Pittsburgh, PA, 15213, United States of America,
dgartner@andrew.cmu.edu, Rema Padman

We study a patient scheduling problem with admission decisions, clinical pathways, day and overnight hospital resources, ward and surgical team assignment flexibility, and overtime considerations. We model the problem using Mixed-Integer Programming and embed it in a rolling horizon planning to take into account uncertain recovery times of and remaining resource capacity for patients. We analyze the impact of flexibility and uncertainty on several metrics.

3 - Coordinated Scheduling for a Multi-station Healthcare Network

Ester Dongyang Wang, PhD Candidate, University of Texas, IROM
Dept., Austin, TX, United States of America, wdy@utexas.edu,
Douglas Morrice, Kumar Muthuraman

As the population ages, our healthcare industry must face the challenge of increasing demand for care under constrained budget and resources. Our research focuses on one of the central factors to the success of healthcare reform-outpatient appointment scheduling. We develop a mechanism that coordinates appointment scheduling among multiple services in a healthcare network to improve access of care and reduce patient no-show rate. Our approach has the potential to yield a global optimal solution.

4 - Appointment Scheduling and Walk-in Strategies with Unpunctual Patients

Mohamad Soltani, University of Alberta, PhD Office, Business
Building,, University of Alberta, Edmonton, AB, T6G 2R3,
Canada, soltani@ualberta.ca, Michele Samorani

It is commonly believed that clinics that schedule appointments have lower patients' waiting time and providers' overtime than clinics that only allow walk-ins. However, if we consider patient unpunctuality, walk-in-only clinics may achieve a higher performance. In this research, we investigate the conditions under which each strategy is preferable.

■ TA16

16-Franklin 6, Marriott

Disjunctive Conic and Optimization Problems

Sponsor: Optimization/Linear and Conic Optimization

Sponsored Session

Chair: Julio Goetz, Postdoctoral Fellow, Ecole Polytechnique Montreal and GERAD, 2900 Boulevard Edouard-Montpetit, Montréal, QC, H3T 1J4, Canada, jgoetz1@gmail.com

1 - A Generalized Trust Region Subproblem with Hollows and Non-Intersecting Linear Constraints

Boshi Yang, The University of Iowa, 14 MacLean Hall, Iowa City, IA, 52242, United States of America, boshi-yang@uiowa.edu, Samuel Burer, Kurt Anstreicher

We study an extended trust region subproblem (eTRS) in which a nonconvex quadratic function is minimized over a structured nonconvex feasible region: the unit ball with r hollows (or holes) and m linear cuts. Under some non-intersecting assumptions, when $r = 0$ or when $r = 1$ and $m = 0$, it is known that the eTRS has a tight, polynomial-time solvable conic relaxation. We show that the conic relaxation is also tight for general r and m precisely when some non-intersecting assumptions are satisfied.

2 - On Disjunctive Conic Cuts: When They Exist, When They Cut?

Mohammad Shahabsafa, Lehigh University, 14 Duh Dr, Apt. 221, Bethlehem, PA, 18015, United States of America, mos313@lehigh.edu

The development of Disjunctive Conic Cuts (DCCs) for MISOCO problems has recently gained significant interest in the optimization community. Identification of cases when DCCs are not existing, or not useful, saves computational time. In this study, we explore cases where either the DCC methodology does not derive a DCC which is cutting off the feasible region, or a DCC does not exist. Among others, we show that deriving DCCs directly for p -order cone optimization problems seems to be impossible.

3 - Disjunctive Conic and Cylindrical Cut Management Strategies for Portfolio Optimization Problems

Sertalp Cay, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, sec312@lehigh.edu, Tamás Terlaky, Julio Goetz

Disjunctive conic and cylindrical cuts lead significant positive impact while solving Mixed Integer Second Order Cone Optimization (MISOCO) problems. The decision for adding and removing these cuts should take depth of the cut and structure of the problem into consideration. In this study, we explore strategies to apply these novel cuts to discrete portfolio optimization problems within a Branch-and-Conic-Cut software package. Preliminary results are provided to compare these strategies.

4 - Novel Family of Cuts for SDP Relaxations for Some Classes of Combinatorial Problems

Elspeth Adams, elspeth.adams@polymtl.ca, Miguel Anjos

k -projection polytope constraints (kPPCs) are a family of constraints that tighten SDP relaxations using the inner description of small polytopes, as opposed to the typical facet description. We examine the properties of kPPCs, methods for separating violated kPPCs and their impact on the bounds in a cutting plane framework. Problems satisfying the required projection property, such as the max-cut and stable set problems, will be considered and results will focus on large instances.

■ TA17

17-Franklin 7, Marriott

Network Resilience and Applications

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Konstantin Pavlikov, University of Florida, 1350 N. Poquito Road, Shalimar, FL, 32579, United States of America, kpavlikov@ufl.edu

1 - Resilient and Structurally Controllable Supply Networks under Disruptions

Amirhossein Khosrojerdi, The University of Oklahoma, 202 West Boyd Street, Suite 218, Norman, OK, 73071, United States of America, akhosrojerdi@ou.edu, Farrokh Mistree, Janet K. Allen, Krishnaiyan Thulsiraman

A resilient supply network is one that has the ability to recover quickly from disruptions and ensure customers are minimally affected. Designing the structure of supply networks to be controllable is a way toward resilience. A three-stage method is proposed to design a resilient and controllable supply network under structural disruptions. The method is exercised using an example from the

petroleum industry.

2 - Embedding Resilience on Logistic and Supply Chain Networks

Jose Santivanez, Associate Professor, Universidad del Turabo, P.O. Box 3030, Gurabo, PR, 00778, Puerto Rico, santivanezj@suagm.edu, Emanuel Melachrinoudis

This paper develops models for improving resilience to disruptions on critical infrastructures such as logistics and supply chain networks through locational, coverage, and path selection decisions. Network resilience is measured by the ratio of the delivered amount of service over the total requested service when a propagating disruption occurs. Availability of service depends on the capability of the network to establish connectivity between service facilities and customers.

3 - Improving Supply Chain Network Resiliency with Preferential Growth Decision Making

Ashley Skeete, PhD Fellow, Western New England University, 1215 Wilbraham Road, Springfield, MA, 01119, United States of America, ashley.skeete@wne.edu, Julie Drzymalski

Network resiliency is the ability to maintain operations and connectedness under the loss of some structures or functions. This research develops decision making techniques in the supply chain context to improve resiliency of existing supply chain networks as they grow with time. Consideration is given to factors such as network topology, production requirements, the presence of redundancies and cost.

4 - Hub Location-allocation for Combined Fixed-wireless and Wireline Broadband Access

Ramesh Bollapragada, Professor, College of Business, San Francisco State University, 1600 Holloway Avenue, San Francisco, CA, 94132, United States of America, rameshb@sfsu.edu, Uday Rao, Min Li, Junying Wu

This paper studies a telecommunications hub location model that includes the classical capacitated facility location problem on a wireline network, as well as a wireless network with technological as well as capacity constraints. There are multiple wireline and wireless hub types, differing in costs and capacities. We present a mathematical model to maximize network profit, build and test a quick greedy heuristic with the optimal, and conduct sensitivity analysis using representative data.

■ TA18

18-Franklin 8, Marriott

Scientometric Data Analytics

Cluster: Modeling and Methodologies in Big Data

Invited Session

Chair: Dohyun Kim, Myongji University, Yongin, Korea, Republic of, norman.kim@gmail.com

1 - Ranking Outliers in Patent Citation Network using Attributes and Graph Structure

Ali Tosyali, Rutgers, the State University of New Jersey, Dept. of ISE 96 Frelinghuysen Road, CoRE Building, Room 201, Piscataway, NJ, United States of America, alitosyali4778@gmail.com, Byunghoon Kim, Jeongsub Choi, Byoung-yul Coh, Jae-min Lee, Myong K (MK) Jeong, Andrew Rodriguez

Being able to rank patents in outlieriness is a crucial task for patent analysis. In the past, existing general outlier ranking methods have been applied to patent data. In this work, we propose a new outlier ranking method developed especially for patents in attributed patent citation network. We utilized both graph structure and attributes to rank outlier patents in patent citation network.

2 - Scientometric Analysis of Carbon Capture and Storage Research

Faezeh Karimi, Dr, University of Sydney, Project Management, Sydney, 2006, Australia, faezech.karimi@sydney.edu.au, Rajab Khalilpour

This study investigates the evolutionary trends of the international collaborations among the research community of carbon capture and storage (CCS) by looking at the collaboration network of countries publishing on CCS. The study elaborates how both international collaboration network and knowledge structure of the field have notably developed and interlinked over the years especially after 2005 during which almost 94% of the publications appeared.

3 - Keyword Hierarchy Detection using Keyword Network Analysis

Dohyun Kim, Myongji University, Yongin, Korea, Republic of, norman.kim@gmail.com, We Shim, Oh-jin Kwon, June Young Lee, Sejung Ahn

We developed a keyword hierarchy detection algorithm using the keyword network. Using the detection method, the hierarchy of keywords collected from the same semantic field may be built. The keyword hierarchy detection method can be used for a automatic preprocessing step to refine keywords in various topic modeling methods.

4 - Integrated Variable Importance Assessment in Multi-stage Manufacturing Processes

Gianluca Gazzola, Rutgers Center for Operations Research,
100 Rockefeller Road, Piscataway, NJ, 08854, United States of
America, ggazzola@scarletmail.rutgers.edu, Jeongsub Choi,
Myong K (MK) Jeong, Byunghoon Kim

We introduce a method for the assessment of variable importance in manufacturing processes characterized by a hierarchy of technical relationships between stage variables. Regression models of direct technical relationships and a novel permutation measure are employed to quantify the local contribution of every variable. Global contributions are finally obtained by integrating these local assessments, based on the overall structure of indirect and direct technical relationships in the process.

■ TA19

19-Franklin 9, Marriott

Computational Integer Optimization

Sponsor: Computing Society

Sponsored Session

Chair: Yan Xu, Director, SAS, 100 SAS Campus Dr., Cary, NC,
United States of America, yan.xu@sas.com

1 - Recent Advances in the FICO Xpress MIP Solver

Michael Perregaard, Xpress Team, FICO, International Square,
Starley Way, Birmingham, B37 7GN, United Kingdom,
MichaelPerregaard@fico.com

We will present some of the recent MIP advances in the FICO Xpress solver, with an emphasis on how it is able to exploit the ever increasing core counts of modern CPUs.

2 - The SAS MILP Solver: Current Status and Future Developments

Philipp Christophel, SAS Institute Inc., 100 SAS Campus Dr.,
Cary, NC, 27607, United States of America,
Philipp.Christophel@sas.com, Menal Guzelsoy, Imre Polik,
Amar Narisetty

We give an overview of the current status of the SAS mixed integer linear programming (MILP) solver that is part of the SAS/OR product. The focus will be on describing recent implementation efforts for the MILP presolver as well as future development directions.

3 - Performance Improvements and New Features in the Gurobi Optimizer

Chris Maes, Senior Developer, Gurobi Optimization, Inc., 125
Beacon St, Apt. #4, Boston, MA, 02116, United States of America,
maes@gurobi.com

This talk will cover the latest developments in the Gurobi Optimizer. We'll discuss the new Gurobi Cloud, which makes it easy to launch one or more Gurobi machines when you need them. We'll also talk about our upcoming release, which includes significant performance enhancements and several new features.

4 - CPLEX Keeps Getting Better

Andrea Tramontani, CPLEX Optimization, IBM Italy, Via Martin
Luther King 38/2, Bologna, Italy, andrea.tramontani@it.ibm.com

We present some of the new features and algorithmic techniques that have been recently added to IBM ILOG CPLEX Optimizer, and we give detailed benchmark results that demonstrate the performance improvements achieved in latest CPLEX versions.

■ TA20

20-Franklin 10, Marriott

Cloud Services and Applications

Cluster: Cloud Computing

Invited Session

Chair: Grace Lin, Data Analytic Technology and Applications (DATA),
Data Analytic Technology and Applications (DATA), Taipei, Taiwan -
ROC, gracelin@iii.org.tw

1 - Revealing Power Structures through Novel Biclustering Approaches

Sabine Baumann, Professor Dr., Jade University, College of
Mgmt, Info., Tech., Friedrich-Paffrath-Str. 101, Wilhelmshaven,
22880, Germany, sabine.baumann@jade-hs.de, Oliver Eulenstein,
Christoph Wunck

Cloud and big data provide unprecedented access to massive interaction networks of people and organizations. However, exploring such rich data environments encounters equally extensive challenges: unreliable, incomplete or distorted

information, or computational limitations. We recover missing interactions from vast corporate networks using novel biclique clustering techniques to detect the most significant edges, and hence provide new insights into power structures.

2 - Running Your Optimization Model on the Cloud with the IBM CPLEX Studio IDE

Frederic Delhoume, Software Engineer, IBM, 9 Rue de Verdun,
Gentilly, 94253, France, delhoume@fr.ibm.com

We will show how to easily run optimization models from the IBM CPLEX Studio IDE. We will also demonstrate how to monitor the cloud service and get local results from the remote optimization service. A REST API way of running models on the cloud will be shown.

■ TA21

21-Franklin 11, Marriott

Medical Decision Making in Cancer Care

Sponsor: Health Applications

Sponsored Session

Chair: Christine Barnett, University of Michigan, 1205 Beal Ave.,
Ann Arbor, MI, United States of America, clbarnet@umich.edu

1 - Predictive Modeling for Optimal Design of Cancer Detection Protocols

Selin Merdan, University of Michigan, 1205 Beal Avenue,
Ann Arbor, MI, 48109, United States of America,
smerdan@umich.edu, Brian Denton

Diagnosis of chronic diseases often involves expensive and invasive tests and procedures. Predictive models can play an important role in determining the optimal diagnostic protocol based on individual patient risk factors. We discuss an approach for developing predictive models using clinical observational data that suffers from common sources of bias such as low disease prevalence and missing data. We illustrate the use of these models for optimization of prostate cancer diagnostic protocols.

2 - Model-based Calibration for Natural History Modeling

Jing Voon Chen, University of Southern California, Epstein Dept
of Indus & Sys Eng, Los Angeles, CA, United States of America,
jingvooc@usc.edu, Julie Hagle

A natural history (NH) model often requires calibration of unobservable model parameters to fit observed data. Uncertainty in the data and in the calibrated parameters impacts confidence in the optimal decision. We propose a method for model-based calibration that is resilient to these uncertainties, especially for comparative analyses of disease screening or treatment strategies. Illustrative examples and sensitivity analyses will be discussed.

3 - Assessment of Individualized Human Papillomavirus (HPV) Vaccination Strategies

Fan Wang, University of Arkansas, 4207 Bell Engineering Center,
Fayetteville, AR, United States of America,
fxw005@email.uark.edu, Shengfan Zhang

The human papillomavirus (HPV) is the most common sexually transmitted virus in the U.S. To prevent multiple cancers attributable to the HPV, HPV vaccine is recommended for preteens and teens who have not been exposed to HPV. We develop a simulation model for the optimal design of personalized HPV vaccination program, which incorporates multiple social-behavioral and demographic risk factors. The efficacy of the HPV vaccination program is evaluated in terms of the HPV-related health outcomes.

4 - Tailoring CRC Screening Strategy for Different Age- and Gender-specific Population Subgroups

Carolina Vivas, Purdue University, West Lafayette, IN 47906,
United States of America, cvivas@purdue.edu, Nan Kong, Robert
Klein, Thomas Imperiale

Standard guidelines for colorectal cancer (CRC) strategies do not consider different age- and gender-specific subgroups for tailored screening recommendations. Recent evidence suggests that men tend to face a higher risk of developing advance adenomas earlier than women. We apply Design of Experiments techniques to quantify the risk differences on CRC disease progression. Model based cost-effectiveness analyses of various screening strategies are conducted for different population subgroups.

■ TA22

22-Franklin 12, Marriott

Two-Sided Matching Markets

Sponsor: Applied Probability

Sponsored Session

Chair: Peng Shi, MIT Operations Research Center, 1 Amherst Street, E40-149, Cambridge, MA, 02139, United States of America, pengshi@mit.edu

Co-Chair: Yash Kanoria, Assistant Professor, Columbia University, New York, United States of America, ykanoria@columbia.edu

Co-Chair: Itai Ashlagi, MIT, 100 Main St, Cambridge, MA, 02139, United States of America, iashlagi@mit.edu

1 - On the Efficiency of Stable Matchings in Large Markets

Sangmok Lee, Univ of Pennsylvania, 3718 Locust Walk, Philadelphia, PA, United States of America, sangmok@sas.upenn.edu, Leeat Yariv

We study the wedge between stability and efficiency in large one-to-one matching markets. We show stable matchings are efficient asymptotically for a large class of preferences. In these environments, stability remains an appealing objective even on efficiency grounds, and monetary transfers are not necessary for efficiency purposes. Nonetheless, for severely imbalanced markets, when preferences entail sufficient idiosyncrasies, stable outcomes may be inefficient even asymptotically.

2 - Short Lists in Centralized Clearinghouses

Nick Arnosti, Stanford University, Stanford, CA, United States of America, narnosti@stanford.edu

In the presence of frictions, participants in centralized clearinghouses generally fail to list all acceptable match partners. As a consequence, mutually acceptable pairs are left unmatched. The number of unmatched agents (and the happiness of matched agents) depends crucially on the structure of correlations in participants' preferences. This work identifies a fundamental tradeoff between match quality and quantity, and uses this to offer guidance for the design of school choice mechanisms.

3 - How Much Choice is There in Two-sided Matching Markets?

Itai Ashlagi, MIT, 100 Main St, Cambridge, MA, 02139, United States of America, iashlagi@mit.edu

We study the structure of two-sided random matching markets with tiers. Our results provide insights on the amount of choice agents have in the core.

■ TA23

23-Franklin 13, Marriott

Asymptotic Optimality in Processing Networks

Sponsor: Applied Probability

Sponsored Session

Chair: Itai Gurvich, Professor, Kellogg School of Management, Northwestern, 2001 Sheridan Rd., Evanston, IL, 60201, United States of America, i-gurvich@kellogg.northwestern.edu

1 - Approximations to Non-stationary Diffusion Processes

Harsha Honnappa, Purdue University, West Lafayette, IN, United States of America, honnappa@purdue.edu, Peter Glynn

Non-stationary diffusion processes emerge as limits to time inhomogeneous queueing processes in appropriately defined 'high intensity' regimes. In general, however, the transition densities of non-stationary diffusion processes are not known in closed form. Thus, in this talk, we present analytical approximations to expectations of these diffusion processes. This is joint work with Peter Glynn.

2 - On the Control of Fork-join Networks

Erhun Ozkan, University of Southern California, Marshall School of Business, Los Angeles, CA, 90089, United States of America, eoarkan@usc.edu, Amy Ward

We study a prototypical fork-join network with two job classes and a shared server that processes both job types. We show that a cmu-type static priority policy is asymptotically optimal when the shared server is in some sense slow at processing the more expensive jobs. Otherwise, a state-dependent slow departure pacing control, under which the shared server sometimes gives priority to the less expensive jobs, is asymptotically optimal.

3 - Insensitivity and Optimality of Load Balancing with Processor Sharing Servers

Varun Gupta, Varun.Gupta@chicagobooth.edu, Neil Walton

We present some recent results and ongoing work on near-optimality and insensitivity properties of shortest queue load balancing under a carefully

constructed many-servers asymptotic regime, when all the servers use the Processor Sharing scheduling rule.

4 - Capacity of Information Processing Systems

Kuang Xu, Stanford University, United States of America, kuangxu@stanford.edu, Laurent Massoulié

We study an information processing system where jobs are to be inspected by a set of experts. Inspections produce noisy results depending on the jobs' hidden labels and the expert types, and an inspection occupies an expert for one time unit. The manager's objective is to assign inspections so as to uncover the jobs' hidden labels, using a minimum number of experts. Our main result is an asymptotically optimal inspection policy as the probability of error tends to zero.

■ TA24

24-Room 401, Marriott

Intelligent Heuristics and Systems

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Sam Thangiah, Professor/director, Slippery Rock University, Artificial Intelligence and Robotics Lab, 250 ATS, Slippery Rock, PA, 16057, United States of America, sam.thangiah@sru.edu

1 - A New Mathematical Model for Pattern Recognition in the Context of Feed Forward Neural Networks

Sam Findler, Slippery Rock University, 510 Campus Side Cir, Slippery Rock, PA, 16057, United States of America, srf5132@gmail.com

This paper sets out a new mathematical model for pattern recognition—in the form of what I call Pattern Recognition Circuits (PRCs) and Pattern Recognition Automata (PRAs). These new forms are given formal definitions and some preliminary theorems are proven. Next, the model is applied to feed forward neural networks, providing experimental grounding for the theory. Finally, the place of this new mathematical model in the context of general computational theory is discussed.

2 - Automatic Construction of Relational Features with Dataconda

Michele Samorani, Assistant Professor, University of Alberta, 3-20F Business Building, University of Alberta, Edmonton, AB, T6G 2R6, Canada, samorani@ualberta.ca

Traditional data mining and statistical techniques require a single table as input; by contrast, I tackle the problem of findings patterns in a set of related tables (Customers, Purchases, etc). This is made possible by Dataconda, a software freely available to academics which automatically generates a large number of features using information from all tables. In this talk, I will illustrate the benefits of this approach through an example in retailing.

3 - Massively Parallel GPU Accelerated Genetic Algorithm for Optimal Task Mapping in HPC Applications

Ramanan Sankaran, Computational Scientist, Oak Ridge National Laboratory, P.O. Box 2008 MS 6008, Oak Ridge, TN, 37831, United States of America, sankaranr@ornl.gov

Parallel applications on high performance computing (HPC) systems require network and topology aware task placement to ensure performance and scalability. We present a genetic algorithm for the quadratic assignment problem (QAP) that utilizes thousands of GPU accelerated compute nodes allocated for the application to compute an optimal task mapping in a few seconds. We show its convergence characteristics and impact on real life physics simulations on Titan, the most capable HPC system in the US.

4 - A Nao Humanoid Robot System for Interacting with Autistic Children

Sam Thangiah, Professor/director, Slippery Rock University, Artificial Intelligence and Robotics Lab, 250 ATS, Slippery Rock, PA, 16057, United States of America, sam.thangiah@sru.edu, Daniel Martin, Michael Parnes, Mike Monfore, Stephen Fulton, Zachary Kearney, Brian Atwell, Justin Cather, Andrew Rindt, Sam Findler

The NAO humanoid robot is a two feet tall robot with two hands and two feet with 25 degrees of freedom, cameras, microphones, sonar, infra-red and tactile and pressure sensors. It has various communication devices and an Intel ATOM processor. We describe a system implemented using the NAO robot to interact with autistic children. The system is designed to interact with autistic children in skill levels ranging from social to communication.

■ TA25

25-Room 402, Marriott

Online Information Intermediaries

Sponsor: Information Systems

Sponsored Session

Chair: Animesh Animesh, Associate Professor, McGill University, 1001 Rue Sherbrooke Ouest, Montreal, QC, H3A1G5, Canada, animesh.animesh@mcgill.ca

1 - First-mover Advantage in Online Review Platform

Qianran Jin, McGill University, 1001 Sherbrooke Street West, Montreal, Canada, qianran.jin@mail.mcgill.ca, Animesh Animesh, Alain Pinsonneault

While first-mover advantage has been widely studied at firm-level, our research focuses on individual-level first-mover advantage in online review platform. We study whether early reviews receive higher proportion of helpful votes than later reviews. Our preliminary results show that early reviews are perceived to be more helpful than later reviews. The first-mover advantage is greater for high frequency reviewer than low frequency reviewer.

2 - What Makes Geeks Tick? A Study of Stack Overflow Careers

Lei Xu, McGill University, 855 Sherbrooke Street West, Montreal, Canada, lei.xu2@mail.mcgill.ca, Tingting Nian, Luis Cabral

The success of a platform depends crucially on a thorough understanding of motivations behind user participation. The identification has always been a challenging task. We use a revealed preference approach to show that career concerns play an important role in user contributions to Stack Overflow, the largest online programming community. We show that career concerns explain 16% drop in answers activity after a job change. Robustness tests are conducted to tease out alternative explanations.

3 - The Dynamics of Online Referral Channels and E-commerce Website Performance

Wenjing Duan, Associate Professor, The George Washington University, 2201 G Street, NW, Washington, DC, 20052, United States of America, wduan@gwu.edu, Jie Zhang

This study investigates the dynamic relationship between three referral channels — search engine, social media, and third-party advertising — and e-commerce website performance. Our results derived from vector autoregressive models suggest a significantly differential predictive relationship between referrals from the three channels and sales performance measures.

4 - The Interactions Between Herding and Social Media Word-of-Mouth: Evidence from Groupon

Xitong Li, Dr., HEC Paris, 1 Rue de la Liberation, Batiment V, 2eme etage, Bureau 207, Jouy-en-Josas, 78351, France, lix@hec.fr, Lynn Wu

This study aims to test if there is any complementary interaction between herding and social media WOM. Using a panel data set from Groupon.com, we show they reinforce each other in driving product sales. To explore the underlying mechanisms behind the complementarities, we find the herding effect is more salient for experience goods than for search goods, but the effect of Facebook-mediated WOM does not significantly differ between the two product categories.

■ TA26

26-Room 403, Marriott

Optimal Sourcing, Procurement Design, and Eco-label System in Supply Chain Management

Cluster: Operations/Marketing Interface

Invited Session

Chair: Xiang Fang, Associate Professor, University of Wisconsin-Milwaukee, 3202 N Maryland Avenue, Milwaukee, WI, 53211, United States of America, fangx@uwm.edu

Co-Chair: He Huang, Professor, Chongqing University, School of Economics and Business Admin., Chongqing, China, huanghe@cqu.edu.cn

1 - Eco-label System Impact on Market Share and Profit

Yu Xia, Associate Professor, Northeastern University, 214 Hayden Hall, 360 Huntington Ave, Boston, MA, 02115, United States of America, Y.Xia@neu.edu, Xu Yang, Shilei Yang

This research works on the design of the eco-label and its impact on market share and profit for the company that adopts the eco-label system. To design an eco-label system, we need to determine number of levels of labels to structure and the index standard of each level. The gaps between levels should be significant enough to promote effort in producing greener product. In addition, reaching a higher level will bring additional business benefit such as profit for the engaged manufacturers.

2 - Dynamic Supply Risk Management with Multisourcing, Discretionary Selling, and Signal-based Forecast

Ting Luo, University of Texas at Dallas, 800 W Campbell Rd, Richardson, TX, 75080, United States of America, ting.luo@utdallas.edu, Long Gao, Nan Yang, Renyu Zhang

We study a firm's procurement and selling decisions in a multiclass demand and multisupplier inventory system. The optimal procurement is driven by multisourcing and intertemporal substitution and optimal selling is driven by customer segmentation and intertemporal rationing; they are synchronized with dynamic forecast for adaptive and resilient risk mitigation. We examine the critical role of advance supply signals and understand when and how to use them.

3 - Optimal Procurement Design for a National Brand Supplier in the Presence of Store Brand

Xinyan Cao, PhD Student, University of Wisconsin - Milwaukee, 3202 N Maryland Avenue, Milwaukee, WI, 53202, United States of America, xinyan@uwm.edu, Xiang Fang

We consider a supply chain consisting of a national brand supplier and a retailer which intends to develop its own store brand. We develop a game-theoretic framework to analyze the strategic interaction between the two players in the presence of asymmetric information.

4 - Duopolistic Procurement Contracts with Horizontal Information Asymmetry

Hongyan Xu, Professor, Chongqing University, School of Econ. and Bus. Administration, Chongqing, China, xuhongyan@cqu.edu.cn, Yu Tang, He Huang

We formulate a Cournot competition model of two chains where suppliers possess private information of reliability and manufacturers may or may not share cost information with the opponent. This paper under various scenarios aims to examine the contract design and the interplay of horizontal information asymmetry and vertical information asymmetry.

■ TA27

27-Room 404, Marriott

Application-motivated Theories and Methods for Multiobjective Optimization

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Margaret Wiecek, Department of Mathematical Sciences, Clemson University, Clemson, SC, 29634, United States of America, wmalgor@clemson.edu

1 - Preference Preservation in Inverse Multi-objective Convex Optimization

Taewoo Lee, University of Toronto, 5 King's College Road, Toronto, Canada, taewoo.lee@mail.utoronto.ca, Timothy Chan

We present a new inverse optimization model for convex multi-objective optimization that accommodates any input solution and determines a nonzero weight vector that preserves the original preference of the decision maker who generated the solution. We demonstrate how a linear approximation to the model and a successive linear programming algorithm can trade-off between preference preservation and computational efficiency, using data from prostate cancer radiation therapy.

2 - Biobjective Robust Optimization Problem over the Efficient Set to Aid Decision Making

Daniel Jornada, Texas A&M University, 1700 Research Pkwy, 280B Schlumberger Bldg, College Station, TX, 77843, United States of America, djornada@tamu.edu, Jorge Leon

We present a biobjective robust optimization formulation for identifying robust solutions from a given Pareto set arising from a multiobjective program (MOP). The objective functions consider both solution and model robustness when decision values are subjected to uncertainty at the time of implementation. The solution approach is based on facial decomposition. We illustrate the applicability of the methodology to aid decision making in the area of energy planning.

3 - Spatial Data for Multiobjective Shortest Path Analyses: Small Decisions with Large Consequences

F. Antonio Medrano, Post Doctoral Researcher, University of California at Santa Barbara, Santa Barbara, CA, 93106, United States of America, medrano@geog.ucsb.edu, Richard Church

Multiojective shortest path analysis is often used for developing alternatives in the engineering design of new infrastructure over terrain. While such analysis may appear to be non-subjective, the decisions made in assigning costs from features and in the connectivity of the raster network will have major impacts on the number of solutions, their spatial configuration, and their objective values. We discuss these factors and decisions when using GIS data, and their impacts on the solution set.

4 - Distributed Computation of Pareto Sets

Margaret Wiecek, Department of Mathematical Sciences,
Clemson University, Clemson, SC, 29634, United States of
America, wmalgor@clemson.edu, Brian Dandurand

The needs of multidisciplinary engineering design have motivated the development of a distributed solution approach to computing Pareto solutions to nonconvex decomposable multiobjective optimization problems. Existing results on augmented Lagrangian coordination techniques and the block coordinate descent method are extended into the multiobjective setting. These convergence analyses lead to a MultiObjective Decomposition Algorithm (MODA) that is applied to packaging in automotive design.

TA28

28-Room 405, Marriott

Auctions for Ad Space

Cluster: Auctions

Invited Session

Chair: Ian Kash, Microsoft Research, 21 Station Road, Cambridge,
United Kingdom, iankash@microsoft.com

1 - General Truthfulness Characterizations via Convex Analysis

Rafael Frongillo, Postdoctoral Fellow, Harvard University,
29 Oxford Street, Cambridge, MA, United States of America,
raf@cs.berkeley.edu, Ian Kash

We present a model of truthful elicitation which generalizes and extends mechanisms, scoring rules, and related settings. Our main result is a generalization of previous characterizations, including a new one for scoring rules on non-convex sets of distributions. We generalize this model to eliciting some property of the agent's private information, and provide the first general result for this setting. We also show how this yields a new proof of a result in mechanism design due to Saks and Yu.

2 - Inefficiency and Low Revenue in GSP Auctions

Indranil Chakraborty, indro@nus.edu.sg

In symmetric-Nash equilibrium GSP auction is efficient and generates more than VCG revenue. The revenue ranking may fail under Nash conditions but not when the maximum GSP revenue is considered. We let bidders to have values from conversions instead of clicks, and assume recency effect on conversion to show that in a broad range of situations the GSP auction is inefficient. When efficient equilibria exist the maximum efficient equilibrium revenue in many situations is lower than the VCG revenue.

3 - Optimising Trade-offs Among Stakeholders in Ad Auctions

David Kurokawa, PhD Student, Carnegie Mellon University,
Computer Science Department, 5000 Forbes Ave, Pittsburgh, PA,
15213, United States of America, dkurokaw@cs.cmu.edu,
Yoram Bachrach, Sofia Ceppi, Ian Kash, Peter Key

We examine trade-offs among stakeholders in ad auctions. Our metrics are the revenue for the auctioneer, number of clicks for users, and welfare for advertisers. We show how to optimize linear combinations of these utilities via a GSP auction with a per-click reserve price. We then examine constrained optimization of these utilities. Finally, we examine a richer setting that allow using the screen real estate in various ways.

4 - Mechanism Design for Mixed Ads

Ian Kash, Microsoft Research, 21 Station Road, Cambridge,
United Kingdom, iankash@microsoft.com, Sofia Ceppi,
Reza Khani, Yoram Bachrach, Peter Key

The GSP auction works when ads are simple, but does not generalize to richer settings. Truthful mechanisms, such as VCG do. However, a straight switch from GSP to VCG incurs significant revenue loss. We introduce a transitional mechanism which mitigates this revenue loss. The mechanism is equivalent to GSP when nobody has updated their bid and is equivalent to VCG when everybody has updated. Our mechanism is based on a technique for making payment functions into a truthful mechanism.

TA29

29-Room 406, Marriott

Applications of Analytics I

Sponsor: Analytics

Sponsored Session

Chair: Tarun Mohan Lal, Mayo Clinic, mohanlal.tarun@mayo.edu

1 - Analytics: A Conceptual Framework

Robert Rose, President, Optimal Decisions LLC, 4 Kirby Lane,
Franklin Park, NJ, 08823, United States of America,
optimaldecisions@mac.com

The term analytics emerged, and went viral, in November 2005. Since then, there have been many different, and often contradictory, definitions proposed for analytics. Questions such as whether or not analytics is a discipline, and what type of relationship it has to disciplines such as statistics, computer science and operations research, have been unanswered. In this talk, a framework will be presented that explains the emergence of analytics, and logically relates it to other disciplines.

2 - Spreadsheet Software for Linear Regression Analysis

Robert Nau, Professor, Duke University, Fuqua School of
Business, Durham, NC, 27708, United States of America,
robert.nau@duke.edu

Spreadsheet add-ins for statistical analysis vary widely in terms of their user interfaces, the detail and design of their output, and support for best practices of analysis. This talk will give a brief overview of some of the market-leading products and compare their linear regression features with a free add-in, RegressIt (<http://regressit.com>), which was originally designed for teaching an advanced elective on forecasting at Duke University and is now publicly available and widely used.

3 - Strategic Research: Analytics Excellence

Charity Maynard, Senior Health System Engineer, Mayo Clinic,
200 First Street SW, Rochester, MN, 55905, United States of
America, Maynard.Charity@mayo.edu

Mayo Clinic has a long rich legacy of integrating analytics, operations research and industrial engineering in clinical care, research and education for achieving excellence. This presentation will highlight the legacy, sophisticated infrastructure, novel application and dissemination of learning. Key success factors for leveraging analytics and engineering to address the formidable challenges in health care today and tomorrow will be discussed.

4 - Analytics to Support Innovation in Outpatient Care Delivery Processes

Tarun Mohan Lal, Mayo Clinic, mohanlal.tarun@mayo.edu

With the growing trend and concern surrounding health care workforce shortages, there is an increasing call for the redesign of office practices to reduce inefficiency and improve capacity through better use of existing office staff. In this presentation, we will discuss some innovative models of care delivery such as increase pre-visit work, non-face face visits being implemented at Mayo Clinic that has potential for improved operational performance and staff satisfaction.

TA30

30-Room 407, Marriott

Sports and Entertainment

Contributed Session

Chair: Stephen Hill

Assistant Professor, UNC Wilmington, 601 South College Road,
Wilmington, NC, 28403-5611, United States of America,
hills@uncw.edu

1 - Does the Number of Days between Professional Sports Games Really Matter?

Keith Willoughby, University of Saskatchewan, 25 Campus Drive,
Saskatoon, SK, S7N 5A7, Canada, willoughby@edwards.usask.ca,
Trevor Hardy

In the sport of football, teams typically play at most one game during a week. Leagues may insert "bye weeks" into the schedule for each team, thereby permitting rest and recuperation for players. Teams may feel unfairly treated if they have more (or less) rest than their opponents. We explored over ten years of regular season results from the Canadian Football League to determine if the number of days off experienced by a team between games impacts team performance.

2 - Optimization of Resource use in Massively Multiplayer Online Games

Betty Love, University of Nebraska at Omaha, UNO Mathematics Dept., 60th & Dodge Sts., Omaha, NE, 68182, United States of America, blove@unomaha.edu, Andrew Cockerill

With over 400 million players worldwide, massively multiplayer online games (MMOs) continue to be a popular source of online recreation. MMOs frequently involve resource management and virtual economies. This project demonstrates the introduction of optimization strategies in the MMO game World of Warcraft. A simulated annealing algorithm was implemented in a Lua script which runs in the game's user interface and determines how to use the player's current resources to maximize virtual profit.

3 - A Gravity Model for Tourist Forecasting at FIFA Soccer World Cups

Ghaith Rabadi, Associate Professor, Old Dominion University, 2102 Eng Systems Build, Dep. of Eng.Mngt. and Systems Eng., Norfolk, VA, United States of America, grabadi@odu.edu, Mohammed Al-salem, Ahmed Ghoniem

FIFA Soccer World Cups are sport mega-events that enjoy tremendous popularity worldwide. This paper analyzes historical bilateral tourist flows over the last two decades to forecast the number of inbound tourists into future World Cup host countries. Hosting sport mega-events will be considered as one of the input factors to measure their impact on the number of tourists forecasted.

4 - Optimal Hiking: Bi-modal Variation of the Traveling Salesperson Problem

Roger Grinde, Associate Professor, University of New Hampshire, Paul College of Business & Economics, 10 Garrison Avenue, Durham, NH, 03824, United States of America, roger.grinde@unh.edu

The problem addressed is motivated by a mountaineering problem where there is a network of peaks (destinations) connected by trails and a network of parking areas connected by roads. Various objectives are possible; generally one wishes to construct a series of hikes that together visit all the destinations. A formulation and solution approach is presented.

5 - Analysis of Potential Solutions to Competitive Imbalance in the NBA

Stephen Hill, Assistant Professor, UNC Wilmington, 601 South College Road, Wilmington, NC, 28403-5611, United States of America, hills@uncw.edu

The National Basketball Association (NBA) is in the midst of an extended period of competitive imbalance with teams in the Western Conference widely viewed as being stronger than those in the Eastern Conference. In this work, we evaluate a set of possible changes to the structure of the NBA. Each of these changes is analyzed via Monte Carlo simulation with the impacts on competitive balance and playoff participation described.

■ TA31

31-Room 408, Marriott

Financial Applications of Data Mining and Machine Learning Techniques

Sponsor: Data Mining

Sponsored Session

Chair: John Guerard, Director Of Quantitative Research, McKinley Capital Management, LLC, 3301 C Street, Suite 500, Anchorage, AK, 99503, United States of America, jguerard@mckinleycapital.com

1 - Optimal Global Efficient Portfolio with Emerging Markets using Earning Forecasts

Shijie Deng, Georgia Inst of Tech, 755 Ferst Dr, Atlanta, GA, United States of America, sd111@gatech.edu

We apply a multi-factor stock selection model which includes earning forecast to analyze the performance of the optimal global portfolio which includes the emerging markets. Under the Markowitz mean-variance framework, applied optimization techniques are employed to address the practical issues of risk-tolerance, turn-over, and tracking-error. The impacts of these practical constraints on the portfolio performance are analyzed through extensive numerical experiments.

2 - Data Mining Corrections Testing

John Guerard, Director of Quantitative Research, McKinley Capital Management, LLC, 3301 C Street, Suite 500, Anchorage, AK, 99503, United States of America, jguerard@mckinleycapital.com, Harry Markowitz, Ganlin Xu

Data mining corrections (DMC) tests of Global, Russell 3000, Non-U.S. stocks, Emerging Markets, Japan-only, and China-only during the 2000-2014 period for 21 individual financial variables and two composite (robust, PCA-based) regression models. We find that earnings forecasting models and regression-based models emphasizing forecasted earnings acceleration and price momentum models dominate the DMC tests which allow us to statistically dismiss Data Mining as a potential source of modeling bias.

3 - Applications of Machine Learning over Alpha Signals to Improve Stock Selection and Boost Returns

Abhishek Saxena, Quantitative Research Analyst, McKinley Capital Management, LLC, Suite 500, 3301 C Street, Anchorage, AK, 99503, United States of America, asaxena@mckinleycapital.com, Sundaram Chettiappan

The paper explores the possibility of enhancing an alpha model through various machine learning techniques. We show that these techniques can have statistically significant additions to both raw returns and simulated returns in various equity universes. These excess returns are mostly attributed to improved stock selection as the risk profile doesn't change significantly in terms of both direct risk measurements (standard deviation based risk models) and exposures to various fundamental factors.

4 - The Rise of the Machines: Machine Learning in Stock Selection

Rochester Cahan, rcahan@empirical-research.com

Models that attempt to forecast the cross-section of future stock returns are often structured as linear multifactor models. In this research we study the efficacy of non-linear modeling techniques in stock selection strategies. We use a range of factors known to predict stock returns as raw ingredients and investigate whether various non-linear and machine learning algorithms can combine those ingredients into predictive alpha signals, using only information known ex ante. We benchmark the predictive power of the non-linear models against traditional linear regression models constructed using the same data and estimation windows.

■ TA32

32-Room 409, Marriott

Principles in Applied Probability

Sponsor: Applied Probability

Sponsored Session

Chair: Josh Reed, Associate Professor, NYU, 44 W. 4th St., New York, NY, 10012, United States of America, jreed@stern.nyu.edu

1 - Relating Busy Period Duration and the Single Big Jump Principle in Heavy Traffic

Bart Kamphorst, PhD Student, CWI, Science Park 123, Amsterdam, 1098 XG, Netherlands, B.Kamphorst@cwi.nl, Bert Zwart

Queueing literature shows many results for the $M/G/1$ queue with a fixed server utilization. However, in practice the server utilization may be increasing due to a growing number of jobs per time unit. This causes a significant increase in waiting times and the busy period duration. I will present asymptotic relations for the tail probabilities of the former characteristics. Moreover, I will illustrate a typical long busy period and discuss its relation with the Principle of a Single Big Jump.

2 - Capacity Allocation in a Transient Queue

Britt Mathijsen, PhD Student, Eindhoven University of Technology, P.O. Box 513, 5600 MB, Eindhoven, Netherlands, b.w.j.mathijsen@tue.nl, Bert Zwart

We consider an optimal capacity allocation problem of a two-period queueing model, being in steady-state in the first time interval, but changing parameters at the instance of the new period. The error in the objective function made by disregarding the transient phase before reaching stationarity in this second interval is quantified and approximated. Furthermore, we analyze the consequence of staffing the system according to its steady-state behavior and propose a corrected staffing rule.

3 - Analysis of Cascading Failures

Fiona Sloothaak, PhD Student, Eindhoven University of Technology, P.O. Box 513, 5600 MB, Eindhoven, Netherlands, f.sloothaak@tue.nl, Bert Zwart

Inspired by analyzing the reliability of energy networks, particularly the occurrence of large blackouts, we consider a stylized model of cascading failures. By using connections with extreme value theory and Brownian bridge approximations, we establish that the number of failed nodes follow a power law. Time permitting, we also discuss connections with similar models and questions from material science.

4 - On a Class of Reflected AR(1) Processes

Josh Reed, Associate Professor, NYU, 44 W. 4th St., New York, NY, 10012, United States of America, jreed@stern.nyu.edu,
Michel Mandjes, Onno Boxma

We study the recursion $Z(n+1) = \max(aZ(n) + X(n), 0)$ when $X(n)$ is i.i.d. with distribution the same as the difference of a positive random variable and an independent, exponential random variable. We find the transform of $Z(n)$ and, when $|a| < 1$, we perform a stationary analysis. In heavy-traffic, we show that the process converges to a reflected Ornstein-Uhlenbeck process and the steady-state distribution converges to the distribution of a normal random variable conditioned to be positive.

TA33

33-Room 410, Marriott

Medical Decision Making in Chronic Disease Screening and Treatment

Sponsor: Health Applications

Sponsored Session

Chair: John Silberholz, PhD Student, MIT, 77 Mass Ave, Bldg E40-130, Cambridge, MA, 02139, United States of America, josilber@mit.edu

1 - An Analytics Approach to Designing Combination Chemotherapy Regimens for Cancer

Dimitris Bertsimas, Professor, MIT, 77 Massachusetts Ave., Cambridge, MA, 02139, United States of America, dbertsim@mit.edu, Allison O'hair, Stephen Relyea, John Silberholz

We present a data-driven approach for designing new chemotherapy regimens for advanced gastric and breast cancer. Our approach combines (i) construction of a large-scale database of clinical trial results, (ii) statistical modeling to predict outcomes of new drug combinations, and (iii) optimization models to select novel treatments that strike a balance between maximizing patient outcomes (exploitation) and learning new things about treatments that may be useful in the future (exploration).

2 - On Estimating Optimization Model Parameters in Health and Medicine

Thomas Trikalinos, Associate Professor, Brown University, thomas_trikalinos@brown.edu

Combining information from independent sources (meta-analysis) can increase the likelihood of optimal actions in operational problems. Using as example the optimization of breast cancer screening strategies, I will discuss methods for and implications of synthesizing model parameter estimates from independent studies, while accounting for biases (systematic errors) and nontransferability (differences between the setting specified by the optimization and the settings of the data sources).

3 - A Robust Approach to Designing Cancer Screening Strategies

John Silberholz, PhD Student, MIT, 77 Mass Ave, Bldg E40-130, Cambridge, MA, 02139, United States of America, josilber@mit.edu, Dimitris Bertsimas, Thomas Trikalinos

Many models have been proposed to evaluate screening strategies for detecting cancer. Though each model for some cancer could be used to identify effective screening strategies, models' assumptions and structures can vary dramatically, leading to differing conclusions about the most effective strategy. Using robust and stochastic optimization, we identify screening strategies that are effective across multiple models, which could increase confidence in the quality of the identified strategies.

4 - Prioritizing Hepatitis C Treatment in United States Prisons

Can Zhang, Georgia Institute of Technology, 499 Northside Cir NW, Apt. 315, Atlanta, GA, 30309, United States of America, czhang2012@gatech.edu, Anthony Bonifonte, Turgay Ayer, Jagpreet Chhatwal, Anne Spaulding

Correctional populations, which represent about 30% of the national Hepatitis C virus (HCV) prevalence, offer a great opportunity to control the HCV epidemic. New HCV treatments are very effective but also outrageously expensive. Therefore, prisons are pressed to prioritize treatment decisions for HCV-infected inmates. We propose a mathematical modeling framework for HCV treatment prioritization decisions in prisons and present extensive numerical results based on large datasets from US prisons.

TA34

34-Room 411, Marriott

Operations in Emergency Medicine

Sponsor: Health Applications

Sponsored Session

Chair: Yu Wang, PhD Student, Indiana University, yw39@indiana.edu

Co-Chair: Alex Mills, Assistant Professor, Indiana University, 1309 E. 10th Street, Bloomington, IN, 47405, United States of America, millsaf@indiana.edu

1 - Coordinated Response of Health Care Networks in Mass Casualty Incidents

Mercedeh Tariverdi, PhD Student, University of Maryland, mercedeh@umd.edu, Elise Miller-Hooks, Thomas Kirsch, Scott Levin

A hybrid analytical-simulation and system-based approach is presented for assessing the benefits of coordinated response of a health care network in a mass casualty incident. The method accounts for incident-related operational disruptions along with other sources of transient system behavior. Critical resource management is included.

2 - An Empirical Study of Patient Discharge Decisions in Emergency Departments

Eric Park, Postdoctoral Associate, The University of British Columbia, 2053 Main Mall, Vancouver, BC, V6T1Z2, Canada, eric.park@sauder.ubc.ca, Yichuan Ding, Mahesh Nagarajan

We analyze the physician's patient discharge decision in EDs. We study how inpatient wards play a role as additional resources to the ED in the discharge process. We study over 530,000 patient discharges in five Canadian EDs.

3 - Allocation Models for Cooperation between Ambulance Services

Lavanya Marla, Assistant Professor, University of Illinois at Urbana-Champaign, 104 S. Mathews Avenue, 216E, Urbana, IL, 61801, United States of America, lavanyam@illinois.edu

We consider a setting where multiple ambulance service providers cooperate to serve a population. Such settings have been observed in the case of large casualties; and in emerging economies where 911-type services compete with existing ad-hoc services. We first demonstrate the opportunity costs due to lack of cooperation. Then we present a game-theoretic framework to model the allocation of ambulances from competing service providers. We conclude with results from a real-world case study.

4 - Surge: Smoothing Usage of Resources is Good for Emergencies

Yu Wang, PhD Student, Indiana University, yw39@indiana.edu, Alex Mills, Jonathan Helm

Major hospitals often experience demand surges close to or above their capacity. We study the interplay between reactive and proactive surge strategies and their impacts on the hospital's immediate response and recovery. We find that immediate recourse actions at best sacrifice long-term recovery for short-term capacity improvement, while proactive workload smoothing provides a Pareto-improving response in both short- and long-term operational performance.

TA35

35-Room 412, Marriott

Panel Discussion: Infusing Learning from Hospitality and Service Design to Healthcare: A Panel Discussion

Cluster: Hospitality, Tourism, and Healthcare

Invited Session

Chair: Rohit Verma, Professor, Cornell University, School of Hotel Administration, 338 Statler Hall, Ithaca, NY, 14853-6902, United States of America, rohit.verma@cornell.edu

1 - Infusing Learning from Hospitality and Service Design to Healthcare: A Panel Discussion

Moderator: Rohit Verma, Professor, Cornell University, School of Hotel Administration, 338 Statler Hall, Ithaca, NY, 14853-6902, United States of America, rohit.verma@cornell.edu, Panelists: Craig Froehle, Nitin Joglekar

While fundamentally different from each other, the Healthcare and Hospitality industries also share many common characteristics, challenges and constraints. The purpose of this session is to discuss if and how lessons learnt from hospitality can be infused to design better services within the context of healthcare, wellness and senior living.

■ TA36

36-Room 413, Marriott

Innovations on Disaster Response Logistics

Sponsor: Public Sector OR

Sponsored Session

Chair: Felipe Aros-Vera, arosvm2@rpi.edu

1 - Competition Over Funding Resources in Humanitarian Operations

Arian Afflaki, Doctoral Student, Duke University, 100 Fuqua Drive, Box 90120, Durham, NC, 27708, United States of America, arian.afflaki@duke.edu, Alfonso Pedraza-Martinez

Donors seek control over their donations, while it hurts the operational efficiency of Humanitarian Organizations (HOs). We model the trade-off between operational performance, fundraising effort, and donor preferences and find that HOs can benefit from limiting donors' control over their donations; however, competition forces HOs to give control to donors.

2 - Optimizing Humanitarian Logistics Concepts of Operations: The Case of Haiti

Erica Gralla, Assistant Professor, George Washington University, 800 22nd Street NW, Washington, 20052, United States of America, egralla@gwu.edu, Liam Cusack, Phillip Graeter

After a disaster, the Logistics Cluster coordinates logistics for various responding humanitarian agencies. They must quickly set up a supply chain, determining entry points, major transport corridors, storage hubs, and vehicle requirements. This research supports these decisions by finding the minimum-cost supply chain configuration. Results for the case of Haiti are presented.

3 - Assessment of Risk Management and Disaster Response Capabilities through the Process Maturity Framework

Miguel Jaller, Assistant Professor, University of California, Davis, One Shields Ave, Ghausi Hall, 3143, Davis, CA, 95616, United States of America, mjaller@ucdavis.edu, Diego Suero, Melissa Del Castillo, Nuris Calderón, Jose William Penagos

This paper explores the Process Maturity Framework to assess the current state of the risk management and disaster response capabilities of a region in a developing country. Using data collected by the team in Colombia, the paper discusses the results in terms of the maturity levels for the different factors that comprise the processes of: risk management and understanding, risk mitigation, and disaster management and response; and puts forward a number of achievable goals and key practices.

4 - Adaptive Decision Making under Dynamic Information Update in Limited Data Environments

Kezban Yagci Sokat, PhD Candidate, Northwestern University, 2145 Sheridan Road, C210, Evanston, IL, 60208, United States of America, kezban.yagcisokat@u.northwestern.edu, Irina Dolinskaya, Karen Smilowitz

After a disaster, there is often limited information about infrastructure damage. New data sources such as OpenStreetMap are emerging. Utilizing these new data sources, we use clustering and various imputation techniques with pre-disaster and post-disaster attributes to approximate incomplete information in a timely manner for routing decisions.

■ TA37

37-Room 414, Marriott

Health Care Modeling and Optimization IX

Contributed Session

Chair: Parastu Kasaie, Postdoctoral Fellow, Johns Hopkins University, 615 N. Wolfe St, E6039, Baltimore, MD, 21205, United States of America, pkasaie@jhu.edu

1 - Dynamic Advance Overbooking with No-Shows and Cancellations

Van-Anh Truong, Columbia University, 500 West 120th St, New York, NY, 10027, United States of America, vt2196@columbia.edu

We introduce the first tractable model of dynamic advance overbooking with no-shows and cancellations. In this fundamental model, advance appointments must be given to a stream of patients arriving randomly over time. Patients might cancel or miss their appointments, with the likelihood of these events increasing with their wait times.

2 - Integrating Quick-response Methods and Staffing Decisions in a Hospital

Jan Schoenfelder, Research Assistant, Augsburg University, Neusässer StraÙe 47, Augsburg, Ba, 86156, Germany, janschoe@indiana.edu, Daniel Wright, Edwin Coe, Kurt Bretthauer

We present an optimization model that combines hospitals' nurse staffing decisions with two classes of quick-response decisions: (i) adjustments to the assignment of cross-trained nurses working the current shift in each unit and (ii) transfers of patients between units and off-unit admissions. We use a simulation to derive insights into the level of benefit that can be expected from integrating the aforementioned quick-response methods in the staffing process.

3 - Analyzing the Relationship Between Two-phased Room Allocation Policies in an Outpatient Clinic

Vahab Vahdatzad, PhD Candidate, Northeastern University, 360 Huntington Avenue, Boston, MA, 02215, United States of America, vahdatzad.v@husky.neu.edu, James Stahl, Jacqueline Griffin

This research analyzes the relationship between two phases of room assignment in an outpatient clinic. Specifically, we studied the interplay between the use of rooms for Medical Assistant and physicians during a patient visits. We demonstrate that policies for assigning rooms to MA and physicians has a significant impact on patient wait time and length of stay. Several room allocation policies are examined using discrete event simulation and interactions between two phases are investigated.

4 - An Agent-Based Simulation Model of HIV Transmission and Control among Men who have Sex with Men in Baltimore City

Parastu Kasaie, Postdoctoral Fellow, Johns Hopkins University, 615 N. Wolfe st, E6039, Baltimore, MD, 21205, United States of America, pkasaie@jhu.edu, David Dowdy

We present an agent-based simulation model to project the population-level impact of implementing HIV preventive therapy (PrEP) and treatment (ART) for high-risk men who have sex with men (MSM) in Baltimore city. We compare a counterfactual scenario in which PrEP and ART continue to be used at current (low) levels against scenarios in which different levels of coverage and adherence are achieved. The primary outcome of interest is the HIV incidence among MSM in Baltimore over five years.

5 - Estimating the Energy Imbalance Characterizing the Rise in Obesity Among Adults in England

Saeideh Fallah-Fini, California State and Polytechnic University, Pomona, 3801 W. Temple Ave, Pomona, CA, 91768, United States of America, sfallahfini@cpp.edu

This paper uses systems dynamics to present a population-level model that quantifies the energy imbalance gap responsible for the obesity epidemic among adults in England (across different gender and ethnicity subpopulations) during the past two decades. The developed model also estimates the magnitude of calorie reduction that should be targeted by obesity interventions to reverse the current trajectory of the obesity epidemic.

■ TA39

39-Room 100, CC

Supply Chain Management and Marketing Interface

Cluster: Operations/Marketing Interface

Invited Session

Chair: Gangshu Cai, Santa Clara University, OMIS Department, Lucas Hall 216N, Santa Clara, CA, 95053, United States of America, gcai@scu.edu

1 - Effects of Demand Uncertainty and Production Lead Time on Product Quality and Firm Profitability

Baojun Jiang, Olin Business School, Washington University in St. Louis, MO, 63130, United States of America, baojunjiang@wustl.edu, Lin Tian

We study the effects of demand uncertainty and production lead time in a distribution channel with one retailer outsourcing its production to one supplier. We show that the supplier may have no incentive to improve its lead time even if it is costless to do so. An increase in the supplier's JIT production capacity can lead to higher or lower product quality, benefiting the retailer but potentially hurting the supplier. A better market can make both the supplier and the retailer worse off.

2 - The Protection Economy: Problem Retention or Problem Prevention?

Oded Koenigsberg, Associate Professor, London Business School, Regent's Park, London, United Kingdom, okenigsberg@london.edu, Eitan Gerstner, Daniel Halbheer

Companies are advised to invest in quality programs to solve and prevent customer problems. This paper shows that profit-maximizing motivate companies to peruse protection strategies under which customer problems are created or preserved so that protection services can be offered to repair the damages created through the problems. Thus, standard economic efficiency measures used in the "solution economy" are inappropriate for the "protection economy".

3 - Co-opetition in Services: The Boardwalk Phenomenon

Lucy Gongtao Chen, National University of Singapore, 15 Kent Ridge Drive, Singapore, Singapore, bizcg@nus.edu.sg, Tinglong Dai, Nagesh Gavirneni, Xuchuan Yuan

We consider two service firms (e.g. restaurants) that compete on price and waiting time and cooperate on entertainment effort that reduces the waiting cost of the patrons. We study monopoly and duopoly settings and in the latter, we consider both individual and joint entertainment efforts. We show that by cooperating on entertainment, the competing service firms are able to achieve efficiency levels equivalent to that of monopoly settings.

■ TA40

40- Room 101, CC

Behavioral Operations III

Contributed Session

Chair: Ling Li, Professor, Department Chair of IT, Old Dominion University, 2064 Constant Hall, Norfolk, VA, 23529, United States of America, lli@odu.edu

1 - Newsvendor Decision with Multiple Reference Points

Feng Li, Dr., South China University of Technology, Wushan Road, Guangzhou, China, fenglee@scut.edu.cn, Ying Wei

This paper studies how bottom line and status quo as reference profits influence the newsvendor behavior and the optimal order quantity. Employing tri-reference point theory, psychological value of the profit is regarded as gain, loss, or failure based on the two benchmarks. We find that the presence of bottom line decreases the optimal order quantity. In addition, the optimal order quantity may decrease with the wholesale price and increase with the retail price.

2 - Prediction on Network Public Opinion in Online Communities of Different Age Structures

Tianjiang Boning, Master, Huazhong University of Science and Technology, 1037 Luoyu Road, Wuhan, HU, 430074, China, t.j.mcgrady@hotmail.com

We get the evolution law of different age structures in different internet public opinion events through simulation and analysis, and analyze the effect of youth group, middle-aged group and elderly group in each community on internet public opinion respectively, and also find the special role that the elderly group plays during the public opinion evolution processes. In the end, we propose some effective suggestions for Government according to simulation results.

3 - Employees' Cyber Security Behavior and Information Security Policy

Ling Li, Professor, Department Chair of IT, Old Dominion University, 2064 Constant Hall, Norfolk, VA, 23529, United States of America, lli@odu.edu, Li Xu, Wu He

This research focuses on cybersecurity by theoretically defining the conceptual domains of employees' online security behavior and beliefs. We examined the relative importance of 10 factors that will be used for developing new training methods and materials to improve employee's awareness and skills to defend against cybersecurity risks, and investigated the relationship between the availability of cybersecurity policy and individual employee's behavior and beliefs toward cybersecurity issues.

■ TA41

41-Room 102A, CC

Studies in Healthcare Productivity

Sponsor: Manufacturing & Service Oper

Mgmt/Healthcare Operations

Sponsored Session

Chair: Robert Batt, Asst. Professor, Wisconsin School of Business, UW-Madison, 975 University Ave., Grainger Hall, 5279, Madison, WI, 53706, United States of America, rbatt@bus.wisc.edu

1 - Mining for Content: A Study of E-visits

Hessam Bavafa, Assistant Professor, Wisconsin School of Business, Madison, WI, United States of America, hbavafa@bus.wisc.edu

We study the micro-structure of e-visits, electronic communications between patients and providers through patient portals. The main promise of e-visits as a new channel for providing primary care services is to decrease the number of office visits and improve patient health. We examine detailed information about the patients, providers, and e-visit details (e.g., timings and text of e-visits) to establish a better understanding of e-visits.

2 - Pareto Improving Flow Control Policies for Multi-server Emergency Departments - New Perspectives

Hung Do, Assistant Professor, University of Vermont, 55 Colchester Ave., Kalkin Hall 207, Burlington, VT, 05405, United States of America, hdo@bsad.uvm.edu, Masha Shunko

Using Emergency Medical Services setting as motivation, we design and analyze flow control policies for service systems with N multiple-server queues. We focus on policies that improve performance of the system and benefit all involved entities. We propose new perspectives on performance measures, novel methods to comparatively analyze flow control policies and reveal managerial insights that help design such Pareto improving policies in practice.

3 - Adopting Best Practices: Public Relative Performance Feedback as a Tool for Standardizing Workflow

Hummy Song, Harvard University, Wyss House, Soldiers Field Road, Boston, MA, 02163, United States of America, hsong@hbs.edu, Karen Murrell, Anita Tucker, David Vinson

In complex service systems, standardizing workflows (not processes) may be an effective way to improve operational performance. We explore how public disclosure of relative performance feedback (RPF) on individual workers' processing times can help standardize workflow and improve productivity. We examine the effect of public RPF on worker productivity and the extent to which this varies by whether standardized processes are in place. We also explore potential mechanisms driving these effects.

4 - The Disposition Decision: Handoffs and End-of-shift Effects in an Emergency Department

Robert Batt, Asst. Professor, Wisconsin School of Business, UW-Madison, 975 University Ave., Grainger Hall, 5279, Madison, WI, 53706, United States of America, rbatt@bus.wisc.edu, Diwas Kc, Bradley Staats, Brian Patterson

We look at the effect of emergency department patients hand-offs on operational variables such as length of stay, revisit rate, physician productivity. We also examine what factors impact the probability of a patient being handed-off at the end of a shift versus being dispositioned by the current doctor.

■ TA42

42-Room 102B, CC

Operational Decision Making in Healthcare

Sponsor: Manufacturing & Service Oper

Mgmt/Healthcare Operations

Sponsored Session

Chair: Vishal Ahuja, Southern Methodist University, P.O. Box 750333, Dallas, TX, United States of America, vahuja@smu.edu

1 - Impact of Severity-adjusted Workload on Health Status of Patients Discharged from an ICU

Song Hee Kim, Assistant Professor, Marshall School of Business, University of Southern California, Los Angeles, CA, United States of America, songheek@marshall.usc.edu, Edieal Pinker, Elizabeth Bradley, Joan Rimar

We examine whether workload has a direct impact on the health status of patients discharged from ICUs, using data from two ICUs and a new measure of patient acuity called the Rothman Index (RI). The RI is updated hourly in the ICU, enabling us to track the health status of patients. Also, leveraging the RI, we measure ICU workload in a novel way that takes into account not only the census but also patient acuity, and study this severity-adjusted workload's impact on the patient disposition.

2 - Evidence of Strategic Behavior in Medicare Claims Reporting

Hamsa Bastani, Graduate Student, Stanford University, United States of America, hsriddhar@stanford.edu, Joel Goh, Mohsen Bayati

Upcoding is the practice where medical providers alter claims data to receive increased reimbursement. Previous studies on detecting upcoding have been limited by unobserved confounders (e.g. provider quality and patient risk). We present a novel approach using a double regression that exploits state-level variations in adverse event regulation and instrumental variables to provide evidence of upcoding at a national scale. We also make several policy recommendations for reducing upcoding.

3 - Screening for Hepatocellular Carcinoma: A Restless Bandit Model

Elliot Lee, University of Michigan, 1205 Beal Ave, Ann Arbor, MI, 48109, United States of America, elliottl@umich.edu,
 Mariel Lavieri, Michael Volk

Currently, all patients at risk for hepatocellular carcinoma (HCC) are screened every six months. Recent medical discoveries have found a correlation between a biomarker measured at each screening, and his/her risk of developing HCC. We model the problem of simultaneously learning while allocating a limited number of screening resources across a population as a restless bandit model. We prove several structural properties of this problem, and ultimately derive a corresponding optimal policy.

4 - Enhancing FDA's Decision Making using Data Analytics

Vishal Ahuja, Southern Methodist University, P.O. Box 750333, TX, United States of America, vahuja@smu.edu, John Birge

Existing FDA surveillance methods are based on voluntary reporting or meta-analysis primarily geared towards identifying new/unknown adverse events. We propose a statistically robust and evidence-based empirical approach that focuses on evaluating specific drug-related adverse outcomes to aid in the FDA decision-making. We demonstrate our approach using a controversial black box warning. Based on a large dataset from the Department of Veterans Affairs, we find that the warning was not warranted.

■ TA43

43-Room 103A, CC

Measurement and Optimization in Online Advertising

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Omar Besbes, Professor, Columbia University, Graduate School of Business, New York, NY, 10027, United States of America, ob2105@columbia.edu

Co-Chair: Vineet Goyal, Associate Professor, Industrial Engineering and Operations Research, Columbia University, 500 West 120th Street, 304 Mudd, New York, NY, 10027, United States of America, vgoyal@ieor.columbia.edu

Co-Chair: Garud Iyengar, Columbia University, S. W. Mudd 314, 500W 120th Street, New York, NY, United States of America, garud@ieor.columbia.edu

1 - Advertiser Revenue Versus Consumer Privacy in Online Advertising

Vibhanshu Abhishek, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, vibs@andrew.cmu.edu, Arslan Aziz, Rahul Telang

Increasing concerns around consumer privacy have questioned the value of targeted advertising. In this paper we quantify the value of privacy-intrusive information in targeted advertising. Using individual level browsing/purchase data we find that using more privacy-intrusive information increases the accuracy of prediction of purchases, but at a decreasing rate. Targeted advertising is also effective in increasing purchase probability. In our data, restricting cookies reduces sales by 14%.

2 - Learning and Optimizing Reserve Prices in Repeated Auctions

Hamid Nazerzadeh, University of Southern California, Bridge Memorial Hall, 3670 Trousdale Parkway, Los Angeles, 90089, United States of America, hamidnz@marshall.usc.edu,
 Yash Kanoria, Renato Paes Leme, Afshin Rostamizadeh, Umar Syed

A large fraction of online advertisements are sold via repeated second price auctions. The reserve price is the main tool for the auctioneer to boost revenues. However, the question of how to effectively set these reserves remains essentially open from both theoretical and practical perspectives. The main challenge here is that using previous bids to learn reserves could lead to shading of bids and loss of revenue. I'll present incentive compatible near-optimal learning algorithms in this context.

3 - Advertising on a Map

Sergei Vassilvitskii, Google, 111 8th Avenue, New York, United States of America, sergei@cs.stanford.edu

We study the mechanism design problem for advertising on a map. Unlike traditional search advertising where there is a linear order on the slots, no such structure exists in the case of a map. We begin with a model of the setting, noting that the utility of an ad is discounted by the presence of competing businesses nearby and its position in the set of ads ordered by distance from the user. We present simple, approximately welfare maximizing allocation schemes with good incentive properties.

4 - Attribution in Online Advertising under Markov Browsing Models

Antoine Desir, Columbia University IEOR department, 500 West 120th Street, Mudd 315, New York, NY, 10027, United States of America, ad2918@columbia.edu, Vineet Goyal, Garud Iyengar, Omar Besbes

Web viewers are exposed to multiple ads across different websites before they potentially make a purchase (leading to a conversion). In turn, a key question facing the online advertising industry is that of attribution. We analyze attribution based on Shapley values. While intractable in general, we provide computationally tractable approximations to Shapley values under a general Markov chain customer browsing behavior model and compare this attribution to heuristics commonly used in practice.

■ TA44

44-Room 103B, CC

Pricing Issues in Revenue Management

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Rene Caldentey, NYU, 44 W 4th St, New York, NY, 10012, United States of America, rcaldent@stern.nyu.edu

Co-Chair: Ying Liu, Stern School of Business, New York University, 44 West 4th Street, KMC 8-154, New York, NY, 10012, United States of America, yliu2@stern.nyu.edu

1 - Incorporating Online Customer Ratings in Pricing Decisions

Marie-claude Cote, Manager, Data Science, JDA Software - Innovation Labs, 4200 Saint-Laurent #407, Montréal, QC, H2W 2R2, Canada, Marie-Claude.Cote@jda.com, Philippe Tilly, Nicolas Chapados

Research have demonstrated that online customer ratings have a huge impact on the decision to choose a product. In hospitality, where the product is a hotel room for a length of stay, customers consult an increasing number of reviews prior to booking. We will describe an approach to automatically incorporate online user rating impact in the pricing decisions of a hospitality revenue management system.

2 - On the Equivalence of Quantity Pre-commitment and Cournot Games

Amr Farahat, Washington University in St. Louis, One Brookings Drive, St. Louis, MO, 63104, United States of America, farahat@wustl.edu, Hongmin Li, Tim Huh

We establish sufficient conditions under which Cournot outcomes solve quantity-followed-by-pricing games. Kreps and Scheinkman (1983) established this connection for homogeneous product duopolies and Friedman (1988) for certain differentiated product oligopolies under restrictive assumptions. Our research provides conditions for more general differentiated product settings, including multinomial logit models.

3 - Pricing Policies for Perishable Products with Demand Substitution

Ying Liu, Stern School of Business, New York University, 44 West 4th Street, KMC 8-154, New York, NY, 10012, United States of America, yliu2@stern.nyu.edu, Rene Caldentey

We study a monopolist's optimal dynamic pricing policy for a family of substitute perishable products. Customers arrive to the market according to an exogenous stochastic process, each with a budget constraint. Upon arrival, each customer first makes a decision among subfamilies that are differentiated by quality, and then selects among horizontally differentiated products within the subfamily. We characterize the optimal pricing policy and study the asymptotic approximation.

4 - Optimal Time and Price of Dynamic Upgrade

Xiao Zhang, PhD Candidate, University of Texas at Dallas, Richardson, TX, United States of America, xxz085020@utdallas.edu, Ozalp Ozer

Upgrade, a strategy used in travel industry to balance the supply-and-demand mismatches among products of different quality levels, is usually offered either at the booking time or the consumption time. We study a revenue management problem of a firm which sells two products at fixed prices and offers upgrade options anytime when necessary. The optimal policy specifies the time and price of the upgrade option, and how many existing customers should be offered this option.

■ TA45

45-Room 103C, CC

Social Learning and Revenue Management

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Costis Maglaras, Columbia Business School, New York, NY, 10027, United States of America, c.maglaras@gsb.columbia.edu

Co-Chair: Alireza Tahbaz-Salehi, Columbia Business School, 3022 Broadway, Uris Hall 418, New York, NY, 10023, United States of America, alirezat@columbia.edu

1 - Monopoly Pricing in the Presence of Social Learning

Davide Crapis, Columbia Business School, 3022 Broadway, New York, NY, 10027, United States of America, dcrapis16@gsb.columbia.edu, Bar Ifrach, Costis Maglaras, Marco Scarsini

A monopolist offers a product to a market of consumers with heterogeneous preferences. Consumers are uninformed about product quality and learn from reviews of others. First, we show that learning eventually occurs. Then, we characterize the learning trajectory via a mean-field approximation that highlights how the learning process depends on price and heterogeneity. Finally, we solve the pricing problem and show that policies that account for social learning increase revenues considerably.

2 - Networks, Shocks, and Systemic Risk

Alireza Tahbaz-Salehi, Columbia Business School, 3022 Broadway, Uris Hall 418, New York, NY, 10023, United States of America, alirezat@columbia.edu, Daron Acemoglu, Asu Ozdaglar

We develop a unified framework for the study of how network interactions can function as a mechanism for propagation and amplification of microeconomic shocks. The framework nests various classes of games over networks, models of macroeconomic risk originating from microeconomic shocks, and models of financial interactions.

3 - Market Entry under Competitive Learning

Kimon Drakopoulos, kimondr@mit.edu, Asu Ozdaglar, Daron Acemoglu

We consider a market entry game with two players, an incumbent and an entrant. The market can be of two types: (a) bad in which case the demand is fully elastic at a price \bar{p} or (b) good in which case there is a positive arrival rate of consumers who are willing to buy at higher prices. The entrant is learning the type of the market by observing the flow of payoffs. We prove that the problem has the structure of a war of attrition game and study its weak perfect Bayesian equilibria.

4 - Social Learning with Differentiated Products

Arthur Campbell, Associate Professor, Yale University, School of Management, 135 Prospect Street, P.O. Box 208200, New Haven, CT, 06520-8200, United States of America, Arthur.Campbell@yale.edu

This paper embeds social learning in a model of firms producing differentiated products. We consider how the structure of social relationships between consumers influence pricing and welfare. The model considers how a variety of characteristics of the social network influence these outcomes. It also serves to highlight the challenges one faces in using metrics such as consumer awareness and the sensitivity of demand to prices as measures of informational efficiency in markets.

■ TA46

46-Room 104A, CC

Empirical Research in Supply Chains and Service Management

Sponsor: Manufacturing & Service Oper Mgmt/Service Operations

Sponsored Session

Chair: Marcelo Olivares, Assistant Professor, Universidad de Chile, Republica 701, Santiago, Chile, molivares@u.uchile.cl

1 - Estimating Customer Spillover Learning of Service Quality: A Bayesian Approach

Andres Musalem, Universidad de Chile, Republica 701, Santiago, Chile, amusalem@duke.edu, Yan Shang, Jeannette Song

We propose a Bayesian framework for estimating customer "spillover learning," — the process by which customers' learn from previous experiences of similar but not necessarily identical services. We apply our model to a data set containing shipping and sales historical records provided by a world-leading third-party logistics company.

2 - Spatial Competition and Preemptive Entry in the Discount Retail Industry

Fanyin Zheng, Columbia Business School, 3022 Broadway, New York, NY, United States of America, fanyin.zheng@gmail.com

I study the competitive store location decisions of discount retail chains in this paper. I model firms' entry decisions using a dynamic duopoly location game and allow stores to compete over the shopping-dollars of close-by consumers. I use various economic modeling technics to make the model tractable and infer market divisions from data using a clustering algorithm. The empirical analysis suggests that dynamic competitive considerations are important in chain stores' location decisions.

3 - Using Real-time Operational Data to Increase Labor Productivity in Retail

Marcelo Olivares, Assistant Professor, Universidad de Chile, Republica 701, Santiago, Chile, molivares@u.uchile.cl

We develop a methodology to re-assign sales employees across departments in a large retail store in order to improve productivity. Our method seeks to maximize the effectiveness of labor by allocating employees to departments that require immediate assistance and where this assistance has a larger impact of sales. The method combines empirical methods to measure the impact of assistance and store operational data collected through video analytics to reassign employees in real-time.

4 - Consumer Search and the Structure of Personal Networks

Raghuram Iyengar, Associate Professor, The Wharton School, University of Pennsylvania, 3730 Walnut Street Suite 700, Philadelphia, PA, 19104, United States of America, riyengar@wharton.upenn.edu

We study how consumers' information search for and purchase of new products are affected by structure of their personal network. To address threats to internal validity common in network studies, we conduct a randomized experiment in which we manipulate the similarity of preference among consumers and their network contacts. We estimate consumers' utility function and determine how network antecedents moderate the weight on others' information.

■ TA47

47-Room 104B, CC

Sustainability in Food Supply Chains

Sponsor: Manufacturing & Service Oper Mgmt/Sustainable Operations

Sponsored Session

Chair: Erkut Sonmez, Assistant Professor, Boston College, 140 Commonwealth Ave, Fulton Hall, Chestnut Hill, MA, 02446, United States of America, erkut.sonmez@bc.edu

1 - Supply Chain Analysis of Contract Farming

A. Serdar Simsek, Cornell ORIE, 282 Rhodes Hall, Ithaca, NY, 14853, United States of America, as2899@cornell.edu, Awi Federgruen, Upmanu Lall

Contract farming sustains the operations of vulnerable farmers while better positioning the manufacturers to manage their supply risks. In this setting, a manufacturer who owns several production plants -each with a random demand for the crop- selects the set of farmers that minimizes her expected procurement and distribution costs before the growing season. We present two solution methods to this problem. We applied our model to a company contracting with hundreds of small farmers in India.

2 - Processed Produce: Introduction, Pricing, and Profit Orientation

Omkar Palsule-desai, Faculty, Indian Institute of Management Indore, Rau Pithampur Road, Indore, India, omkardpd@iimahd.ernet.in, Muge Yayla-Kullu, Nagesh Gavirneni

We examine product characteristics and market dynamics to identify conditions under which it is optimal to introduce the processed produce, and it should be managed by cooperatives instead of private firms. We develop a mathematical model capturing (i) competition between non-profit and for-profit firms, (ii) consumers' valuation discount, and (iii) product perishability. We provide ample evidences to policy makers promoting processed products offered by cooperatives.

3 - Converting Retail Food Waste Into By-product

Deishin Lee, Assistant Professor, Boston College, 140 Commonwealth Ave., Fulton Hall 344, Chestnut Hill, MA, 02467, United States of America, deishin.lee@bc.edu, Mustafa Tongarлак

By-product synergy (BPS) is a form of joint production that uses the waste stream from one (primary) process as useful input into another (secondary) process. We investigate how BPS can mitigate food waste in a retail grocer setting, and how it interacts with other mechanisms for reducing waste (i.e., waste disposal fee and tax credit for food donation). We derive the retailer's optimal order policy under BPS, showing how it affects the amount of waste.

4 - Improving Food Bank Gleaning Operations: An Application in New York State

Erkut Sonmez, Assistant Professor, Boston College, 140 Commonwealth Ave, Fulton Hall, Chestnut Hill, 02446, United States of America, erkut.sonmez@bc.edu, Miguel Gomez, Deishin Lee, Xiaoli Fan

We develop a stochastic optimization model to help food banks to improve their gleaning operations. Gleaning refers to collecting food from what is left in the fields after harvest, and donating the goods to food banks or pantries that service food insecure individuals.

■ TA48

48-Room 105A, CC

Managing Contracts and Financial Flow in Supply Chain

Sponsor: Manufacturing & Service Oper Mgmt/IFORM
Sponsored Session

Chair: Lingxiu Dong, Associate Professor, Washington University in St. Louis, One Brookings Drive, St. Louis, MO, 63132, United States of America, dong@wustl.edu

1 - Buyer Intermediation in Supplier Finance

Tunay Tunca, ttunca@rhsmith.umd.edu, Weiming Zhu

We analyze the role and the efficiency of buyer intermediation in supplier financing (BIF). We theoretically demonstrate that BIF can significantly improve the supply chain surplus over traditional financing. Using data from a large Chinese online retailer, we estimate model parameters, empirically verify the theory, and predict efficiency gains.

2 - Financial Pooling in Supply Chains

S. Alex Yang, Assistant Professor, London Business School, Sussex Place, London, United Kingdom, sayang@london.edu, Qu Qian, Ming Hu

Trade credit pools liquidity between suppliers and retailers. Due to this pooling effect, even if the supplier's cost of capital is higher, the retailer may still demand for trade credit. Supply chain finance increases the efficiency of this pooling effect, and hence reduces the overall chain financing cost.

3 - Trade Credit and Supplier Competition

Jiri Chod, Boston College, Carroll School of Management, Chestnut Hill, MA, jiri.chod@bc.edu, S. Alex Yang, Evgeny Lyandres

We study the effect of competition among suppliers on their willingness to provide trade credit. Providing trade credit to a financially constrained buyer allows this buyer to reallocate his cash budget to purchasing from competing suppliers. Thus, relaxing the buyer's financial constraint may backfire at the supplier who provides financing. This is a possible explanation of the empirical regularity that firms selling differentiated products tend to offer more trade credit.

4 - Push, Pull, and Delayed Payment Contracts when a Manufacturer Expands His Product Line

Xiaomeng Guo, PhD Candidate, Olin Business School, Washington University in St. Louis, Campus Box 1156, One Brookings Drive, St. Louis, MO, 63130, United States of America, xiaomeng.guo@wustl.edu, Lingxiu Dong, Danko Turcic

A manufacturer's ability to sell a new product often depends on a retailer's willingness to stock the product. We construct a game-theoretic model of a supply chain with stochastic, price-sensitive demand and consider three basic wholesale price contracts: push, pull and delayed payment contracts. We show how a manufacturer can influence the retailer's incentive to carry a second product by choosing a "correct" contract type and clarify which contract should be expected in equilibrium.

■ TA49

49-Room 105B, CC

Uncertainty in Sourcing and Procurement

Sponsor: Manufacturing & Service Oper Mgmt/Supply Chain
Sponsored Session

Chair: Zohar Strinka, PhD Candidate, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, zstrinka@umich.edu

1 - Supplier Diversification under Random Yield and Price Dependent Demand

Guang Xiao, Olin Business School, Washington University in St. Louis, St. Louis, United States of America, xiaoguang@wustl.edu, Lingxiu Dong, Nan Yang

We consider a firm's supply diversification problem under supply random yield and price sensitive demand. We study two pricing schemes: responsive pricing and ex ante pricing. We characterize the sourcing decisions under each pricing scheme and compare them to study the strategic relation between diversification and responsive pricing.

2 - Risk Pooling under Price and Demand Uncertainty

Refik Gullu, Professor, Bogazici University, Industrial Engineering Dept., Bebek, Istanbul, 34342, Turkey, refik.gullu@boun.edu.tr, Nesim K. Erkip

We consider purchasing and distribution decisions for a commodity whose price is random and correlated with its demand. A model, where the purchasing decisions of locations are pooled is proposed. We obtain the optimal purchase quantity, time and quantity of allocation, and quantify the benefits of pooling price risk.

3 - Bunching Supply Contracts with Information Asymmetry in a Two-echelon Supply Chain

Zahra Mobini, Erasmus University Rotterdam, Rotterdam, Netherlands, mobinidehkordi@ese.eur.nl, Albert Wagelmans, Wilco Van Den Heuvel

In a two-echelon supply chain consisting of a supplier and a retailer where the latter has private information about his cost parameter, we analyze the design of the supplier's optimal menu of contracts. Instead of offering a separating menu, the supplier offers a menu of bunching contracts where each contract is intended to appeal to more than one retailer type. We investigate the effects of offering such a menu on the supplier's profit.

4 - Overstock Goods Auctions

Zohar Strinka, PhD Candidate, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, zstrinka@umich.edu, H. Edwin Romeijn

Manufacturers sometimes find themselves with a considerable quantity of overstock goods. In these cases, some turn to online liquidation auctions to sell excess inventory. We propose implementing US Treasury-style auctions in this setting which allow bidders to specify pairs of bid price and a desired quantity at that price. We consider bidders who are themselves retailers and face newsvendor-type costs based on the number of units won and uncertain demand.

■ TA50

50-Room 106A, CC

Operations Management and Marketing Interface

Sponsor: Manufacturing & Service Operations Management
Sponsored Session

Chair: Ozge Sahin, Johns Hopkins University, ozge.sahin@jhu.edu

Co-Chair: Yao Cui, Cornell University, 401N Sage Hall, Ithaca, United States of America, yao.cui@cornell.edu

1 - Econometric Models of Pairwise Externalities and Social Attractiveness for the Music Industry

Stefano Nasini, Post-doctoral Researcher, IESE Business School, 3-7, Arnau i Gari, Barcelona, Spain, snasini@iese.edu, Víctor Martínez-de-Albéniz

We developed an econometric model of social attractiveness that integrates time variation of individual decisions with the structural information concerning their spillovers. The exponential family of distributions is used to jointly deal with the dynamic and structural aspect of such a complex statistical setting. It resulted in a well-suited model for the analysis of artist goods. An application to a large data set of song diffusion on the radio is presented.

2 - Inventory Management for Luxury Goods

Ruslan Momot, INSEAD, Boulevard de Constance, Fontainebleau, 77305, France, ruslan.momot@insead.edu, Elena Belavina, Karan Girotra

Firms selling conspicuous goods face a trade-off: producing more allows for extracting more revenues but compromises the product's reputation for exclusivity. We capture this trade-off in a dynamic model of strategic customer and firm behavior that includes limited memory. Firms should follow stationary cyclic strategies alternating scarcity and overproduction. The former builds a reputation whereas the latter exploits it. The longer the customer memory, shorter is the overproduction phase.

3 - A Newsvendor Model with Product Bundling

Qingning Cao, University of Science and Technology of China, 96 Jinchai Rd, SM 611, Hefei, China, caoq@ustc.edu.cn, Jun Zhang, Kathy Steckle, Xianjun Geng

This paper studies a firm's optimal ordering decision of a primary product when the firm can bundle this product with another product. The firm makes an ordering decision before demand uncertainty resolves, and then retails this primary product either alone or in a mixed bundle with a secondary product. Our results suggest that as compared to a no-bundling benchmark, the firm should overstock (understock) when the wholesale price is high (low).

4 - Strategic Consumers, Revenue Management and the Design of Loyalty Programs

So Yeon Chun, McDonough School of Business, Georgetown University, 3700 O St. NW, Washington, DC, United States of America, scl286@georgetown.edu, Anton Ovchinnikov

Several major airlines recently switched their loyalty programs from "mileage/segment-based" toward "spending-based". We study the impact of this switch on firm's profit and consumer utility. We present a novel model of strategic consumers' response to firm's pricing and loyalty program decisions, incorporate such response into the firm's pricing and loyalty program design problem, compare the solutions under the mileage-based versus spending-based design, and discuss managerial implications.

■ TA51

51-Room 106B, CC

Economics of Innovation in Supply Chains

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Ayhan Aydin, Assistant Professor Of Operations Management, George Mason University School of Business, 4400 University Drive MS 5F4, Fairfax, VA, 22030, United States of America, aaydin2@gmu.edu

1 - Product Quality in a Decentralized Supply Chain: Value of Information Asymmetry

Narendra Singh, Narendra.Singh@scheller.gatech.edu, Stylianos Kavadias, Ravi Subramanian

We study an OEM's optimal product design quality and sourcing strategies in a supply chain consisting of an OEM, who has in-house option, and a supplier, who has more favorable cost structure and the power to dictate contract terms. We show that a two-part tariff contract, as opposed to a price-only contract, may leave both the OEM and the supplier worse off. Further, we show that asymmetric information about the OEM's cost structure may lead to higher profits for both the OEM and the supplier.

2 - Information Acquisition and Innovation in Competitive Markets

Yi Xu, Associate Professor, Smith School of Business, University of Maryland, College Park, MD, 20742, United States of America, yxu@rhsmith.umd.edu, He Chen, Manu Goyal

In this paper, we study firms' information acquisition strategies and innovation strategies in a competitive market with uncertainty. The firms can resolve the market uncertainty through different information acquisition methods. We highlight the strategic interactions between information acquisition and innovation investments in such a market.

3 - Investment in Core Technologies and Consumer Markets

Ayhan Aydin, Assistant Professor Of Operations Management, George Mason University School of Business, 4400 University Drive MS 5F4, Fairfax, VA, 22030, United States of America, aaydin2@gmu.edu, Rodney Parker

We consider a two-tier supply chain, an upstream tier composed of two competing providers of a component that is used by multiple OEMs (integrators) in the lower tier. Upstream firms invest to develop the technology of the component further. We investigate the effects of downstream market factors, the nature of technology, competition, and the level of uncertainties in the R&D process on the level of upstream investments and the adoption of the higher technologies by the downstream firms.

■ TA52

52-Room 107A, CC

Consumer-driven Management Science

Sponsor: Marketing Science

Sponsored Session

Chair: Ricardo Montoya, Assistant Professor, University of Chile, Republica 701, Santiago, Chile, rmontoya@dii.uchile.cl

1 - Product Showcasing in the Presence of Experience Attributes

Daria Dzyabura, Assistant Professor of Marketing, NYU Stern School of Business, 40 West 4th Street, Tisch 805, New York, NY, 10012, United States of America, ddzyabur@stern.nyu.edu, Srikanth Jagabathula

We formalize a firm's showcase decision, or selecting a subset of products to carry in a physical store, while a 'large' product line is offered through the online channel. Some customers visit the offline store to gain information about product features. We formalize the showcase problem as an IP, which we show to be NP-complete, derive closed-form solutions for special cases, and adapt the local search heuristic to the general problem. We gather conjoint data to estimate the model parameters.

2 - Price Drop Protection Policy with Partial Refunds

Dinah Cohen-Vernik, Assistant Professor Of Marketing, Rice University, 6100 Main St, Houston, TX, 77006, United States of America, dv6@rice.edu, Amit Pazgal

Many retailers now offer to refund customers the full price difference as long as the price drop occurred within a specified short period of time after the purchase. Despite the popularity of such policy, the existing marketing research on the topic is scarce. In this paper we investigate the price difference refund policy (referred to as price drop protection) and demonstrate how it can improve retailer's profits.

3 - Clicks and Editorial Decisions: How Does Popularity Shape Online News Coverage?

Pinar Yildirim, Assistant Professor Of Marketing, The Wharton School, University of Pennsylvania, 748 Huntsman Hall, Philadelphia, PA, 19104, United States of America, pyild@wharton.upenn.edu, Ananya Sen

Using online news data from a large Indian English daily newspaper, this paper analyzes how demand side incentives shape news media reporting. To establish a causal link, we instrument the views of articles using days with rain and days with electricity shortage as exogenous shocks to reader attention. We provide evidence for extended coverage and higher resource allocation to issues which receive high number of clicks.

4 - Stock-out Detection System Based on Sales Transaction Data

Ricardo Montoya, Assistant Professor, University of Chile, Republica 701, Santiago, Chile, rmontoya@dii.uchile.cl, Andres Musalem, Marcelo Olivares

We present a methodology based on real-time point-of-sales data to infer on-shelf product availability. We develop our methodology using process control theory and apply it to a big-box retailer. We use historical transactional data to develop our methodology and empirically test it in two field studies. We analyze the results and implications.

■ TA53

53-Room 107B, CC

Behavior in Operational Contexts

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Anton Ovchinnikov, Queen's University, 143 Union Str, West, Kingston, Canada, anton.ovchinnikov@queensu.ca

1 - Behavioral Ordering: Inventory, Competition and Policy

Bernardo Quiroga, Assistant Professor, Business And Behavioral Science, Clemson University, 100 Sirrine Hall, Clemson, SC, 29634, United States of America, bfquirog@gmail.com, Anton Ovchinnikov, Brent Moritz

We study the effect of observed inventory decisions on performance. Our goal is to measure and understand profit losses due to behavioral (intuitive but suboptimal) ordering. The current literature, primarily focused on a newsvendor making decisions in isolation, reports results implying profit losses of 1-5% compared to the analytical optimum. In contrast, we show that when a behavioral inventory manager competes against a management-science-driven competitor, profit losses are much larger.

2 - Inequity and Loss Aversion in Pay What You Want

Yulia Vorotyntseva, PhD Candidate, The University of Texas at Dallas, Richardson, United States of America, Yulia.Vorotyntseva@utdallas.edu, Ozalp Ozer

Pay-What-You-Want pricing is an exemplar of fairness-driven behavior in a business context: the price for a product is fully determined by a buyer, and the seller cannot reject any offer. The objective of our work is to find out key factors affecting the buyers' selection of prices under PWYW. We use a distributional fairness approach and build a hierarchical Bayesian model of buyers' behavior. We then test it in a controlled laboratory experiment.

3 - Inventory Decisions in the Presence of Strategic Consumers

Yaozhong Wu, National University of Singapore, NUS Business School, Singapore, yaozhong.wu@nus.edu.sg, Yang Zhang, Benny Mantin

In the presence of strategic consumers, who may delay their purchase to the markdown season, a retailer is faced with an extra consideration in addition to the traditional newsvendor setting: excess inventory may induce strategic consumers to delay their purchase and may further harm the revenue. We develop a model that accounts for both the strategic consumers and the retailer's inventory decisions. We design behavioral experiments to test our model predictions.

4 - When to Hire the First Employee? Behavioral Evidence and Insights

Beatrice Boulu-reshef, Behavioral Research Associate, Darden School of Business, 100 Darden Boulevard, Charlottesville, VA, 22903, United States of America, Boulu-ReshefB@darden.virginia.edu, Anton Ovchinnikov, Charles Corbett

Effectively any entrepreneur shifts from doing all the work him/herself to hiring someone to do part of that work. We use an analytical model and behavioral experiments to study when entrepreneurs should and do hire their first employee. Understanding both the optimal timing/conditions of hiring and the deviations of the hiring patterns from optima have the potential to provide insights to a very broad spectrum of entrepreneurs at the critical early stage of their new venture formation process.

■ TA54

54-Room 108A, CC

Applying Machine Learning in Online Revenue Management

Cluster: Tutorials

Invited Session

Chair: David Simchi-Levi, Professor, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, dslevi@mit.edu

1 - Tutorial: Applying Machine Learning in Online Revenue Management

David Simchi-Levi, Professor, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, dslevi@mit.edu

In a dynamic pricing problem where the demand function is unknown a priori, price experimentation can be used for demand learning. In practice, however, online sellers are faced with a few business constraints, including the inability to conduct extensive experimentation, limited inventory and high demand uncertainty. In this talk we discuss models and algorithms that combine machine learning and price optimization that significantly improve revenue. We report results from live implementations at companies such as Rue La La, Groupon and a large European Airline carrier.

■ TA55

55-Room 108B, CC

Extensions of DEA

Cluster: Data Envelopment Analysis

Invited Session

Chair: Endre Bjørndal, Associate Professor, Norwegian School of Economics, Helleveien 30, Bergen, 5045, Norway, Endre.Bjørndal@nhh.no

1 - Assessment of Alternative Approaches to Include Exogenous Variables in DEA Estimates

Jose M. Cordero, Universidad de Extremadura, Av Elvas sn, Badajoz, Spain, jmcordero@unex.es, Daniel Santin

The aim of this paper is to compare the performance of some recent methods developed in the literature to incorporate the effect of external variables into the estimation of efficiency measures such as the conditional approach developed by Daraio and Simar (2005, 2007) or the one-stage model proposed by Johnson and Kuosmanen (2012). To do this, we conduct a Monte Carlo experiment using a translog function to generate simulated data.

2 - Compensating for Exogenous Cost Drivers in the Regulation of Electricity Networks

Endre Bjørndal, Associate Professor, Norwegian School of Economics, Helleveien 30, Bergen, 5045, Norway, Endre.Bjørndal@nhh.no, Maria Nieswand, Mette Bjørndal, Astrid Cullmann

The present yardstick model used by the Norwegian regulator compensates, via two-stage DEA efficiency analysis, for a number of environmental factors. These factors are correlated with measured efficiency and company size. We compare conditional nonparametric methods to current benchmarking model, and we discuss whether the choice of method affects the revenue caps of companies in a systematic manner.

3 - Slacks-based Measure Variations Revisited

Kaoru Tone, Professor, National Graduate Inst. for Policy Studies, 7-22-1 Roppongi, Minato-ku, Tokyo, 106-8677, Japan, tone@grips.ac.jp

In Tone (2010), I developed four variants of the SBM model where main concerns are to search the nearest point on the efficient frontiers of the production possibility set. However, in the worst case, a massive enumeration of facets of polyhedron associated with the production possibility set is required. In this paper, I will present a new scheme for this purpose which requires a limited number of additional linear program solutions for each inefficient DMU.

■ TA56

56-Room 109A, CC

Execution Mode Choices for NPD

Cluster: New Product Development

Invited Session

Chair: Pascale Crama, Singapore Management University, 50 Stamford Road, Singapore, 178899, Singapore, pcrama@smu.edu.sg

1 - Managing Exploration and Execution

Nittala Lakshminarayana, University of California San Diego, 9256 Regents Road Apt. G, La Jolla, CA, 92037, United States of America, Lakshminarayana.Nittala@rady.ucsd.edu, Sanjiv Erat, Vish Krishnan

We model Innovation as a multi-stage activity consisting of Exploration and Execution. Within this parsimonious model that mimics many contexts in Innovation, we consider the effect of incentives and several institutional features on the optimal idea generation and development strategy.

2 - Customer Co-design: The Role of Product Lines

Sreekumar Bhaskaran, sbhaskar@mail.cox.smu.edu, Amit Basu

Involving customers in the new product design can be a powerful means to achieve high levels of customer satisfaction and market success. However, the "co-design" process may require participating customers to commit significant time and effort, while facing the uncertainty that the firm may overprice the custom product. Since this reduces a customers incentive to commit effort up-front, co-design can be difficult to motivate. We develop analytical models that capture these various effects.

3 - Flexibility and Knowledge Development in Product Development: Insights from a Landscape Search Model

Mohsen Jafari Songhori, Jsp Research Fellow, Tokyo Institute of Technology, J2 Bldg., Room 1704, 4259 Nagatsuta-cho., Tokyo, 226-8502, Japan, mj2417@gmail.com, Majid Abdi, Takao Terano

This study introduces a landscape model of Product Development (PD). The model captures different PD performance aspects (e.g. development time, quality and cost) and their trade-offs. Moreover, knowledge development dynamics and flexibility are incorporated in the model to investigate how strategies toward these, in PD process, are associated with the performance measures.

■ TA57

57-Room 109B, CC

Applications of Stochastic and Dynamic Programming in Energy

Sponsor: ENRE – Energy II – Other (e.g., Policy, Natural Gas, Climate Change)

Sponsored Session

Chair: Andrew Liu, Assistant Professor, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47907, United States of America, andrewliu@purdue.edu

1 - Approximate Dynamic Programming for Pricing-based Real-time Demand Management

Ozgur Dalkilic, The Ohio State University, 205 Drees Labs, 2015 Neil Ave, Columbus, OH, 43210, United States of America, dalkilic.1@buckeyemail.osu.edu, Atilla Eryilmaz, Antonio Conejo

We consider the real-time demand management problem of a load aggregator that coordinates the consumer demand to match a predetermined daily load. The aggregator's objective is to minimize its payment to the real-time market. Under uncertainty of the market prices, we derive dynamic pricing algorithms that approximate the optimal dynamic programming solution. We show via numerical investigations that the proposed algorithms coordinate flexible demand and achieve close to optimal allocation.

2 - A Revenue Adequate Stochastic Programming Market Clearing Mechanism for Effective Integration of Volatile Renewable Generation

Golbon Zakeri, Dr., University of Auckland,
Auckland, New Zealand, g.zakeri@auckland.ac.nz

Petration of generation from volatile renewable sources of electricity generation has substantially increased in electricity markets around the world. Various authors (e.g. Pritchard et al and Morales et al) have proposed mechanisms to deal with this however these approaches are not revenue adequate under each scenario (although they are in expectation). We will introduce a variation of the stochastic dispatch mechanism that is revenue adequate under each scenario and present its properties.

3 - Parallel Computing of Stochastic Programs with Application to Energy System Capacity Expansion

Andrew Liu, Assistant Professor, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47907, United States of America, andrewliu@purdue.edu, Run Chen

Power grids' planning and operations exhibit extreme multiscale, ranging from hourly operation to decades of planning. The linkage between decisions at different time scales may be relaxed to produce multiple independent subproblems. We propose to use an augmented Lagrangian multiplier method to design parallel algorithms to solve such multiscale problems. Convergence of the embedded algorithm for convex problems will be shown, along with preliminary numerical results.

■ TA58

58-Room 110A, CC

Topics in Oil, Natural Gas, and Alternative Fuels

Sponsor: ENRE – Energy II – Other (e.g., Policy, Natural Gas, Climate Change)

Sponsored Session

Chair: Sauleh Siddiqui, Assistant Professor, Johns Hopkins University, 3400 N. Charles St. Latrobe 205, Baltimore, MD, 21218, United States of America, siddiqui@jhu.edu

1 - Rate-of-return Regulation and Investment in a Natural Gas Pipeline

Olivier Massol, IFP School, 228-232 avenue Napoléon Bonaparte, Rueil-Malmaison, France, olivier.massol@ifpen.fr, Florian Perrotton

We examine the economics of a natural gas pipeline project provided by a foreign private firm in a LDC. The infrastructure could trigger possible future developments of the domestic gas sector. We address two questions. First, can a rate-of-return (ROR) type of regulatory organization induce the firm to rationally accept to build ahead of proven demand? Second, how far would the allowed ROR have to rise for the pipeline design to be adopted be congruent with the socially desirable one?

2 - Multistage Stochastic Model for Natural Gas Contract and Maintenance Scheduling of Power Plants

Zhouchun Huang, University of Central Florida, 4000 Central Florida Blvd, Orlando, FL, 32816, United States of America, hzclinger@gmail.com, Qipeng Zheng

Natural gas contracting and equipment maintenance scheduling are two major factors that affect the profit of a natural gas power plant. We consider both of them together and propose a multistage stochastic model to address the uncertainties of gas and electricity prices in the market. A scenario-based decomposition strategy is applied to solve the model and the numerical results will be present.

3 - A Crude Oil Market Model for the United States

Olufolajimi Oke, PhD Candidate, Johns Hopkins University, 3400 N Charles St, Latrobe 205, Baltimore, MD, 21218, United States of America, ooke1@jhu.edu, Max Marshall, Ricky Poulton, Sauleh Siddiqui, Daniel Huppman

The United States' crude oil industry currently faces infrastructural and environmental challenges, as production surges and crude-by-rail shipments and incidents increase. We adapt Huppman and Egging's dynamic Generalized Nash Equilibrium model (Multimod) to the US market. Thus, we can analyze the transportation of crude oil and explore possible scenarios to recommend decisions for safe movement, as well as gauge the economic impact of new regulations and policy interventions.

4 - Volumes for the Renewable Fuel Standard using Multiobjective Programs with Equilibrium Constraints

Sauleh Siddiqui, Assistant Professor, Johns Hopkins University, 3400 N. Charles St. Latrobe 205, Baltimore, MD, 21218, United States of America, siddiqui@jhu.edu, Adam Christensen

We apply a Multiobjective Program with Equilibrium Constraints to the United States renewable fuel market to help understand why it has been so difficult in releasing the 2014 mandate for the Renewable Fuel Standard. Our analysis provides a variety of policy alternatives to aid in setting these volume obligations and is applicable to a wide variety of climate and energy market settings.

■ TA59

59-Room 110B, CC

Fire Management 1: Suppression

Sponsor: ENRE – Environment II – Forestry

Sponsored Session

Chair: Vitaliy Krasko, Colorado School of Mines, 1500 Illinois St, Golden, CO, United States of America, vkrasko@mymail.mines.edu

1 - Efficient use of Aerial Firefighting Assets

Matthew Thompson, US Forest Service, 800 E Beckwith, Missoula, MT, 59801, United States of America, mpthompson02@fs.fed.us

This presentation will explore themes in measuring and improving the efficiency of aerial firefighting assets. Insights from case studies in the US and Italy will be highlighted.

2 - The Development and use of Forest Fire Detection System Performance Measures

Dave Martell, david.martell@utoronto.ca

Forest fire detection systems are designed to detect fires while they are small but concerted efforts to minimize detection size can enhance the performance of the detection sub-system at the expense of overall fire management system performance. We describe the development and use of a detection system performance measure designed to overcome such problems.

3 - A Network Interdiction Approach for Mitigating a Pyro-Terror Attack

Eghbal Rashidi, PhD Student, Mississippi State University, 1212 Louisville St, # 58, Starkville, MS, 39759, United States of America, er442@msstate.edu, Hugh Medal

We study a problem in which a group of terrorists seek to maximize the impact of a pyro-terror attack by optimally locating the fire ignition points on a landscape, whereas fire managers wish to interdict the expansion of fire and mitigate the damage using an optimal fuel treatment plan. We model the problem as a Stackelberg game and develop a decomposition algorithm to solve it.

4 - Machine Learning Methods to Improve Fire Suppression Policies on Simulated Landscapes

Hailey Buckingham, hailey.buckingham@oregonstate.edu, Claire Montgomery

Any policy which informs wildfire suppression decisions affects the future evolution of the landscape as patterns of growth, harvest, and fire each adjust to the influence of the policy's fire suppression regime. Improving a policy is difficult because the long-term effects may not be obvious a priori because present decisions change future states. In this study, we use machine learning techniques and monte carlo simulations of forested landscapes to improve a wildfire suppression policy.

■ TA60

60-Room 111A, CC

Education I

Contributed Session

Chair: Nabil Belacel, Senior Research Officer, NRC, 100 des Aboiteaux Street, Moncton, NB, E1A7R1, Canada, nabil.belacel@nrc.gc.ca

1 - Co-Author Network Analysis of Operations Management Journals

Bonie(he) Zhang, PhD Candidate, Rutgers Business School, 1 Washington Park, Newark, United States of America, boni.zhang@rutgers.edu, Yao Zhao, Xinxin Xuan

We study the co-author network of flag-ship INFORMS journals in operations management such as Management Science and Operations Research. Our empirical exploration characterizes the changing patterns of the co-author network and provides insights to authors on how to improve productivity through exploitation of the academic social network.

2 - Case Study: Vastrapur Car Rental Services

Balaraman Rajan, Assistant Professor, California State University East Bay, 25800 Carlos Bee Blvd, Hayward, CA, 94542, United States of America, balaraman.rajan@csueastbay.edu, Ravichandran Narasimhan

In this case we discuss the revenue model for a rental car business in India. The case can be used for teaching topics in probability and decision modeling at both undergraduate and graduate level. The first part of the case focuses on expected value and the second part of the case involves decision making under uncertainty and strategic choices. It can also be extended to train students in basic simulation using Crystal Ball or other such tools.

3 - A Learner-Analytics Based Approach for Attenuating the Course-Level Dropout Rate

Aysegul Demirtas, Graduate Student, Arizona State University, 699 S Mill Avenue, Tempe, AZ, 85281, United States of America, ademirt2@asu.edu, Jennifer Bekki, Esma Gel, George Runger

Despite their potential to attract larger numbers of students, online courses remain plagued by a student attrition problem. We apply data mining and learner analytics techniques to better understand online learner behavior in an effort to attenuate the online course drop-out rate. We present our modeling approach, utilizing data from student interactions with the course LMS, and our findings on course-level persistence based on the application of our approach to data from multiple courses.

4 - The School Closing Problem

Jing Xu, University of Pennsylvania, 209S 33rd Street, Department of Mathematics, Philadelphia, PA, 19104, United States of America, xjing@sas.upenn.edu

When school districts face declining enrollments, schools must be closed to reduce costs. The choice of which schools to be shuttered is controversial. Surprisingly, few papers have considered this problem. This paper considers the effect of using existing school choice mechanisms to close schools. It turns out simple modifications of existing algorithms produce perverse results. We also establish non-existence of a Pareto-efficient and strategy-proof mechanism in a basic school closing model.

TA61

61-Room 111B, CC

Sustainability in Energy Sector: Policy Analysis and Technology Assessment

Sponsor: ENRE – Environment I – Environment and Sustainability Sponsored Session

Chair: Yihsu Chen, Associate Professor, University of California, Merced, 5200 N. Lake Rd, Merced, CA, 95343, United States of America, ychen26@ucmerced.edu

1 - Market Impacts of Energy Storage in a Transmission-Constrained Power System

Afzal Siddiqui, University College London, Department of Statistical Science, Gower Street, London, UK, WC1E 6BT, United Kingdom, afzal.siddiqui@ucl.ac.uk, Vilma Virasjoki, Paula Rocha, Ahti Salo

Intermittent renewable energy (RE) technologies require conventional power plants to ramp up more often. In turn, energy storage may offset the intermittency of RE technologies and facilitate their integration into the grid. In order to assess the consequences of storage, we use a complementarity model with market power, transmission constraints, and uncertainty in RE output. We find that although storage reduces congestion and ramping costs, it may actually increase greenhouse gas emissions.

2 - Do Emissions Caps Lead to Carbon Leakage in Regional Markets? The Case of South-east Europe

Verena Viskovic, PhD Student, University College London, 50 Tiber Gardens, London, N/, N10XE, United Kingdom, verena.viskovic@gmail.com, Yihsu Chen, Afzal Siddiqui

We examine the extent of carbon leakage in neighbouring jurisdictions with different carbon emissions reduction policies. We use a complementarity model to illustrate carbon leakage on a three-node power system. Subsequently, we model a 19-node Southeastern European network in order to study carbon leakage on the periphery of the EU.

3 - Equilibrium Investment Strategies in Renewable Portfolio Standards under Uncertainty

Yuta Kamobayashi, Tokyo University of Science, 2641 Yamazaki, Noda-shi, Chiba, Japan, 7414609@ed.tus.ac.jp, Ryuta Takashima, Makoto Tanaka, Yihsu Chen

Recently renewable portfolio standard (RPS) has been introduced due to further penetration of renewable energies. In this paper, we propose a two-period competition model in an oligopolistic electricity industry with uncertain demand in order to consider investment behaviors for firms in a framework of the PRS. We analyze an effect of the RPS on investments in renewables and non-renewables. Additionally, we show how a percentage of production from renewables affects the market equilibrium.

4 - Analysis of Regional Market Impact of EPA's Clean Power Plan: Mass-based or Rate-based Standard?

Duan Zhang, University of California, Merced, 1392 Dynes St, Merced, CA, 95348, United States of America, dzhang8@ucmerced.edu, Yihsu Chen, Makoto Tanaka

We studied the market and emission outcomes of the EPA proposed rate-based emission policy or the Clean Power Plan. A theoretical model was built to generate contestable hypothesis. A large-scale simulation of the Pennsylvania-Jersey-Maryland electricity market in 2012 was used to validate the hypotheses and quantify the magnitude of impacts, including distribution of economics rent as well as the shift of pollution emissions. We report the preliminary results in this talk.

TA62

62-Room 112A, CC

Reliability and Random Factors in Power Systems

Cluster: Energy Systems: Design, Operation, Reliability and Maintenance

Invited Session

Chair: Bo Zeng, Assistant Professor, University of South Florida, Tampa, 4202 E. Fowler Avenue, Tampa, FL, 33620, United States of America, bzeng@usf.edu

1 - Protect Power System from Electromagnetic Pulse

Feng Pan, Research Engineer, Pacific Northwest National Laboratory, P.O. Box 999 MSIN K1-85, Richland, WA, 99352, United States of America, feng.pan@pnnl.gov, Russell Bent, Aric Hagberg

Power grids are vulnerable to Electromagnetic pulse (EMP) that can lead a power grid to collapse in a short time. We introduce an optimization model to configure a power grid prior to an EMP so that the damage caused by EMP is reduced. This talk will focus on the modeling aspect.

2 - Modeling Cascading Failures and Restoration Times in Power Networks to Address Resilience

Sinan Tas, Assistant Professor, Penn State University-Berks College, sut12@psu.edu, Vicki Bier

Prevention is generally the default solution in security investments of critical infrastructure. Electric power networks are capacity-constrained systems, which makes them a perfect candidate for cascading failure. Moreover, different components take substantially different times to recover. In this study, we will analyze investments that will possibly improve overall resilience of the network (rather than preventive ones that decreases the likelihood of such attacks).

3 - Joint Planning of Energy Storage and Transmission for Wind Energy Generation

Wei Qi, PhD Candidate, University of California, Berkeley, 1117 Etcheverry Hall, Berkeley, CA, 94720, United States of America, qiwei@berkeley.edu, Yong Liang, Zuo-jun Max Shen

Abstract: Regions with abundant wind energy usually have no ready access to power infrastructure. We propose models of transmission network planning with co-location of energy storage systems for wind energy delivery. Our models determine the sizes and sites of storage stations as well as the corresponding topology and capacity of the transmission network. Then we present various insights regarding storage value, technology advancements and layout robustness.

■ TA63

63-Room 112B, CC

KINFORMS Sponsored Session

Sponsor: KINFORMS

Sponsored Session

Chair: Chang Won Lee, Corresponding Author, Hanyang University, School of Business, Seoul, 133-791, Korea, Republic of, leecw@hanyang.ac.kr

1 - Study on the Supply Chain Management Critical Success Factors (csf)

Chang Won Lee, Corresponding Author, Hanyang University, School of Business, Seoul, 133-791, Korea, Republic of, leecw@hanyang.ac.kr, Gary Gaukler

For many companies, managing their supply chain has become increasingly central to their business success. Thus, it is crucial to investigate and identify appropriate supply chain practices for today's business environment. We call these practices, the Critical Success Factors (CSF) for supply chain management (SCM). Appropriate measures are developed and tested with a questionnaire survey. The results of the empirical analysis confirm that SCM-CSF can be conceptualized.

2 - Retailer's Optimal Sourcing Strategy under Consumer Stockpiling: A Risk Management Approach

Jiho Yoon, Michigan State University, N468 North Business Complex, Michigan State University, East Lansing, MI, 48824-1121, United States of America, yoon@broad.msu.edu, Ram Narasimhan, Myungkyo Kim

We study a retailer's sourcing strategy under consumers' stockpiling behavior and the factors associated with the selection of an optimal strategy in multi-tier supply chains in the presence of supply disruption risk. Stockpiling behavior occurs when consumers attempt to mitigate the negative impact of a supply shortage. Our analysis shows that optimal sourcing strategy is highly dependent on multiple factors.

3 - Relationships in Servitization, Satisfaction and Intention to Reuse: Customers' Perspective

Sang Hyung Ahn, Professor, Seoul National University, Graduate School of Business, Seoul, Korea, Republic of, shahn@snu.ac.kr, Chang Won Lee

This study presents to find out a relationship among characteristics of servitization, satisfaction and intention to reuse in terms of customers' perspective. The results were examined to identify significant factors affecting servitization, satisfaction and intention to reuse. The study provides decision-makers with more accurate information to develop appropriate servitization practices in terms of customers perspective.

4 - Industrialization, Productivity and the Shift to Services and Information

Hosun Rhim, Professor Of Logistics, Service, And Operations Management, Korea University Business School, Anam-dong, Seongbuk-gu, 136-701, Seoul, Korea, Republic of, hrhim@korea.ac.kr, Uday Karmarkar, Kihoon Kim

The traditional explanation for the shift to services was the steady growth of manufacturing productivity. But this does not explain the initial growth in manufacturing, or that of information intensive services relative to physical services. The authors adduce a second factor that explains both trends: the relative maturity of a market.

■ TA64

64-Room 113A, CC

The Journey to Organizational Decision Quality (ODQ)

Sponsor: Decision Analysis

Sponsored Session

Chair: Carl Spetzler, CEO, Strategic Decisions Group, 745 Emerson Street, Palo Alto, CA, 94301, United States of America, cspetzler@sdg.com

1 - Progress in the Adoption of ODQ (Organizational Decision Quality)

Carl Spetzler, CEO, Strategic Decisions Group, 745 Emerson Street, Palo Alto, CA, 94301, United States of America, cspetzler@sdg.com

To set the stage for the following speakers, this session will provide a quick review of ODQ, the ODQ maturity curve, and the progress that companies are making on the journey to ODQ. After the following speakers, we will have a panel discussion on the challenges faced by champions on the journey to ODQ and how they are best met.

2 - Lessons Learned Deploying ODQ

Larry Neal, Independent, 3667 Cantelow Rd, Vacaville, CA, 95688, United States of America, lnealjr@wildblue.net, Frank Koch

A panel of seasoned practitioners will discuss the lessons learned in deploying the concepts of Decision Quality throughout their organization, or ODQ. After brief opening remarks, the panel will discuss the learnings both positive and negative, of their experiences. The focus of this session is to help other institutions follow suit and raise the bar on their organization decision making practices. Attendees will come away with readily usable insights and tips for their own use.

3 - Applying Decision Analysis at Pfizer – Lessons Learned from the Field

Rodger Thompson, Sr. Director/team Leader, Pfizer, Inc., 500 Arcola Road, Collegeville, PA, 19426, United States of America, rodger.thompson@pfizer.com

This presentation will discuss the journey that the Portfolio and Decision Analysis (PDA) group at Pfizer has undertaken to bring decision excellence to the Pfizer organization. The discussion will focus on lessons learned on adapting the Dialog Decision Process to Pfizer to enable integration of the six components of decision quality.

■ TA65

65-Room 113B, CC

Recent Findings and Experiences in Probability Elicitation

Sponsor: Decision Analysis

Sponsored Session

Chair: Saurabh Bansal, Assistant Professor, Penn State Univrsity, 405 Business Building, University Park, PA, 16802, United States of America, sub32@psu.edu

1 - Indirect Elicitation of Subjective Probabilities through Pair-Wise Comparisons

David Budescu, Professor, Fordham University, 441 E Fordham Road, 220 Dealy Hall, Bronx, NY, 10458, United States of America, budescu@fordham.edu, Han Hui Por

We test a new method for eliciting subjective probabilities. Judges compare pairs of possible outcomes and identify which of the two is more likely, and by how much. These judgments generate a matrix from which the target probabilities are estimated by the geometric means. We compared the quality of our estimates with traditional direct estimates and show that they were significantly more accurate, suggesting that the new approach is a good candidate for replacing standard elicitation methods.

2 - Eliciting and Modeling Continuous Forecasts

Joe Tidwell, University of Maryland, Biology/Psychology Building, College Park, United States of America, jtidwell@umd.edu

Accurate forecasting models for continuous outcomes offer many benefits, including eliminating most close-call counterfactuals, better information about tail risks, and the ability to obtain forecasts for any value across the range of possible outcomes. In a series of experiments, we evaluate various methods for eliciting small sets of judgments from individual forecasters regarding real-world events and then aggregating these judgments over forecasters into continuous forecast models.

3 - Estimating Continuous Distributions by Quantifying Errors in Probability Judgments for Fixed Values

Asa Palley, Duke University, The Fuqua School of Business, 100 Fuqua Drive, Box 90120, Durham, NC, 27708, United States of America, asa.palley@duke.edu, Saurabh Bansal

In many managerial decision problems, the distribution for a continuous random variable must be obtained from expert judgments. Using a scale-free model of judgmental errors, we present a method for estimating distribution parameters through linear combinations of the judgments provided, where the weights are explicit functions of the expert's errors. Finally, we demonstrate the application and benefits of our approach using data collected in an experimental study.

4 - A Turning Point Model Based on Exponential Smoothing

Xiaoja Guo, University College London, Dept. of Management and Innovation, Gower Street, London, WC1E 6BT, United Kingdom, x.guo.11@ucl.ac.uk, Casey Lichtendahl, Yael Grushka-Cockayne

We propose a turning point model that extends the damped multiplicative trend exponential smoothing model. Our model offers the ability to dynamically update the local level and the growth trend, and ultimately to predict the turning point. This dynamic turning point model can be contrasted with non-dynamic models that are popular in the literature, such as the Bass diffusion model. We fit the model to several well-studied time series and examine the model's performance.

■ TA66

66-Room 113C, CC

Airline/Airport Operations Management

Sponsor: Aviation Applications

Sponsored Session

Chair: Ahmed Ghoniem, Isenberg School of Management, UMass Amherst, 121 Presidents Dr., Amherst, MA, 01002, United States of America, aghoniem@isenberg.umass.edu

1 - A Simulation-optimization Approach for Robust Aircraft Routing and Flight Retiming

Mohamed Haouari, Professor, Qatar University, BP 2713, Doha, Qatar, mohamed.haouari@qu.edu.qa, Mohamed Ben Ahmed, Farah Zeghal Mansour

We propose a novel simulation-optimization approach for solving the robust aircraft routing and flight retiming problem. The approach requires iteratively solving a mixed-integer quadratic programming problem that aims at optimally inserting buffer times between consecutive flights, and invoking a Monte-Carlo procedure for assessing the robustness of the generated schedules. We present the results of extensive computational experiments that were carried out on a real data.

2 - Airlines' Hedging Policies: An Empirical Approach to the U.S. Domestic Market

Soheil Sibdari, Associate Professor, UMass Dartmouth, 285 Old Westport Rd, North Dartmouth, MA, Dartmouth, United States of America, ssibdari@umassd.edu

We study airlines's hedging policies during years 2002-2015 according to their corporate's yearly report. An empirical study examines airlines' policy and determine the impact of airline size, market share, and the airlines' aircraft sizes on the hedging effectiveness.

3 - Meta-heuristic Algorithm for the Multiple Runway Aircraft Scheduling Problem

Bulent Soykan, Old Dominion University, Dep. of Eng. Mngt. and Systems Eng., Norfolk, VA, United States of America, bsoyk001@odu.edu, Ghaith Rabadi

Multiple Runway Aircraft Scheduling Problem involves assigning both landing and taking-off aircrafts to runways, sequencing them on each runway and assigning each aircraft a landing or take-off time while considering predetermined time windows for each aircraft to land or take-off. This research aims to develop a tabu search/path relinking algorithm for the static case of the problem, where all information of aircraft is known in advance.

4 - A Two-Stage Airport Surface 4D Taxiing Trajectory Scheduling Strategy Considering Runway Exit Select

Xiang Zou, Tsinghua University, Room 430, Main Building, Tsinghua Univ., Beijing, China, x-zou10@mails.tsinghua.edu.cn, Bang An

This paper proposes a two-stage airport taxing scheduling policy. In the first stage, all of the interested aircrafts are assigned initial routes. Then, aircrafts unavailable to fulfill their initially assigned routes are rescheduled. We do not fix the runway exits of landing aircrafts. Instead, we introduce Runway Exit Availability and a MIP model to assign 4D taxiing trajectories. Test in the environment of Beijing Capital Airport shows the effectivity and efficiency of the approach.

■ TA67

67-Room 201A, CC

Advanced Routing Models

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Qie He, University of Minnesota, 111 Church Street SE, Minneapolis, United States of America, qhe@umn.edu

1 - Pollution-routing Problems with Speed and Departure Time Optimization

Raphael Kramer, PhD Student, Universita degli Studi di Modena e Reggio Emilia, Via Amendola 2, 42122, Reggio Emilia, Italy, raphael.kramer@unimore.it, Thibaut Vidal, Anand Subramanian, Nelson Maculan

We consider the Pollution-Routing Problem with possible departure time optimization. This enables to better allocate human resources to time periods with higher delivery needs. An algorithm for speed and departure time optimization is introduced for any fixed route. Its optimality is proven. Integrating this algorithm into a classical metaheuristic generates high-quality routing solutions. Experimental analyses show the impact of departure time on speeds decision, emissions and labor costs.

2 - Exact Formulations and Algorithms for the Pollution Routing Problem

Yongjia Song, Virginia Commonwealth University, 821 W Franklin Street, Richmond, VA, United States of America, ysong3@vcu.edu, Ricardo Fukasawa, Qie He

We propose for the first time exact formulations of the pollution routing problem. These formulations are all mixed integer convex programs, with one being a mixed integer second-order cone program. The lower bounds provided by the continuous relaxations of these formulations are compared theoretically. Based on our formulations, instances with up to 25 customers in the literature are solved to optimality for the first time.

3 - A Column Generation Algorithm to Solve the Pollution Routing Problem

Fernando Santos, PhD, University of Waterloo, 200 University Avenue West, Waterloo, Canada, fernandoafonso1@gmail.com, Qie He, Ricardo Fukasawa, Yongjia Song

We introduced a set partitioning formulation and a column generation algorithm to solve the Pollution Routing Problem (PRP). To price out negative reduced cost routes we proposed a labelling algorithm that derives novel dominance rules in order to prune out unpromising labels and perform faster.

4 - The Deterministic Dispatch Waves Problem

Mathias Klapp, PhD Student, Georgia Tech, 755 Ferst Drive NW, Main Building #326, Atlanta, GA, 30332-0205, United States of America, maklapp@gatech.edu, Alan Erera, Alejandro Toriello

We study last-mile delivery systems by formulating the deterministic dispatch waves problem (DWP) that models a distribution center where geographically positioned orders arrive at known action periods (waves) throughout the day. At each wave, the decision maker chooses whether to dispatch a single vehicle or not and the subset of open orders to serve in the vehicle's route, with the objective of minimizing operational costs and penalties for unserved requests.

■ TA68

68-Room 201B, CC

Joint Session TSL/Public Sector: Resilience in Interdependent Infrastructure System

Sponsor: Transportation, Science and Logistics

Sponsored Session

Chair: Mohammad Khodayar, Southern Methodist University, 6251 Airline Rd, Junkins Bldg, suite 334, Dallas, TX, 75275, United States of America, mkhodayar@mail.smu.edu

1 - Interdiction Analysis of Coupled Electricity and Natural Gas Networks

Bowen Hua, The University of Texas at Austin, 1616 Guadalupe St, Austin, TX, 78701, United States of America, bhua@utexas.edu, Ross Baldick

We present a bilevel optimization model to identify the critical components of the coupled power and natural gas pipeline system. The upper-level problem involves the interdiction decisions and the lower-level problem represents the operation of the coupled system. We model the system operation as an MILP to include the nonlinear flow-pressure relations. Some theoretical properties of this bilevel program are analyzed. A decomposition algorithm is proposed to solve the problem.

2 - Quantifying the Resilience of an Urban Traffic – Electric Power Coupled System

Elise Miller-Hooks, Professor, University of Maryland, College Park, MD, elisemh@umd.edu, Seksun Moryadee, Steven Gabriel, Hossein Fotouhi

A nonlinear, stochastic, mixed integer program is presented for quantifying the resilience of the coupled traffic-power network to a disruption. The model captures interdependencies in this system, and seeks an optimal allocation of limited mitigation, preparedness and response resources to obtain an efficient resource allocation plan and maximum resilience estimate.

3 - Improving the Resilience of Multiple Energy Carrier Microgrids Against Deliberate Disruptions

Saeed Dehghan Manshadi, Southern Methodist University, 6251 Airline Rd, Junkins Bldg, Dallas, TX, 75275, United States of America, manshadi@mail.smu.edu, Mohammad Khodayar

This paper proposes a framework to identify the vulnerable components in the coordinated natural gas and electricity distribution networks in microgrids and to ensure the resilient operation of such interdependent networks. The proposed framework addresses deliberate actions to disrupt the energy flow in the microgrids and proposes reinforcement strategies to increase the resilience of the energy supply.

■ TA69

69-Room 201C, CC

Maritime Logistics

Sponsor: Transportation, Science and Logistics

Sponsored Session

Chair: Irina Benedyk, United States of America, birina@purdue.edu

1 - Solving the Pre-Marshalling Problem to Optimality

Kevin Tierney, Assistant Professor, University of Paderborn,
Warburger StraÙe 100, Paderborn, 33098, Germany,
kevin.tierney@upb.de, Stefan Voss, Dario Pacino

The pre-marshalling problem is a key problem at container terminals. The goal is to find a minimal sequence of re-shuffling containers in a set of stacks such that they are arranged according to the time each container must leave the stacks. We present a novel algorithm using A* and IDA* combined with several novel branching and symmetry breaking rules. We solve over 500 previously unsolved benchmark instances to optimality clearly outperforming current state-of-the-art methods.

2 - A Genetic Algorithms Based Approach to Develop Cost-Effective Annual LNG Delivery Program

Fatih Mutlu, Asst. Professor, Qatar University, Doha, Doha, Qatar,
fatihmutlu@qu.edu.qa

Developing a cost effective annual delivery program for liquefied natural gas suppliers is known to be among the most challenging integrated inventory, production, and maritime delivery routing problems. We use a genetic algorithms based approach to solve this problem. We produce alternative routes for the vessels, each of which represents a chromosome. Our method performs better than the exact solution method in all of the problem instances we solved.

3 - A Mathematical Model for the Ship Scheduling and Cargo Assignment Problem

Salomon Wollenstein Betech, Student, Instituto Tecnológico de
Estudios Superiores de Monterrey, Av Carlos Lazo 100, Alvaro
Obregón, DF, 01389, Mexico, s.wollenstein@gmail.com

Middle-size companies with maritime shipping face a scheduling and cargo-assignment problem. Given a set of demands, suppliers, contracts, and ships, the company must design their operations to minimize cost. A mathematical model is proposed that simultaneously solves the ship scheduling and cargo assignment problem for a period of a year, discretizing time in days. The algorithm is capable of solving the problem at a rate of five ships and ports in ten minutes.

4 - A Bivariate Probit Model to Analyze Perspectives for Container Shipping on the Northern Sea Route

Irina Benedyk, United States of America, birina@purdue.edu,
Srinivas Peeta

This study seeks to explore opportunities and barriers for container freight shippers to use the Northern Sea Route. A stated preference survey of freight shippers in East Asia and Europe is conducted. A Bivariate Probit Model is used to investigate attitudes towards the usage of the North Sea Route, and identify key factors that influence them.

■ TA70

70-Room 202A, CC

Advanced Analytics in Tactical Decision Making

Sponsor: Railway Applications

Sponsored Session

Chair: Krishna Jha, Vice President Research And Development, Optym,
7600 NW 5th Place, Gainesville, FL, 32607, United States of America,
krishna.jha@optym.com

1 - Forecast Locomotive Surplus and Deficit to Balance the Terminals and Shops

Kamalesh Somani, CSX Transportation, 500 Water St,
Jacksonville, FL, 32202, United States of America,
Kamalesh_Somani@CSX.com, Shankara Kuppa,
Artyom Nahapetyan

Number of locomotives coming into a terminal may not be same as number of locomotives going out. This creates imbalance where some terminals are in constant need for locomotives and some other terminals usually have spare locomotives. Similarly a shop may receive more locomotive than its capacity and at the same time another shop may not be used to its full capacity. We developed advance analytics tools which help to minimize network balancing cost and any train delay because of locomotives.

2 - Failure Prediction and Sensor Spacing Optimization Along Track Corridors

Yanfeng Ouyang, Univ. Of Illinois, 205 N. Mathews Ave, Urbana,
United States of America, yfouyang@illinois.edu, Zhaodong Wang

This talk describes a machine-learning based framework for determining sensor deployment to ensure optimal reporting of potential incident-prone failures of the passing traffic. A simulation-based optimization model is used to find the optimal sensor spacing.

3 - Development and Application of Line-of-road Emulator Tool in CSX

Yu Wang, Manager Operations Research, CSX Transportation
Inc., 500 Water Street, Jacksonville, FL, 32202,
United States of America, Yu_Wang@csx.com, Eric Pachman

Line-of-Road Emulator is a web-based tool to visualize train movements in a GIS view. The tool can highlight slow-moving and/or long-dwell trains with different styles of bubbles, which provides informative insights to help railroad managers understand the situation and investigate the reasons causing congestions. The tool was used to create an illustration video about the congestion happened on the northern tier of CSX network in 2014 winter, and has received high evaluation from the users.

4 - Optimization Algorithms for Hump Yard Decision Support System

Alexey Sorokin, Senior Systems Engineer, Optym, 7600 NW 5th
Place, Gainesville, FL, 32607, United States of America,
alexey.sorokin@optym.com, Ravindra Ahuja, Krishna Jha

Rail cars are classified to their appropriate outbound trains in yards. Important decisions made by yardmasters include the order in which trains should be humped and classification track on which a block should be built at any point in time. We developed optimization modules for a real-time decision support system that can assist yardmasters with these decision. Benefits of the optimization algorithms were computed using a hump-yard simulation system previously developed by Optym.

■ TA72

72-Room 203A, CC

DDAS for Industrial and System Engineering Applications I

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Shiyu Zhou, Professor, University of Wisconsin-Madison,
Department of Industrial and Systems Eng, 1513 University Avenue,
Madison, WI, 53706, United States of America, shiyuzhou@wisc.edu

Co-Chair: Yu Ding, Professor, Texas A&M University, ETB 4016,
MS 3131, College Station, TX, United States of America,
yuding@iemail.tamu.edu

1 - Dynamic Data Driven Applications Systems (DDAS): New Capabilities in Data Analytics

Frederica Darema, Program Director, Air Force Office of Scientific
Research, United States of America, frederica.darema@us.af.mil

This talk provides an overview of future directions enabling in new methodologies for analytics through the DDAS (Dynamic Data Driven Applications Systems) paradigm. We will discuss how DDAS allows new capabilities in data analytics to enable optimized and fault tolerant systems management, improved analysis and prediction of system conditions, in a diverse set of application areas ranging from aerospace applications to smart cities, to manufacturing planning and control, and cybersecurity.

2 - Offline Learning for Dynamic Data-driven Capability Estimation for Self-aware Aerospace Vehicles

Douglas Allaire, Assistant Professor, Texas A&M University,
425 MEOB, 3123 TAMU, College Station, TX, 77843,
United States of America, dallaire@tamu.edu, Benson Isaac

A self-aware aerospace vehicle can dynamically adapt the way it performs missions by gathering information about itself and its surroundings and responding intelligently. We present an information-theoretic approach to offline learning via the optimization of libraries of strain, capability, and maneuver loading using physics-based computational models. Online capability estimation is then achieved using a Bayesian classification process that fuses dynamic, sensed data.

■ TA73

73-Room 203B, CC

Functional Data Analysis

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Moein Saleh, Discover Financial Services/ Arizona State University, 699 S Mill Ave, Tempe, AZ, 85281, United States of America, Moein.Saleh@asu.edu

1 - On the Use of Gaussian Processes for Surface and Profile Data

Enrique Del Castillo, Penn State University, Industrial Eng. and Statistics Depts., State College, United States of America, exd13@psu.edu

Standard applications of Gaussian Processes in manufacturing data have traditionally been based on models of the form $z(x,y)$ where x,y,z are coordinates acquired with some sensor, so correlation is assumed to occur on euclidean space external to the surface. We show new methodology that assumes instead correlation exists on the intrinsic surface points along geodesic distances, and show how this leads to better surface reconstruction in both simulated and real datasets.

2 - Functional Clustering with Applications in Single Molecule Experiments

Ying Hung, yhung@stat.rutgers.edu

Cell adhesion experiments refer to biomechanical experiments that study protein, DNA, and RNA at the level of single molecules. Motivated by analyzing a single molecule experiment, a new statistical framework is proposed based on functional clustering approaches. Simulations and applications to real experiments are conducted to demonstrate the performance of the proposed method.

3 - Design of Experiments for Functional Response

Moein Saleh, Discover Financial Services/ Arizona State University, 699 S Mill Ave, Tempe, AZ, 85281, United States of America, Moein.Saleh@asu.edu, Rong Pan

Applications of DOE for single response variable can be seen in nearly every disciplines in science and engineering. However, there are very few publications that discussed optimal design for the experiments with multiple responses taken over different points of a continuum variable. This continuum can be any other continuous variable for functional data analysis such as time in longitudinal study. My study focuses on developing a framework for designing the experiments for functional response.

4 - Monitoring and Diagnostics of High Dimensional Multi-stream Data

Samaneh Ebrahimi, Research Assistant, Georgia Institute of Technology, 755 Ferst Drive, Atlanta, GA, 30332, United States of America, samaneh.ebrahimi@gatech.edu, Kamran Paynabar, Chitta Ranjan

Correlated high-dimensional data streams (HDDS) pose significant challenges in Statistical Process Monitoring. In this research, we integrate PCA and Adaptive Lasso, and propose a novel approach for effective process monitoring and diagnosis of HDDS. The effectiveness of the proposed approach is validated through simulation and a case study.

■ TA74

74-Room 204A, CC

System and Process Informatics in Additive Manufacturing (I)

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Linkan Bian, Assistant Professor, Mississippi State University, 260 McCain Building, Mississippi State, Starkville, MS, 39762, United States of America, bian@ise.msstate.edu

1 - Accelerated Process Optimization for Laser-based Additive Manufacturing (LBAM)

Amir M. Aboutaleb, Mississippi State University, 260 McCain Building, Mississippi State, MI, 39762, United States of America, aa1869@msstate.edu, Linkan Bian, Alaa Elwany, Nima Shamsaei, Scott M. Thompson

A novel Design-of-Experiment methodology is proposed to efficiently optimize process control parameters for LBAM by leveraging data obtained from prior related but non-identical studies. Our method accounts for unavoidable difference between the experimental conditions of the current and prior studies and quantify the associated uncertainty, which is further updated using real-world data generated in the current study.

2 - Concurrent Process Plan Optimization for Additive Manufacturing

Bahir Khoda, Professor, North Dakota State University, Room # 202F Civil and Industrial Enginee, 1410 14th Avenue North, Fargo, ND, 58102, United States of America, akm.khoda@ndsu.edu, Amm Nazmul Ahsan, Md Habib

Implementing additive manufacturing processes effectively requires addressing issues of process proficiencies and resource utilization, both of which have a strong environmental impact. In this paper, both part build orientation and material deposition direction are concurrently optimized by analyzing part geometry to minimize the resource requirement. A concurrent multicriteria process plan optimization framework is developed using Genetic Algorithms (GA) technique.

3 - Online Sensor-based Monitoring in Aerosol Jet Printing Process

Prahalad Rao, SUNY Binghamton, 4400 Vestal Pkwy. E, Binghamton, NY, United States of America, prao@binghamton.edu, Roozbeh Salary, Jack Lombardi, Mark Poliks

Aerosol Jet Printing (AJP) is an additive manufacturing process (AM) is emerging as a viable method for printing conformal electronics. However, teething quality related problems in AJP remain unresolved. We propose approaches based on image processing and sensor data analytics to achieve online quality monitoring in the AJP process. The effectiveness of the proposed approach is assessed and evaluated with several real case studies implemented on an aerosol jet printer setup.

■ TA75

75-Room 204B, CC

IBM Research Best Student Paper Award I

Sponsor: Service Science

Sponsored Session

Chair: Ming-Hui Huang, National Taiwan University, Taiwan - ROC, huangmh@ntu.edu.tw

1 - Best Student Paper Competitive Presentation

Ming-Hui Huang, National Taiwan University, Taiwan - ROC, huangmh@ntu.edu.tw

Finalists of the IBM Research Best Student Paper Award present their research findings in front of a panel of judges. The judging panel will decide the order of winners, which will be announced during the business meeting of the Service Science Section at the Annual Conference.

1 - Service Innovation and the Role of Collaboration

Cong Feng, Syracuse University, 721 University Avenue, Syracuse NY, United States of America, feng@congfeng.net, K. Sivakumar

Results show that (1) the effect of service innovation on firm performance is greater for service firms than manufacturing firms; (2) the relationship between the propensity for service innovation and three types of collaboration is significant; and (3) vertical and third-party collaborations are more beneficial than horizontal collaboration for service firms.

2 - Brand Equity and Extended Service Contract Purchase Decisions

Moein Khanlari Larimi, University of Alberta, Canada, khanlari@ualberta.ca, Paul Messinger

In this paper, we explore the role of brand equity on consumers' extended service contract (ESC) purchase decisions. We draw from past findings to show that higher brand equity has an overall positive impact on ESC purchase decisions. We also explore the positive impact of stores on ESC purchase decisions.

3 - Regulating Greed over Time

Stefano Traca, Massachusetts Institute of Technology, Cambridge, MA, United States of America, stet@mit.edu, Cynthia Rudin

In retail, there are predictable yet dramatic time-dependent patterns in customer behavior, such as periodic changes in the number of visitors, or increases in visitors just before major holidays (e.g., Christmas). The current paradigm of multi-armed bandit analysis does not take these known patterns into account, which means that despite the firm theoretical foundation of these methods, they are fundamentally flawed when it comes to real applications. This work provides a remedy that takes the time-dependent patterns into account, and we show how this remedy is implemented in the UCB and e-greedy methods. In the corrected methods, exploitation (greed) is regulated over time, so that more exploitation occurs during higher reward periods, and more exploration occurs in periods of low reward. In order to understand why regret is reduced with the corrected methods, we present a set of bounds that provide insight into why we would want to exploit during periods of high reward, and discuss the impact on regret. Our proposed methods have excellent performance in experiments, and were inspired by a high-scoring entry in the Exploration and Exploitation 3 contest using data from Yahoo! Front Page. That entry heavily used time-series methods to regulate greed over time, which was substantially more effective than other contextual bandit methods.

4 - Assessing the Impact of Product and Service Quality on Consumer Returns: A Data Analytics Study

Necati Ertekin, Texas A&M University, Mays Business School,
College Station TX 77840, United States of America,
nertekin@mays.tamu.edu, Gregory Heim, Michale Ketzenberg

We contribute to the understanding of consumer return behavior by examining the association between in-store customer experience during a purchase and a subsequent return. We demonstrate that retail efforts such as increasing salesperson competence and improving store environment that are so long believed to prevent returns may indeed induce returns.

■ TA76

76-Room 204C, CC

Advances in Simulation-based Optimization I

Sponsor: Simulation

Sponsored Session

Chair: Jie Xu, George Mason University, 4400 University Dr., MS 4A6,
Engr Bldg, Rm 2100, Fairfax, VA, 22030, United States of America,
jxu13@gmu.edu

1 - Estimating the Probability of Convexity of a Function Observed with Noise

Nanjing Jian, PhD Student, Operations Research and Information
Engineering, 288 Rhodes Hall, Cornell University, Ithaca, NY,
14850, United States of America, nj227@cornell.edu,
Shane Henderson

Given estimates of the values of a function observed with noise from simulation on a finite set of points, we wish to sequentially estimate the probability that the function is convex. By updating a Bayesian posterior on the function values, we iteratively estimate the posterior probability of convexity by solving certain linear programs in a Monte Carlo simulation. We discuss a variety of variance reduction methods for the estimation and the linear programs associated with each.

2 - Adaptive Sampling Trust Region Optimization

Sara Shashaani, Associate Professor, Department of Statistics,
Purdue University, 250 N University Street, West Lafayette, IN,
47907, United States of America, pasupath@purdue.edu,
Raghu Pasupathy

We develop derivative free algorithms for optimization contexts where the objective function is observable only through a stochastic simulation. The algorithms we develop follow the trust-region framework where a local model is constructed, used, and updated as the iterates evolve through the search space. We incorporate adaptive sampling to keep the variance and the squared bias of the local model in lock step, in a bid to ensure optimal convergence rates.

3 - Parallel Empirical Stochastic Branch & Bound

Sajjad Taghiye, George Mason University, 4400 University Dr.,
MS 4A6, Engr Bldg, Rm 2100, Fairfax, VA, 22030,
United States of America, staghiy2@gmu.edu, Jie Xu

To efficiently solve problems with time-consuming high-fidelity simulations, we develop a new parallel algorithm known as parallel empirical stochastic branch & bound (PESBB) to exploit the power of high performance computing. We will discuss synchronous and asynchronous versions of PESBB and present initial numerical results to demonstrate the scalability of PESBB.

4 - Finding the Best using Multivariate Brownian Motion

Seong-hee Kim, Professor, Georgia Institute of Technology,
755 Ferst Dr NW, Atlanta, GA, 30332, United States of America,
skim@isye.gatech.edu, Ton Dieker, Seunghan Lee

We present a new fully sequential procedure based on multivariate Brownian motion when variances are known but unequal. The procedure uses an ellipsoid as a continuation region, and a system with the worst sample mean is eliminated whenever the procedure's statistic exits the ellipsoid. The size of the ellipsoid changes as the number of survivors decreases. Experimental results are provided for both equal and unequal variances.

■ TA77

77-Room 300, CC

Green Supply Chain Management

Contributed Session

Chair: Vinay Gonela, Assistant Professor Of Management, Southwest
Minnesota State University, CH 214, 1501 State Street, Marshall, MN,
56258, United States of America, vinay.gonela@smsu.edu

1 - The Impact of Contracts on Environmental Innovation in a Supply Chain

Seyoun Jung, PhD Student, KAIST (Korea Advanced Institute of
Science and Technology), 85 Hoegiro, Dongdaemun-gu, Seoul,
Korea, Republic of, ssebea@business.kaist.ac.kr, Bosung Kim,
Kun Soo Park

We examine the impact of contracts between a supplier and a manufacturer on the supplier's environmental innovation. We calculate and compare the equilibrium outcomes under three types of contract such as wholesale-price, revenue-sharing, and quality-dependent contracts.

2 - Producer-dominated Green Supply Chain Collaboration under Trade-in Programs

Chih-Tien Chiu, Doctoral Student, National Taiwan University,
No.1, Sec. 4, Roosevelt Rd., Taipei, 10617, Taiwan - ROC,
d03741001@ntu.edu.tw, Mu-chen Chen, Jiuh-bing Sheu

This paper aims to address new-product/used-product pricing in a green logistics. We adopt the dynamic programming approach integrated with the logit model to formulate the n-period trade-in pricing-logistics problem, where the logit model is utilized for trade-in service channels choice. Data collected via stated preference experiments are used for the parameter estimation of the logit model, followed by conducting quantitative analyses to provide important findings and managerial insights.

3 - Metrics for Sustainable Operations: Current State and Path to Improvement

Remi Charpin, Clemson University, 100 Sirrine Hall, Clemson,
United States of America, rcharpi@clemson.edu, Aleda Roth

From an operations and supply chain management lens, we examine sustainability metrics currently being reported by firms. We propose that certain metrics are 'attractors,' as they are apt to lead the business towards sustainability, whereas others are deemed to be 'detectors' that are likely to be used for 'greenwashing.'

4 - Stochastic Optimization of Sustainable Industrial Symbiosis Based Hybrid Generation Bioethanol Supply Chain

Vinay Gonela, Assistant Professor Of Management, Southwest
Minnesota State University, CH 214, 1501 State Street, Marshall,
MN, 56258, United States of America, vinay.gonela@smsu.edu,
Atif Osmani, Jun Zhang, Joseph Szmerekovsky

This paper focuses on designing a new industrial symbiosis based hybrid generation bioethanol supply chain (ISHGBSC). A SMILP model is proposed to design the optimal ISHGBSC under different sustainability standards. The result provides guidelines for policy makers to determine the appropriate standard to use under different sustainable concerns. In addition, it provides investors a guideline to invest in different technologies under different sustainability standards.

■ TA78

78-Room 301, CC

Big Data and Energy

Contributed Session

Chair: Feng Gao, SGRI North America, 5451 Great America Parkway,
Santa Clara, CA, 95054, United States of America, feng.gao@sgrina.com

1 - Resilient Power System State Estimation using Compressive Sensing

Hanif Livani, Assistant Professor, University of Nevada Reno,
Electrical & Computer Engineering, MC 0111, 1185 Perry St, /
Room 302, Reno, NV, 89557, United States of America,
hlivani@unr.edu

Phasor Measurement Units (PMU) have become widely used for power system monitoring and control. However, they are not installed on all the buses in a network. Therefore, PMU-only state estimation encounters problems arising from a limited number of installed PMUs and probable data losses as the results of congestion or disconnection in communications. In this study, we propose power system state estimation using Compressive Sensing (CS) algorithm which is resilient to loss of data.

2 - Data Exploration of Publicly Reported Power Outages to Assess Grid Reliability and Damages

Michael Sohn, Staff Scientist, Lawrence Berkeley National Laboratory, One Cyclotron Road, Mail Stop: 90R2008, Berkeley, CA, 94720, United States of America, mdsohn@lbl.gov, Joseph Eto, Kristina Lacomme, Laurel Dunn

We have amassed a database of power outages, with high temporal resolution, from across the US. We present an analysis of the database, focusing on the distribution of outages by duration, customers affected, location, time, etc. We also link the data to orthogonal datasets to estimate the types of customers affected for a particular outage. Finally, we estimate the cost of power interruptions, and discuss implications on the reliability costs nationwide.

3 - Energy Disaggregation Based on Stochastic Dynamic Programming with Collocation Method

Feng Gao, SGRI North America, 5451 Great America Parkway, Santa Clara, CA, 95054, United States of America, feng.gao@sgrina.com, Chris Saunders, Yang Yu, Wendong Zhu, Guangyi Liu

The purpose of energy disaggregation is to separate energy consumption for a consumer into the energy data for individual appliances. The benefit lies in the promotion of improved consumption behaviors and adaptation of energy-efficient devices. The paper presents a dynamic model for devices power consumption; considers uncertainty of consumption; and proposes a fix-point iterative schema to efficiently resolve the stochastic problem. The paper demonstrates its result on a simulated data set.

4 - Transmission Planning with Renewable Distributed Generation Uncertainty

Fikri Kucuksayacigil, Iowa State Uni. Industrial Engineering, 3004 Black Engineering, Ames, IA, 50011, United States of America, fksayaci@iastate.edu, Kyung Jo Min

There have been substantial developments of distributed generation from renewable energy sources. This has created new challenges in transmission planning as distributed generation leads to uncertainties on the use of transmission lines. To address this uncertainties, we utilize a jump-diffusion demand process and binomial lattice to show how the best transmission is planned under the risk of self-supporting communities. From the resulting analysis, economic implication and managerial insights will be discussed.

■ TA79

79-Room 302, CC

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - SigmaXL, Inc. - What's New in SigmaXL® Version 7

John Noguera, CTO & Co-founder, SigmaXL, Inc.

SigmaXL is a user friendly Excel Add-In tool for Process Improvement, Six Sigma Quality and Statistics. We introduce SigmaXL and the new features in Version 7: "Traffic Light" Automatic Assumptions Check for T-tests and ANOVA, Automatic Normality Check for Pearson Correlation and Small Sample Exact Statistics for One-Way Chi-Square, Two-Way (Contingency) Table and Nonparametric Tests. Exact statistics are appropriate when the sample size is too small for a Chi-Square or Normal approximation to be valid.

2 - Mathworks - MATLAB: An Environment for Operations Research and Data Analytics

Seth DeLand, MathWorks, Data Analytics. Product Manager

MATLAB is a platform for analysis, visualization, simulation, and optimization. You can access and analyze real-world data and develop customized algorithms that scale to your largest problems. Join us to see how MATLAB can help you explore data, develop algorithms, and integrate analytics into enterprise applications. You'll also learn about new features including mixed-integer linear programming, machine learning, and working with Big Data.

Tuesday, 11:00am - 12:30pm

■ TB01

01-Room 301, Marriott

Cyber and Logistics Applications

Sponsor: Military Applications

Sponsored Session

Chair: Natalie Scala, Assistant Professor, Towson University, Dept. of e-Business and Tech Management, 8000 York Road, Towson, MD, 21252, United States of America, nscala@towson.edu

1 - Operations Research Initiatives in Cyber Defense

Paul Goethals, Army Cyber Institute, United States Military Academy, West Point, NY, United States of America, paul.goethals@usma.edu

Despite the reduction in the total Army population, the cyber force structure continues to grow in strength and impact. This presentation describes a number of Operations Research initiatives that could benefit the cyber community. Research trends and areas of future work are also offered.

2 - Automated Identification Technology Devices for Naval Seabasing

Natalie Scala, Assistant Professor, Towson University, Dept. of e-Business and Tech Management, 8000 York Road, Towson, MD, 21252, United States of America, nscala@towson.edu, Jennifer Pazour

We present a value focused decision model for naval seabasing. We discuss automated identification technology devices as alternatives to a multi-objective decision model with the goal of selecting the preferred device for seabasing logistics support. Criteria for this model include metrics and associated measures related to seabasing.

3 - Logistics Engineering Solution for Reverse-engineering Topology

Alan Briggs, INFORMS Maryland, 8606 Aspen Grove Court, Odenton, MD, 21113, United States of America, awbriggs@gmail.com

Using monte carlo simulation, author uses proximate location data to reverse engineer network topology.

■ TB02

02-Room 302, Marriott

Homeland Security Decision Making

Cluster: Homeland Security

Invited Session

Chair: Jun Zhuang, University at Buffalo, SUNY, 317 Bell Hall, Buffalo, NY, 14221, United States of America, jzhuang@buffalo.edu

Co-Chair: Fei He, Assistant Professor, Texas A&M University-Kingsville, 700 University Blvd., Kingsville, TX, 78363, United States of America, fei.he@tamuk.edu

1 - Multi-Objective Optimization Models in Urban Security

Jose Emmanuel Ramirez-Marquez, Associate Professor, Stevens Institute of Technology, 1 Castle Point Rd, Hoboken, NJ, 07030, United States of America, jmarquez@stevens.edu, Mohammed Muaafa

The allocation of limited resources is a daily dilemma for police commanders. More than 50% of police department costs go into patrolling operations, which include responding to emergencies and maintaining police presence. This study aims to address the challenging tradeoff police face when designing patrolling strategies between lessening the economic burden of crime prevention and maintaining high levels of public safety.

2 - A Literature Review of Recent Attacker-defender Games

Fatemeh Mousapour, SUNY Buffalo, 338 Bell Hall, Buffalo, NY, United States of America, f.mousapoor@yahoo.com, Jun Zhuang

This research provides an extensive review of game-theoretic analysis of attacker-defender models. Those models are categorized according to different defense measures, attack tactics, system structures, game types, player rationality and risk preferences. Statistical charts and tables are presented to identify patterns and trends in this area. Through the content analysis framework, some research gaps and future research directions are identified.

3 - Protecting and Restoring Facilities from Intentional Attacks

Chi Zhang, Assistant Professor, Tsinghua University, 100084
Beijing, Department of Industrial Engineering, Beijing, China,
czhang@tsinghua.edu.cn, Sachuer Bao

Besides protecting facilities from intentional attacks, another paramount issue is taken into consideration- restoring destroyed facilities to optimal service level within a given time interval. The defender decides which facilities to protect before an attack, and resource allocation between improving capacities of operational facilities and rebuilding destroyed facilities after an attack, to maximize profit by satisfying customer demands. The problem is solved by an ant colony algorithm.

4 - Coordinating Pre- and Post-disaster Resource Allocation at Multiple Locations

Fei He, Assistant Professor, Texas A&M University-Kingsville, 700
University Blvd., Kingsville, TX, 78363, United States of America,
fei.he@tamuk.edu, Jun Zhuang

Resource allocation in the face of disaster aims to improve the efficiency and effectiveness of disaster relief. In this research, disaster preparedness and relief at multiple locations are modeled in a two-stage stochastic programming framework with the objective of loss minimization. New insights of coordinating preparedness and relief at multiple locations are provided.

5 - Model Validation for a Public-private Partnerships Model in Disaster Management

Vineet Madasseri Payyappall, PhD Student, University at Buffalo,
305 Winspear Avenue (Upper), Buffalo, NY, 14215, United States
of America, vineetma@buffalo.edu, Peiqiu Guan, Jun Zhuang

This research designed and conducted an experiment to validate a public-private partnerships model in disaster management. A two-staged experiment was conducted in a computer simulated environment. The risk behaviors of the subjects were evaluated in the first stage, and the second stage collected the decision of the subjects, who played the role of the private sectors, under different scenarios. The experiment shows that our model results are consistent with the experimental results.

■ TB03

03-Room 303, Marriott

New Topics in Scheduling

Cluster: Scheduling and Project Management

Invited Session

Chair: Rainer Kolisch, rainer.kolisch@wi.tum.de

1 - Coordinating Subcontractor Scheduling with Divisible Jobs

Behzad Hezarkhani, Assistant Professor, Nottingham University
Business School, Jubilee Campus, Nottingham, United Kingdom,
behzad.hezarkhani@nottingham.ac.uk, Wieslaw Kubiak

We study a decentralized scheduling problem with a single subcontractor and several agents having divisible jobs. Under complete information, we design pricing schemes that always make the agents' decisions coincide with efficient schedules. Under private information, we prove that the pivotal mechanism makes truth-telling the only optimal choice of the agents when announcing their processing times. We comment on the subcontractor's revenue under complete and private information.

2 - Single Machine Scheduling via Decision Theory

J.J. Kanet, Department of MIS/OM/DSC, 300 College Park,
University of Dayton, Dayton, OH, 45419-2130,
United States of America, Kanet@udayton.edu

We consider the following procedure for scheduling a single machine. At time t the machine is free with a set N of n jobs ready to occupy it. Thus, we have n choices for jobs to occupy the machine starting at time t with the remaining $n-1$ jobs completed later. Given that a job k is tentatively chosen to next occupy the machine, we calculate its completion time and the expected value (E) of the completion times of the remaining $n-1$ jobs. We do this for each of the n choices, producing for each the set of completion times $C = \{C_j | j \in N\}$. We then evaluate the objective $Z = f(C)$ choosing that job k for which Z is minimum to next occupy the machine. We provide an unbiased estimator of the set C and show that the procedure provides optimum results when the objective Z is to minimize flow time or maximum tardiness.

3 - Scheduling on a Single Machine under Time of Use Tariffs

Kan Fang, Tianjin University, No 92 Weijin Road, Nankai District,
Tianjin, 300072, China, zjumath@gmail.com, Nelson Uhan

We consider the problem of scheduling jobs on a single machine to minimize the total electricity cost of processing these jobs under time-of-use electricity tariffs. We show the computational complexity of this problem for both the uniform-speed and speed-scaling cases, present different approximation algorithms for the speed-scaling case and analyze their computational performance. We also show how to compute optimal schedules for the preemptive version of the problem in polynomial time.

4 - The Value of Flexibility and Shift Extensions in Physician Scheduling

Andreas Fögener, University of Augsburg, Universitätsstraße 16,
Universität Augsburg, WiWi, Augsburg, De, 86159, Germany,
andreas.fuegener@unikat.uni-augsburg.de, Jens Brunner

Scheduling physicians is a relevant topic in hospitals. In the literature, demand is usually assumed to be deterministic. However, surgery durations and emergencies contain uncertainty. We model stochastic physician demand using a scenario-based approach. We introduce flexible shift extensions, where physicians might have to work longer to match supply with demand and simultaneously increase predictability of working hours. We propose a mixed-integer model and a column generation heuristic to solve our problem.

■ TB04

04-Room 304, Marriott

The Business of Music and Emotion in Social Media

Cluster: Social Media Analytics

Invited Session

Chair: Chris Smith, TRAC-MTRY, 28 Lupin Lane, Carmel Valley, 93924,
United States of America, cmsmith1@nps.edu

1 - Philippine Language and Emotion During Typhoon Haiyan/Yolanda

Amanda Andrei, Graduate Student, Georgetown University,
aa1436@georgetown.edu

An investigation of language and emotion in tweets from the Philippines before and after 2013 super typhoon Haiyan/Yolanda using Linguistic Inquiry and Word Count (LIWC), breakpoint analysis, and a computational clustering tool revealed differences in topics and emotions depending on whether messages were expressed in English or Filipino.

2 - Subscribe or Sell: iTunes vs. Google Play Music all Access

Hooman Hidaji, PhD Student, University of Alberta, #1604 8515
112 St. NW, Edmonton, AL, T6G1K7, Canada,
hooman.hidaji@ualberta.ca

Recently, subscription has become a popular method of user monetization in online media business along with selling model. It is expected that firms utilize both approaches to cover as much demand as possible. However, pricing strategy of the firms is crucial in determining the demand for the two. In this study, using an economic model with endogenous demand, we set to model how the firm decides on the business model. Different user types and business model-dependent demand are considered.

3 - Stock Market Prediction using Disparate Data Sources

Bin Weng, Auburn University, 425 Opelika Rd Apt. 224, Auburn,
AL, 36830, United States of America, bhw0018@auburn.edu,
Fadel Megahed

Stock market prediction has attracted much attention from academia as well as business. In recent years, social media is considered as a new source to affect human's behavior and decision-making. In this paper, we will develop a new way to predict the movement of the stock market using disparate data source, social media data and market data. In order to predict the stock price more accurately, the model is developed using multivariable selection method and machine learning statistic methods.

■ TB05

05-Room 305, Marriott

Social Media in Business

Cluster: Social Media Analytics

Invited Session

Chair: Dokyun Lee, Carnegie Mellon University, Pittsburgh, PA,
United States of America, leedokyun@gmail.com

1 - Understanding the Impact of Discussions on Quality of Crowdsourced Content – The Case of Wikipedia

Srikar Velichetty, PhD Student, Eller College of Management,
University of Arizona, 1130 E Helen St, Tucson, AZ, 85719,
United States of America, srikarv@email.arizona.edu,
Jesse Bockstedt, Sudha Ram

We investigate the impact of discussions on the quality of Crowdsourced content using a data science approach that involves conducting an exploratory study to uncover the associations among different discussion characteristics and article quality and building a prediction model. By identifying appropriate instruments to overcome selection, we build a model to quantify the impact of these characteristics. Our results show that most of these characteristics have a positive impact on quality.

2 - Toward Effective Information Diffusion on Social Media Platforms: An Analysis of Dyadic Relationship

Jing Peng, The Wharton School, University of Pennsylvania, 3730 Walnut Street Suite 500, Philadelphia, PA, 19104, United States of America, jingpeng@wharton.upenn.edu, Ashish Agarwal, Kartik Hosanagar, Raghuram Iyengar

We investigate the impact of dyadic network characteristics on information diffusion in social media platforms with directed networks. We propose a novel hazard model to deal with the problem that a user may receive the information from multiple others. The model is estimated using diffusion of ads on Digg.com. We find that a non-reciprocal follower is more likely to adopt than a reciprocal follower and the effects of network embeddedness are more complicated than that in undirected networks.

3 - Monetizing Sharing Traffic through Incentive Design: A Randomized Field Experiment

Tianshu Sun, University of Maryland Smith School of Business, 3330 Van Munching Hall, College Park, MD, 20740-2840, United States of America, tianshusun@rhsmith.umd.edu, Siva Viswanathan, Elena Zheleva

Customers share product information with each other everyday. While the share of a product indicates clear purchase intent of either sender or recipient, most of such sharing traffic does not lead to successful purchases. In collaboration with a daily deal platform, we conduct a large field experiment to study whether and how firms can monetize sharing traffic, by targeting senders with incentive. Specifically, we examine the impact of incentive design on sender's purchase as well as referrals

4 - Founder and Funder, Just One Click Apart: How Social Media Facilitates Investor Entrepreneur Match

Fujie Jin, the Wharton School, University of Pennsylvania, 500 Jon M Huntsman Hall, 3730 Walnut Street, Philadelphia, PA, 19104, United States of America, jinfujie@wharton.upenn.edu

This study examines how entrepreneurs' social media presence facilitates the funding process across geographic regions. Comparison will be drawn between traditional angel investors or VCs and the new crowdfunding platform to show how entrepreneurs could optimally manage their social media profile to appeal to different investor groups.

■ TB06

06-Room 306, Marriott

Engineering Approaches in Finance

Sponsor: Financial Services

Sponsored Session

Chair: James Primbs, Associate Professor, California State University Fullerton, 800 N. State College Blvd., Fullerton, CA, United States of America, jprimbs@fullerton.edu

1 - On Feedback Control-based Stock Trading: Some Back Tests with High-frequency Data

B. Ross Barmish, Professor, University of Wisconsin, ECE Department, Madison, WI, 53706, United States of America, barmish@engr.wisc.edu

The takeoff point for this paper is a new paradigm for stock trading involving adaptive feedback control loops. I will first overview the key elements of our theory with emphasis on "model-free" trading and money management. Subsequently, I will describe recent back tests of our trading algorithms using high-frequency data. Given that our underlying theory requires continuity of the stock price, it is natural to study whether performance improves as a function of the trading frequency.

2 - Construction of Nonlinear Simultaneous Equations Models for Electricity Supply and Demand Functions

Yuji Yamada, Professor, University of Tsukuba, 3-29-1 Otsuka, Bunkyo-ku, Tokyo, 112-0012, Japan, yuji@gssm.otsuka.tsukuba.ac.jp

In this work, we develop a new methodology for estimating supply and demand functions in the Japan Electric Power Exchange (JEPX) spot market. To this end, we generalize the standard simultaneous equations approach using linear regressions for nonlinear case and show that the nonlinear structural equations may be constructed based on the reduced equations of a nonparametric regressions model. Then, we demonstrate the proposed approach using empirical data.

3 - Trading a Portfolio of Pairs in the Presence of Transaction Costs

James Primbs, Associate Professor, California State University Fullerton, 800 N. State College Blvd., Fullerton, CA, United States of America, jprimbs@fullerton.edu, Yuji Yamada

In this work we consider the problem of trading a portfolio of pairs when transaction costs are present. We develop a receding horizon approach based on a power utility function and proportional transaction costs. The resulting methodology is very computational tractable, even for a portfolio of many potentially correlated pairs. Backtested results on historical data are provided.

4 - Backtesting Simultaneous Long-short and Proportional-integral Investment Schemes

Sean Warnick, Associate Professor, Brigham Young University, TMCB 2222, Provo, UT, 84602, United States of America, sean.warnick@gmail.com, Scott Condie, Nathan Woodbury

Simultaneous Long-Short is an investment strategy analyzed by Barmish and Primbs that uses feedback control techniques to make investment decisions. An extension of the technique uses proportional-integral control to make such decisions. Importantly, these methods use a feedback architecture—and no explicit market model—to manage investments. This study explores the performance of these methods compared to other methods that use some estimate of a market model through various backtests.

■ TB07

07-Room 307, Marriott

Quantitative Risk Measurement and Modeling

Cluster: Risk Management

Invited Session

Chair: Nan Chen, Professor, Chinese University of Hong Kong, 709A William Mong Engineering Building, Hong Kong, Hong Kong - PRC, nchen@se.cuhk.edu.hk

1 - On the Measurement of Economic Tail Risk

Xianhua Peng, Assistant Professor, Hong Kong University of Science and Technology, Department of Mathematics, Hong Kong, Hong Kong - PRC, maxhpeng@ust.hk

We show that the only risk measures that satisfy a set of economic axioms for the Choquet expected utility and the statistical property of elicibility (i.e. there exists an objective function such that minimizing the expected objective function yields the risk measure) are the mean functional and the median shortfall, which is the median of tail loss distribution. We argue that median shortfall is a better alternative than expected shortfall for setting capital requirements in Basel Accords.

2 - Leverage, Market Liquidity, and Financial Fragility

Nan Chen, Prof, Chinese University of Hong Kong, 709A William Mong Engineering Building, Hong Kong, Hong Kong - PRC, nchen@se.cuhk.edu.hk, Jing Chen

We provide a simple model to show how systemic fragility is built up as highly leveraged investors crowd to similar trading strategies. As their wealth grows over time, the destabilizing impact of their trading becomes more imminent, causing amplified volatility, jump risk, and correlation co-movements in the security prices.

3 - A Simulation Measure Approach to Monte Carlo Methods for Default Timing Problems

Alex Shkolnik, University of California, Berkeley, CA, United States of America, ads2@berkeley.edu, Kay Giesecke

Reduced-form models of name-by-name default timing are widely used to measure portfolio credit risk and to analyze securities exposed to a portfolio of names. Monte Carlo (MC) simulation is a common computational tool in such settings. We introduce a new change of measure perspective for MC simulation for default timing problems. The perspective provides the means of analyzing current methods and suggests a new MC algorithm which outperforms a widely used and standard technique.

■ TB08

08-Room 308, Marriott

Sharing Economy and Peer-to-Peer Marketplaces

Cluster: Business Model Innovation

Invited Session

Chair: Jose Guajardo, University of California Berkeley,
545 Student Services Bldg #1900, Berkeley, CA, 94720-1900,
United States of America, jguajardo@berkeley.edu

1 - The Efficacy of Incentives in Scaling up Marketplaces

Ashish Kabra, INSEAD, Boulevard de Constance, Fontainebleau,
France, ashish.kabra@insead.edu, Elena Belavina, Karan Girotra

Achieving scale is key to the efficacy, survival and eventual domination of marketplaces. Marketplace operators often run aggressive promotions and incentive schemes to attract new users or increase the usage of existing users. Using detailed transaction and location data from a leading transportation marketplace, we estimate and compare the short-term and long-term effects of incentives given to the “buyer” side and “seller” side of the marketplace.

2 - Business Models in the Sharing Economy: Manufacturing Durables in Presence of Peer-to-peer Markets

Zhe Zhang, PhD Student, Carnegie Mellon University, 5000
Forbes Avenue, Pittsburgh, PA, 15213, United States of America,
zhezhang@cmu.edu, Jose Guajardo, Vibhanshu Abhishek

We investigate the interaction between a manufacturer of durable goods and a peer-to-peer marketplace where consumers trade the temporary use of the durable good as a service. We analyze market outcomes under alternative business models and market structures.

3 - Outsourcing Tasks Online: Matching Supply and Demand on Peer-to-peer Internet Platforms

Chiara Farronato, Harvard Business School, Soldiers Field,
Boston, United States of America, chiara.farronato@gmail.com,
Zoe Cullen

We study a central problem for peer-to-peer markets: how to create matches when demand and supply are highly variable. We develop a model of a matching market for services, and estimate it using data from TaskRabbit. We find that supply is highly elastic and estimate average gains from each trade to be \$37. Because of the matching frictions, the ex-ante gains are more modest, but are maximized by the elastic supply. Finally, we explore heterogeneity of platform success across cities.

4 - First Ranked First to Serve: Strategic Agents in a Service Contest

Konstantinos Stouras, PhD Candidate, INSEAD,
Bd. de Constance, Fontainebleau, 77305, France,
Konstantinos.STOURAS@insead.edu, Karan Girotra,
Serguei Netessine

We develop a model of a virtual call center that pays its agents on-demand, by committing to a (relative) performance agent ranking prioritization scheme. We show that the optimal design of such a “service contest” is often coarse. Discarding available information about agents’ relative performance, or deploying coarser priority classes can paradoxically create higher incentives for agents to voluntarily participate and provide better service.

■ TB09

09-Room 309, Marriott

Ecosystem Analytics & Visualization

Sponsor: Technology, Innovation Management & Entrepreneurship

Sponsored Session

Chair: Rahul Basole, Associate Professor, Georgia Institute of
Technology, 85 Fifth Street NW, Atlanta, GA, 30332,
United States of America, basole@gatech.edu

1 - Integrated Analytics Framework for Business Ecosystem Dynamics

Hyunwoo Park, Georgia Institute of Technology, 85 5th St. NW
Rm 339, Atlanta, GA, 30309, United States of America,
hwpark@gatech.edu, Rahul Basole

We propose a computational framework and interactive prototype for specifying and analyzing business ecosystem dynamics. Our research fuses simulation with data/process mining and information visualization techniques, enabling decision makers to specify micro-behavior of firms, generate and test hypotheses, gain insights, and communicate results effectively. We illustrate our approach using real-world examples based on a unique curated dataset from multiple sources.

2 - Network Visualization Analysis of Main Paths and Directions of Firm Innovation

Jianxi Luo, Assistant Professor, Singapore University of
Technology and Design, 8 Somapah Rd, Singapore, 487372,
Singapore, luo@sutd.edu.sg, Bowen Yan

We present a method to represent the technology space as a network of patent technology classes, and then overlay the network map to visualise firms’ technology capability positions and main paths of diversification over time. Based on a few case studies, we show this method can reveal the differences in innovation behaviours and strategies of different firms and aid in the assessment of the firm’s past and existing capability positions and the exploration of future innovation directions.

3 - Quantifying the Ecosystem of Digital Platform Companies

Rahul Basole, Associate Professor, Georgia Institute of
Technology, 85 Fifth Street NW, Atlanta, GA, 30332,
United States of America, basole@gatech.edu, Peter Evans

The rise of digital platforms is transforming industries and economies. Using an integrated dataset (Crunchbase and Capital IQ), we quantify, compare, and visualize the structure of 1,000+ platform companies. We discuss theoretical and managerial implications.

4 - Visualizing the Start-Up Genome

Raul Chao, ChaoR@arden.virginia.edu, Rahul Basole

Our study uses novel visual analytic techniques to analyze start-up activities. Specifically, drawing on an analogy from genetics, we aim to visualize what we refer to as the “Start-Up Genome” – a unique sequence of activities that defines and differentiates one start-up from another.

5 - Data-driven Visualizations of Market Differentiation in Emerging Sectors

Martha Russell, Executive Director, mediaX at Stanford
University, 210 Panama Street, Cordura Hall,
Stanford, CA, 94305-4115, United States of America,
martha.russell@stanford.edu, Jukka Huhtamäki,
Neil Rubens, Kaisa Still

Using keywords from a dataset built from online promotional information, we visualize the character and strength of startups’ market objectives in emerging sectors.

■ TB10

10-Room 310, Marriott

Frontiers in IS Research

Sponsor: E-Business

Sponsored Session

Chair: Min-Seok Pang, Assistant Professor, Temple University, 1810 N
13th St, Speakman 201c, Philadelphia, PA, 19122, United States of
America, minspang@temple.edu

1 - Fundraising Patterns and Entrepreneurial Performance in Crowdfunding Platforms

Eun Ju Jung, George Mason University, Enterprise Hall, 4400
University Drive, School of Business, Fairfax, VA, 22030, United
States of America, jej978@gmail.com, Vallabh Sambamurthy,
Anjana Susarla

Crowdfunding provides entrepreneurs with new opportunities for funding and ultimately fosters entrepreneurship and new firm creation. However, there is a dearth of research on entrepreneurial performance after fundraising success. In this paper, we examine how the dynamics in fundraising processes are related to entrepreneurial performance. This study will contribute to crowdfunding and entrepreneurship literature and offer practical implications.

2 - IT Security Effectiveness: Influence of Breach Type and Public Attention

John D’arcy, University of Delaware, 207A Purnell Hall,
Newark, DE, 19716, United States of America, jdarcy@udel.edu,
Asli Basoglu

This study explores factors that bias auditor judgments of companies’ information security effectiveness. We developed a dataset consisting of security breaches against publicly traded companies, public attention attributed to these breaches in the form of abnormal Google search volume, and auditor evaluations of these companies’ IT internal controls. Our results suggest that breach source and abnormal public attention both contribute to biased evaluations of information security effectiveness.

3 - Studying Influence of Comments in Online News Papers

Iljoo Kim, Assistant Professor, Saint Joseph's University, 347 Mandeville Hall, 5600 City Avenue, Philadelphia, PA, 19131, United States of America, ikim@sju.edu, Gautam Pant

In this work, we study online comments and their influence in online news articles. Using text-mining techniques, we attempt to explain and/or predict influence of online newspaper comments on the context of the original article or even on creating a new agenda through the discussions among commenters. This is done based on the textual signals embedded within comments as well as news articles.

4 - Politics and Information Technology Investments in The U.S. Federal Government in 2003-2015

Min-Seok Pang, Assistant Professor, Temple University, 1810 N 13th St, Speakman 201e, Philadelphia, PA, 19122, United States of America, minsipang@temple.edu

What makes some US federal agencies digitally advanced and others lagging? This study investigates how politics affects IT investment in federal agencies. With a panel dataset from 133 federal agencies, our empirical analyses produce several intriguing findings. A federal agency makes more capacity-building IT investments (i) when its head is appointed with legislative approval, (ii) when the federal government is less divided, and (iii) when it is neither too conservative nor too liberal.

■ TB11

11-Franklin 1, Marriott

Machine Learning under a Modern Optimization Lens

Sponsor: Optimization/Integer and Discrete Optimization
Sponsored Session

Chair: Dimitris Bertsimas, Professor, MIT, 77 Massachusetts Ave., Cambridge, MA, 02139, United States of America, dbertsim@mit.edu

1 - Sparse Principal Component Analysis via a Modern Optimization Lens

Lauren Berk, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA, 02139, United States of America, lberk@mit.edu, Dimitris Bertsimas

We develop tractable algorithms that provide provably optimal solutions to the exact Sparse Principal Component problems of up to 1000 dimensions, using techniques from Mixed Integer Optimization and first order methods. Unlike earlier SPCA methods, our approach retains complete control over the degree of sparsity of the components, and provides solutions with higher explained variance.

2 - Robust Support Vector Machines

Colin Pawlowski, MIT, 77 Massachusetts Ave., Cambridge, MA, 02139, United States of America, cpawlows@mit.edu, Dimitris Bertsimas

We consider a maximal-margin classifier which is the non-regularized formulation of SVM. Using Robust Optimization, we develop new, computationally tractable methods that are immunized against uncertainty in the features and labels of the training data. Experiments on real-world datasets from the UCI Machine Learning Repository show out-of-sample accuracy improvements for robust methods in a significant number of problems analyzed.

3 - Optimal Trees

Jack Dunn, Operations Research Center, MIT, 77 Mass Ave, Bldg E40-130, Cambridge, MA, 02139, United States of America, jackdunn@mit.edu, Dimitris Bertsimas

Decision trees are widely used to solve the classical statistical problem of classification. We introduce a new method for constructing optimal decision trees using Mixed-Integer Optimization, and show using real data sets that these trees can offer significant increases in accuracy over current state-of-the-art decision tree methods. We also demonstrate the benefits of using Robust Optimization when constructing these trees.

4 - Logistic Regression using Robust Optimization

Daisy Zhuo, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, zhuo@mit.edu, Dimitris Bertsimas

Logistic regression is one of the most commonly used classification methods, yet the solution can be sensitive to inaccuracy and noise in data. Here we propose an approach using Robust Optimization to find stable solutions under uncertainties in data features and labels. Using more than 80 real-world problems, we demonstrate that the robust logistic regressions lower misclassification error significantly in the majority of the data sets.

■ TB12

12-Franklin 2, Marriott

Nonlinear Programming in Stochastic and Multilevel Problems

Sponsor: Optimization/Mixed Integer Nonlinear Optimization and Global Optimization
Sponsored Session

Chair: Alexander Vinel, Auburn University, 3301 Shelby Center, Auburn, AL, 36849-5346, United States of America, alexander.vinel@auburn.edu

1 - Branch-and-cut Algorithm for Integer Bilevel Linear Optimization Problems

Sahar Tahernejad, Graduate Student, Lehigh University, 12 Duh Drive- No. 132, Bethlehem, PA, 18015, United States of America, sat214@lehigh.edu, Ted Ralphs

We extend the branch-and-cut framework of Denegre and Ralphs for solving integer bilevel linear optimization problems (IBLPs). IBLPs differ from standard integer optimization problems in that there are solutions which are integer but not feasible and they should be removed from the feasible solution set. Our proposed algorithm applies a variety of cut generation techniques for removing such solutions. We report on numerical experiments on some benchmark IBLPs.

2 - On Pessimistic Versus Optimistic Bilevel Linear Programs

M. Hosein Zare, University of Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA, 15261, United States of America, moz3@pitt.edu, Osman Ozaltin, Oleg Prokopyev

We study the relationships between Pessimistic and Optimistic Bilevel Linear Programs. In particular, we focus on the case when the upper-level decision-maker (i.e., the leader) needs to consider the uncertain behavior of the lower-level decision maker (i.e., the follower). We derive some computational complexity properties, and illustrate our results using a defender-attacker application.

3 - Identifying Risk-averse Low-diameter Clusters in Graphs with Random Vertex Weights

Maciej Rysz, NRC-AFRL, 1350 N. Poquito Road, Shalimar, FL, United States of America, mwrysz@yahoo.com, Pavlo Krokhmal

We consider the problem of finding a k-club of minimum risk contained in a graph whose vertices have stochastic weights. A stochastic programming framework that is based on the formalism of coherent risk measures is used to find the corresponding subgraphs. A combinatorial branch-and-bound solution algorithm is proposed.

4 - Solution Procedures for a Class of Mixed-integer Nonlinear Programming Problems

Alexander Vinel, Auburn University, 3301 Shelby Center, Auburn, AL, 36849-5346, United States of America, alexander.vinel@auburn.edu, Pavlo Krokhmal

We study solution approaches for a class of mixed-integer non-linear programming problems with our interest stemming from recent developments in risk-averse stochastic programming. We explore possible applications of some of the solution techniques that have been successfully used in mixed-integer second-order conic programming and show how special structure of problems under consideration can be utilized.

■ TB13

13-Franklin 3, Marriott

Stochastic Approximation

Sponsor: Optimization/Optimization Under Uncertainty
Sponsored Session

Chair: Raghu Pasupathy, Associate Professor, Department of Statistics, Purdue University, 250 N University Street, West Lafayette, IN, 47907, United States of America, pasupath@purdue.edu

1 - Budget-constrained Stochastic Approximation

Uday Shanbhag, The Pennsylvania State University, 310 Leonhard Building, University Park, PA, 16801, United States of America, udaybag@engr.psu.edu, Jose Blanchet

We consider a convex constrained stochastic convex optimization problem in which the simulation budget is fixed and computation is expensive. We consider stochastic approximation schemes in which the sample-size is either constant or updated at every step while meeting this budget and provide suitable finite-time error bounds.

2 - Optimal Averaging Schemes for Stochastic Approximation Methods

Farzad Yousefian, Postdoctoral Research Associate, Penn State, 333 Logan Ave., Apt. 307, State College, PA, 16801, United States of America, szy5@psu.edu, Angelia Nedich, Uday Shanhag

We develop optimal weighted averaging stochastic approximation schemes for solving stochastic variational inequality problems. We show that the gap function associated with the averaged sequence diminishes to zero at the optimal rate. We also develop a window-based variant of this scheme that displays the optimal rate and the superiority in the constant factor of the bound comparing to the classic averaging schemes. Preliminary numerical results on a stochastic Nash-Cournot game are presented.

3 - Adaptive Sampling Line Search for Local Simulation Optimization

Raghu Pasupathy, Associate Professor, Department of Statistics, Purdue University, 250 N University Street, West Lafayette, IN, 47907, United States of America, pasupath@purdue.edu, Fatemeh Hashemi

We present an algorithm for continuous simulation optimization that combines adaptive sampling ideas with a classical line search method from deterministic nonlinear programming. We will discuss theoretical properties and a brief example.

4 - Noisy Collective Nonconvex Optimization

Mengdi Wang, Assistant Professor, Princeton University, 302 Trinity Ct #2, Princeton, NJ, 08540, United States of America, mengdiw@princeton.edu

Paper not available at this time.

■ TB14

14-Franklin 4, Marriott

Joint Session OPT/ICS: Stochastic Programming: Progressive Hedging and Related Methods

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Jonathan Eckstein, Professor, Rutgers University, 100 Rockefeller Road, Piscataway, NJ, 08854, United States of America, jeckstei@rci.rutgers.edu

1 - Scalable Lower and Upper Bounding Techniques for Stochastic Unit Commitment with Progressive Hedging

Jean-paul Watson, Sandia National Laboratories, P.O. Box 5800, MS 1326, Albuquerque, United States of America, jwatson@sandia.gov, David Woodruff, Sarah Ryan

We describe configurations of a scenario-based decomposition strategy for solving the stochastic unit commitment problem, based on the progressive hedging algorithm. We consider both upper and lower bounding aspects of progressive hedging in the mixed-integer case, and demonstrate parameterizations that yield extremely tight optimality gaps for 100-generator cases and moderately tight optimality gaps for 350-generator cases.

2 - Progressive Hedging and Dual Decomposition

David Woodruff, UC Davis, One Shields Avenue, Davis, CA, 95616, United States of America, dlwoodruff@ucdavis.edu

The PH algorithm proposed by Rockafellar and Wets and the DDSIP algorithm proposed by Caroe and Schultz can both be thought of as primal-dual algorithms and both can be used to address stochastic mixed-integer programs. In this talk I describe work with numerous co-authors to use the two algorithms together. In addition we describe an algebraic modeling language (Pyomo) interface to DDSIP that is useful with, or without, PH.

3 - Asynchronous Projective Progressive-hedging-like Stochastic Programming Decomposition Methods

Jonathan Eckstein, Professor, Rutgers University, 100 Rockefeller Road, Piscataway, NJ, 08854, United States of America, jeckstei@rci.rutgers.edu

We present a class of stochastic programming algorithms based on new Combettes-Eckstein monotone operator splitting methods. Unusually, these splitting methods need to re-solve only a subset of the subproblems at each iteration, using boundedly outdated information. Applying these techniques to stochastic programming yields methods that resemble progressive hedging, but can operate in a fully asynchronous manner. Convergence is guaranteed under the same conditions as for progressive hedging.

■ TB15

15-Franklin 5, Marriott

Recent Advances in Nonlinear Programming

Sponsor: Optimization/Nonlinear Programming

Sponsored Session

Chair: Hande Benson, Associate Professor, Drexel University, LeBow College of Business, Philadelphia, PA, 19104, United States of America, hvb22@drexel.edu

1 - Solving the Problem of Portfolio VAR Minimization as a Nonlinear Program

Arun Sen, Director, Navigant Consulting, 685 3rd Avenue, 14th Floor, New York, NY, 10017, United States of America, arunsen@alumni.princeton.edu

Minimizing Value at Risk (VAR) is challenging as the optimization problem is non-convex. In previous work the problem was formulated as an MPEC (mathematical program with equilibrium constraints), that was solved using branch-and-bound techniques. We show that the same MPEC can be solved effectively as a nonlinear program, specifically by use of interior-point methods, and that this a flexible approach that is easily able to incorporate additional constraints on the optimal portfolio.

2 - Fast Algorithms for LAD Lasso Problems

Robert Vanderbei, Princeton University, ORFE, Sherrerd Hall, Princeton, NJ, 08544, United States of America, rvdb@princeton.edu

We will present a new algorithm for the LAD Lasso problem. We will compare this new algorithm against existing state-of-the-art algorithms.

3 - Cubic Regularization for First-order Methods

David Shanno, RUTCOR - Rutgers University (Emeritus), Rutgers University, New Brunswick, NJ, United States of America, shannod@comcast.net, Hande Benson

Regularization techniques have been used to help existing algorithms solve "difficult" nonlinear optimization problems. Over the last decade, regularization has been proposed to remedy issues with equality constraints and equilibrium constraints, bound Lagrange multipliers, and identify infeasible problems. In this talk, we will focus on the application of cubic regularization in the context of the symmetric rank one and the conjugate gradient methods for nonlinear programming.

4 - Value Driven Design Delegation - An Optimization Model

Vinod Cheriyan, Enova International, 1255 S Michigan Ave. Apt 3711, Chicago, IL, 60605, United States of America, vinod.cheriyan@gmail.com, Chris Paredis, Anton Kleywegt

Rather than satisfaction of stakeholder needs, the Value Driven Design approach focuses on maximization of economic value. For large, complex systems, the systems designer maximizes the value by delegating detailed design to many subsystem teams. We study the convergence properties of such a value-driven, delegation-based system design process, where knowledge is distributed. We model the design as an optimization problem. We propose an algorithm and show that it converges to a critical point.

■ TB16

16-Franklin 6, Marriott

Various Aspects of Mixed Integer Conic Optimization

Sponsor: Optimization/Linear and Conic Optimization

Sponsored Session

Chair: Sertalp Cay, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, sec312@lehigh.edu

1 - Portfolio Optimization Problems with Cone Constraints and Discrete Decisions

Umit Saglam, Assistant Professor, East Tennessee State University, Department of Management and Marketing, College of Business and Technology, Johnson City, TN, 37614, United States of America, saglam@etsu.edu, Hande Benson

In this study we consider both single-period and multiperiod portfolio optimization problems based on the Markowitz (1952) mean/variance framework. Our model is aggregated from current literature. We solve these models with a MATLAB based Mixed Integer Linear and Nonlinear Optimizer (MILANO). We have devised and implemented the first solution method for such problems and demonstrate its efficiency on large-scale portfolio optimization models. We also provide substantial improvement in runtimes.

2 - Computational Study of a Second Order Cone Relaxation for Binary Quadratic Polynomial Problems

Julio Goetz, Postdoctoral Fellow, Ecole Polytechnique Montreal and GERAD, 2900 Boulevard Edouard-Montpetit, Montréal, QC, H3T 1J4, Canada, jgoetz1@gmail.com, Miguel Anjos

This work presents a computational study of the second order cone relaxation for binary quadratic problems proposed by Ghaddar, Vera and Anjos (2011) who used a polynomial optimization approach. We explore how this relaxation can be strengthened using additional constraints, and also, we explore the relation of disjunctive conic cuts with this relaxation.

3 - Computational Approaches to Mixed Integer Second Order Cone Optimization

Aykut Bulut, PhD Candidate, Lehigh University, 200 W. Packer Ave., Bethlehem, PA, 18015, United States of America, aykut@lehigh.edu, Ted Ralphs

We introduce an open-source Mixed Integer Second Order Cone Optimization (MISOCO) solver. We present computational experiments on various approaches to solve MISOCO problem. We test using outer approximation method to solve continuous relaxations. We also discuss using various valid inequalities to improve the continuous relaxations. We discuss computational performance of these approaches on conic benchmark library (CBLIB 2014) problems.

4 - Solving Robust Portfolio Optimization Problems in Practice

Sarah Drewes, Senior Consultant, Dr., MathWorks, Adalperostr. 45, Ismaning, Germany, Sarah.Drewes@mathworks.de

Robust versions of the Markowitz mean-variance model can reduce the estimation risk induced by its sensitivity to changes in expected returns or the covariance matrix. Probabilistic versions of the classical model can be formulated as nonlinear and often second order cone programs. We study how to solve these problems also by general nonlinear solvers (MATLAB Optimization Toolbox) and in case of discrete variables. We evaluate both computational performance and complexity of implementation.

■ TB17

17-Franklin 7, Marriott

Network Modeling and Design

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Mario Ventresca, Assistant Professor, School of Industrial Engineering, Purdue University, 315 N Grant St, Lafayette, IN, 47906, United States of America, mventresca@purdue.edu

1 - Action-based Network Models

Viplove Arora, Graduate Student, School of Industrial Engineering, Purdue University, 45 N Salisbury St, Apt. 9, West Lafayette, IN, 47906, United States of America, arora34@purdue.edu, Mario Ventresca

Complex networks are very useful representations of real world complex systems. A number of network generation procedures have been proposed that are capable of producing networks with a restricted subset of structural properties. However, a unifying model remains elusive. We present initial results on an action-based perspective that has potential to yield more general network structures than existing techniques. A machine learning approach to learn a probabilistic model will be presented.

2 - Automatically Inferring Complex Network Models

Mario Ventresca, Assistant Professor, School of Industrial Engineering, Purdue University, 315 N Grant St., Lafayette, IN, 47906, United States of America, mventresca@purdue.edu

Complex networks are becoming increasingly important across many disciplines. However, the problem of network modeling is extremely intricate and time consuming. Hence, frameworks have been proposed to estimate model parameters, but are focused on capturing a small subset predefined network characteristics such as degree distribution. I will present recent work on a highly robust automated inference approach that is able to discover arbitrary network models with minimal human insight.

3 - Cut-set Separation Schemes for the Robust Single-commodity Network Design Problem

Daniel Schmidt, Carnegie Mellon University, 720 S Negley Ave, Pittsburgh, PA, 15232, United States of America, schmidt@cmu.edu, Chrysanthos Gounaris

We address the exact solution of the Robust Single-Commodity Network Design Problem in which customer demands are uncertain and realize from within an appropriately defined uncertainty polytope. We explore techniques to approximate the arc-flow based formulation with fewer variables. We also evaluate the use of meta-heuristics for the NP-hard problem of separating cut-set inequalities in the context of a branch-and-cut solution approach.

4 - Network Design Problem for Battery Electric Bus

Yousef Maknoon, EPFL, Route Cantonale, Lausanne, Switzerland, yousef.maknoon@epfl.ch, Shadi Sharif Azadeh, Michel Bierlaire

In electric bus planning, for battery installation, we need to investigate two points: (1) the type and location of charger stations (2) the capacity of battery of each bus. In this presentation, first we describe the problem and the design elements. Then, we present its mathematical form followed by the resolution approach. Finally, we demonstrate the computational results on our case study and discuss about the robustness of the plan.

■ TB18

18-Franklin 8, Marriott

Data Mining for Different Type of Big Data

Cluster: Modeling and Methodologies in Big Data

Invited Session

Chair: Young-seon Jeong, Chonnam National University, Department of Industrial Engineering, Gwangju, Korea, Republic of, youngseonjeong@gmail.com

1 - Classification of Uncertain Data using Group to Object Distances

Behnam Tavakkol, PhD Candidate, Rutgers University, 5200 BPO Way, Piscataway, NJ, 08854, United States of America, btavakkol66@gmail.com, Myong K (MK) Jeong, Susan Albin

Uncertain data problems have features represented by multiple observations or their fitted PDFs. We propose two approaches for classifying uncertain data objects. The first uses existing Probabilistic Distance Measures for object-to-object distances and classifies with KNN. The second features a new probabilistic distance measure for object to class distances.

2 - The Classification Methodology of Chip Quality using Canonical Correlation Analysis

Ki-hyun Kim, Samsung Electronics Co., Banwol-dong, Hwaseong-si, Gyeonggi-do, Korea, Republic of, bluenamja@daum.net

In this study, we proposed classification methodology using a canonical correlation analysis as feature selection method at multi-dimensional chip level data generated in the semiconductor manufacturing industry. As the result of this research, we were able to extract important variables in the various PCM variables from the correlation of the multiple FBC variables and PCM variables. The proposed method was improved the accuracy of quality classification for a chip tested in the probe test.

3 - Multivariate Monitoring for Metal Fabrication Process in Mobile Devices Manufacturing

Seonghyeon Kang, M.s. Candidate, Korea University, Innovation Hall 817, Korea University, 145 Anam-ro, Seongbuk-gu, Seoul, 136-713, Korea, Republic of, shyeon.kang@gmail.com, Seoung Bum Kim

In mobile industry, using metal case of devices is rapidly increased for thin and attractive design. However, fabricating metal is the difficult process because accurate control of equipment are required. In this study, we propose an efficient multivariate monitoring procedure to observe more than 40 parameters of metal fabrication equipment. The effectiveness of the proposed procedure is demonstrated by real data from the mobile plant in one of the leading mobile companies in South Korea.

4 - Multivariate Monitoring of Automated Material Handling Systems in Semiconductor Manufacturing

Sangmin Lee, Korea University, Innovation Hall 817, Korea University, 145 Anam-ro, Seongbuk-gu, Seoul, 136-713, Korea, Republic of, smlee5679@gmail.com, Seoung Bum Kim

Monitoring all possible contingencies in automated material handling system (AMHS) of semiconductor manufacturing is a difficult task because tremendous hardware and software systems are involved. This study presents an efficient multivariate monitoring procedure to monitor more than 100 KPIs in AMHS. The effectiveness and applicability of the proposed procedure is demonstrated by real data from semiconductor fabrication plant in one of the leading semiconductor companies in South Korea.

5 - Quantifying the Level of Risk of Functional Chips in Semiconductor Wafers

Young-seon Jeong, Chonnam National University, Department of Industrial Engineering, Gwangju, Korea, Republic of, youngseonjeong@gmail.com, Byunghoon Kim, Seung-hoon Tong, Inkap Chang, Myong K (MK) Jeong

This talk presents the procedure to quantify the level of risk of functional chips in dynamic random access memory (DRAM) wafers. To screen risky functional chips, the risk level of each chip is estimated by the posterior probability for functional chips. The functional chips closer to the class of defective chips may have a higher probability of being failed in the near future. The experimental results by using real-life wafers show the effectiveness of the proposed method.

■ TB21

21-Franklin 11, Marriott

Bundled Payment Systems

Sponsor: Health Applications

Sponsored Session

Chair: Danny Hughes, Harvey L. Neiman Health Policy Institute, 1891 Preston White Drive, Reston, VA, 20191, United States of America, dhughes@neimanhpi.org

1 - Optimizing Provider Decisions under Bundled Payments

Brenda Courtad, University of Cincinnati, 2925 Campus Green Dr, Cincinnati, OH, 45221, United States of America, courtabl@mail.uc.edu

When moving from fee-for-service to bundled payments the providers focus shifts from revenue generating to cost reducing. We develop a partially observable Markov decision process to aid providers in deciding which interventions to implement to reduce costs.

2 - Increasing Healthcare Value in Accountable Care Organizations through Incentive Redesign

Christian Wernz, Virginia Tech, Industrial and Systems Engineering, Blacksburg, VA, 24060, United States of America, cwernz@vt.edu, Hui Zhang, Barry Barrios, Danny Hughes

ACOs are incentivized by the Centers for Medicare and Medicaid Services (CMS) to lower costs while meeting quality standards. We determined how CMS' incentive program can be improved, and how ACOs can optimally distribute incentives among their members. Using multiscale decision theory, we performed an in-depth analysis of computed tomography (CT) scanner investments and use in ACO hospitals, calibrated the model with Medicare data, and show how CT scan cost can be lowered and outcomes improved.

3 - Mitigating Small Provider Financial Risk under Prospective Bundled Payment Systems

Danny Hughes, Harvey L. Neiman Health Policy Institute, 1891 Preston White Drive, Reston, VA, 20191, United States of America, dhughes@neimanhpi.org, Jeremy Eckhause

Retrospective bundled payment models, which cover all medical services within an episode of care, usually include stop loss provisions to manage financial risk. As payments shift to prospective bundled payments, the mechanisms to manage these stop loss provisions may no longer exist. We develop nonlinear programming models to develop pricing strategies that address the inherent higher risk to smaller providers under such a payment system.

4 - Bundled Payments: The Roles of Organization and Diagnosis

Turgay Ayer, Georgia Institute of Technology, 765 Ferst Dr., Atlanta, GA, 30332, United States of America, ayer@isye.gatech.edu, Mehmet Ayyaci, Jan Vlachy

Medicare has started contracting with healthcare providers for bundled payments. However, most providers do not have experience with the risks and opportunities for such payment mechanism. We propose a game-theoretic model to capture the power dynamics between physicians and the hospital under various patient pathways. We use the model to generate hypotheses and test these hypotheses using real data.

■ TB22

22-Franklin 12, Marriott

Learning High-dimensional/ Sparse Models

Sponsor: Applied Probability

Sponsored Session

Chair: Varun Gupta, University of Chicago Booth School of Business, Chicago, IL, United States of America Varun.Gupta@chicagobooth.edu

1 - Robust Methods for High-dimensional Regression

Po-ling Loh, Assistant Professor, University of Pennsylvania, 3730 Walnut St, 466 Jon M. Huntsman Hall, Philadelphia, PA, 19104, United States of America, loh@wharton.upenn.edu

We discuss new methods for robust regression in high-dimensional settings. Our procedures draw upon classical approaches in robust statistics, designed for scenarios where the number of parameters is fixed and the sample size grows to infinity — however, these methods may be adapted to perform robust inference in high dimensions, as well. We also prove that the robust estimators, which involve minimizing nonconvex functions, may nonetheless be optimized to desirable accuracy.

2 - Statistical Guarantees for Individualized Rank Aggregation

Sahand Negahban, Yale University, 24 Hillhouse Ave, New Haven, CT, 06510, United States of America, sahand.negahban@yale.edu

We study a version of rank aggregation known as collaborative ranking. In this problem we assume that individual users provide us with pairwise preferences and from those preferences we wish to obtain rankings on items that the users have not had an opportunity to explore. We provide a theoretical justification for a nuclear norm regularized optimization procedure.

3 - Inference in High-dimensional Varying Coefficient Models

Mladen Kolar, Assistant Professor, Chicago Booth, 5807 South Woodlawn Avenue, Chicago, IL, 60637, United States of America, mkolar@chicagobooth.edu, Damian Kozbur

We focus on the high-dimensional linear varying-coefficient model and develop a novel procedure for estimating the coefficient functions. Our procedure works in a high-dimensional regime, under arbitrary heteroscedasticity in residuals, and is robust to model misspecification. We derive an asymptotic distribution for the normalized maximum deviation of the estimated coefficient function and demonstrate how these results can be used to make inference in high-dimensional dynamic graphical models.

4 - Elementary Estimators for High-dimensional Statistical Models

Eunho Yang, IBM T.J. Watson, P.O. Box 218, Yorktown Heights, United States of America, eunho@cs.utexas.edu

We propose a class of closed-form estimators for sparsity-structured high-dimensional models. Our approach builds on observing the precise manner in which the classical MLE breaks down under high-dimensional settings. We provide a rigorous statistical analysis that shows that our simple estimators recovers the same asymptotic convergence rates as those of computationally expensive L1-regularized MLEs. We corroborate statistical performance, as well as computational advantages via simulations.

■ TB23

23-Franklin 13, Marriott

New Advances in Production Planning and Scheduling

Cluster: Stochastic Models: Theory and Applications

Invited Session

Chair: Jingshan Li, Professor, 1513 University Ave, Madison, WI, 53706, United States of America, jli252@wisc.edu

1 - Coordination in Multi-product Manufacturing Systems: Modeling and Analysis

Cong Zhao, Research Assistant, University of Wisconsin-Madison, 1513 University Ave, Room 3235, Madison, WI, 53706, United States of America, czhao27@wisc.edu, Ningxuan Kang, Li Zheng, Jingshan Li

Multi-product systems are common in today's manufacturing process. Effective coordination between products in such systems is important in operation. We study a two-product geometric manufacturing system and derive closed-form expressions of performance measures. An optimal allocation policy of buffer thresholds is developed, and the monotonicity of optimal buffer size with respect to machine parameters is investigated. The managerial insights to achieve optimal production control are discussed.

2 - Level Scheduling in Automotive Assembly Lines and its Effect on the Consumption of Resources

Heinrich Kuhn, Professor, Catholic University of Eichstaett-Ingolstadt, Supply Chain Management & Operations, Auf der Schanz 49, Ingolstadt, 85049, Germany, heinrich.kuhn@ku-eichstaett.de, Dominik Woerner

Level scheduling approaches in sequencing of assembly lines are used as substitutional model for the underlying economic and sustainable objectives since a leveled distribution of materials requirements does not necessarily contribute directly to these objectives. We conduct a case study at a major German automotive company selecting relevant part families whose consumption is currently unequal distributed by an extensive simulation study.

3 - A New Scenario Based Sales and Operations Planning Model

Nico Vandaele, Professor, KU Leuven, Naamsestraat 69 Box 3555, Leuven, 3000, Belgium, nico.vandaele@kuleuven.be, Catherine Decouttere, Gerd Hahn, Torben Sens

We apply a scenario-based approach to the sales and operations planning process where both model-based and non-model based Key Performance Indicators are taken into account. This allows us to balance customer service, derived from aggregate order lead times, and relevant costs of operations when determining volume/mix decisions for internal and external production. An industry-derived case example with distinct outsourcing options is used to highlight the benefits of the approach.

■ TB24

24-Room 401, Marriott

Urban Data Analytics and Mining

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Xun Zhou, Assistant Professor, University of Iowa, S210 Papajohn Business Building, 21 E Market Street, Iowa City, IA, 52242, United States of America, xun-zhou@uiowa.edu

1 - A Data Mining Approach to the Discovery of Emerging Hotspot Patterns in Urban Data

Amin Vahedian Khezerlou, University of Iowa, S283 Papajohn Business Building, The University of Iowa, Iowa City, IA, 52242-1994, United States of America, amin-vahediankhezerlou@uiowa.edu, Xun Zhou

Emerging hotspots can be observed in urban data, e.g., cellular service or traffic congestions due to non-periodic events (e.g., sport games, accidents). Efficiently identifying these patterns help city planners and service providers respond early to the congestions. Previous hotspot detection techniques focused on patterns with fixed footprints. We propose an efficient data mining approach to detect emerging congestion patterns with dynamic footprints and validate our method on real urban data.

2 - Exploiting Geographic Dependencies for Real Estate Ranking

Yanjie Fu, Rutgers University, 504 N 5th St, Harrison, NJ, 07029, United States of America, yanjie.fu@rutgers.edu, Hui Xiong, Hui Xiong

We propose a geographic method, named ClusRanking, for estate evaluation by leveraging the mutual enforcement of ranking and clustering power model the geographic dependencies of estates for enhancing estate ranking. Indeed, the geographic dependencies of the investment value of an estate can be from the characteristics of its own neighborhood (individual dependency), the values of its nearby estates (peer dependency), and the prosperity of the affiliated latent business area (zone dependency).

3 - A General Geographical Probabilistic Factor Model for Point of Interest Recommendation

Bin Liu, Rutgers University, 900 Davidson Road, 47 Nichols Apartment, Piscataway, NJ, 08854, United States of America, binben.liu@rutgers.edu

The problem of point of interest recommendation is to provide personalized places. The decision process for a user to choose a POI can be influenced by numerous factors, such as personal preferences, geographical considerations, and user mobility behaviors. We propose a general geographical probabilistic factor model framework which takes various factors into consideration. Extensive experimental results show promise of the proposed methods.

■ TB25

25-Room 402, Marriott

Software-Driven Innovation and Business Strategies

Sponsor: Information Systems

Sponsored Session

Chair: Narayan Ramasubbu, University of Pittsburgh, 354 Mervis Hall, Pittsburgh, PA, 15228, United States of America, nramasubbu@katz.pitt.edu

1 - Business Value of the Mobile Enterprise: An Empirical Study of Mobile Sales Force in Banking

Ajit Sharma, Ross School of Business, 701 Tappan Street, Ann Arbor, MI, United States of America, asharmaz@umich.edu

The press and research on mobility has remained focused on the customer-firm interface. While there is sufficient evidence of gains from mobile marketing in better targeting and lift, the benefits of mobile-centric enterprise processes remain under-studied. In this paper, we empirically assess the reduction in process time and error rates by shifting from a traditional "sales person in the field-computer in the office" sales process to a "sales person in the field with a tablet" sales process.

2 - Lost in Cyberspace: An Investigation of Digital Borders, Location Recognition, and Experience Attribution

Brian Dunn, Assistant Professor, University of Oklahoma, 307 West Brooks Ste. 307D, Norman, OK, 73072, United States of America, bkdunn@ou.edu, Narayan Ramasubbu, Dennis Galletta, Paul Lowry

Do website users know where they are? Given that they may visit multiple sites in the same session, they may not, which has important implications for the owners of those sites. However, past research has yet to account for this possibility. To understand when users recognize where they are online and how they attribute credit to the sites that are helpful to them, we introduce the

concepts of 'digital borders' and 'border strength' and use them in an experimental investigation.

3 - Design Control in Open Innovation: An Examination of Open Source Software Production

Shivendu Pratap Singh, University of Pittsburgh, Room 229, Mervis Hall, Pittsburgh, 15260, United States of America, shs161@pitt.edu

Firms are opting for co-creating software, by attracting developers on platforms like GitHub. This shared model of development requires flexible software design controls to influence community engagement, which could result in proliferation of design options. Flexible design control policy could have side effects such as accumulation of technical debt and need to be judiciously managed. This paper examines the antecedents and consequences of design control policies in social software production.

4 - Time-dependent Pricing for Mobile Data: Analysis, Systems, and Trial

Soumya Sen, ssen@umn.edu, Carlee Joe-wong, Mung Chiang, Sangtae Ha

Dynamic pricing of mobile data traffic can alleviate network congestion by creating temporally-varying price discounts. But realizing it requires developing analytical models for price point computation, systems design, and field experiments to study user behavior. In this paper, we present the architecture, implementation, and a user trial of a day-ahead time-dependent pricing.

■ TB26

26-Room 403, Marriott

Retailer Pricing

Cluster: Operations/Marketing Interface

Invited Session

Chair: Kathy Steckle, UT Dallas, SM30 JSOM, 800 W Campbell Rd, Richardson, TX, 75080, United States of America, ksteckle@utdallas.edu

Co-Chair: Xuying Zhao, University of Notre Dame, Notre Dame, IN, Xuying.Zhao.29@nd.edu

1 - Optimal Price Trajectories and Inventory Allocation for Inventory Dependent Demand

Stephen Smith, Professor, Santa Clara University, 500 El Camino Real, Lucas Hall 216H, Santa Clara, CA, 95053-0382, United States of America, ssmith@scu.edu, Narendra Agrawal

Retail demand is often inventory dependent because larger inventories create more attractive displays and low inventories can create broken assortments. This research jointly optimizes the price trajectory and the allocation of a given amount of inventory across a set of non-identical stores with inventory dependent demands.

2 - The Effect of Reward Purchase on Dynamic Pricing

Hakjin Chung, Stephen M. Ross School of Business, University of Michigan, Ann Arbor, MI, United States of America, hakjin@umich.edu, So Yeon Chun, Hyun-soo Ahn

In many loyalty programs, consumers are provided with an option to acquire products by redeeming loyalty points instead of cash. We characterize when consumers use points or cash depending on their willingness-to-pay in cash as well as in points. Then, we incorporate this consumer choice model into the seller's dynamic pricing model, where the revenues from both posted price and reimbursement for reward sales are embedded in each period.

3 - An Off-price Retailer with Two Ordering Opportunities

Moutaz Khouja, Professor, UNC Charlotte, 9201 University City Blvd, Charlotte, NC, 28223, United States of America, mjkhouja@uncc.edu, Jing Zhou

We develop a model of an off-price retailer who has two procurement opportunities for next season. The first opportunity occurs after the end of the current season where she buys excess inventory from retailers and manufacturers and store them until next season. The second opportunity occurs before the selling season begins again. The product quantity available in the first opportunity is limited while the price in the second opportunity is a random variable that depends on consumer demand.

4 - Multi-product Price Promotions with Reference Price Effects

Kevin Li, UC Berkeley, IEOR Department, Berkeley, CA, 94720, United States of America, kbl4ew@berkeley.edu, Candace Yano

We consider a retailer's problem of setting prices, including promotional prices, over a multi-period horizon for multiple products with correlated demands, considering customer stockpiling and the effect of reference prices on customers' buying behavior. These factors limit the efficacy of deep discounts and frequent promotions. We present structural results and numerical examples that provide insight into the nature of optimal policies and the impact of various parameters.

■ TB27

27-Room 404, Marriott

Multiple Criteria Decision Aiding

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Roman Slowinski, Prof., Poznan University of Technology, Pl. Marii Skłodowskiej-Curie 5, Poznan, PL, 60-965, Poland, roman.slowinski@cs.put.poznan.pl

1 - FITradeoff: Flexible and Interactive Tradeoff Elicitation Procedure

Adiel T. DeAlmeida, Professor, Universidade Federal de Pernambuco, Caixa Postal 7462, Recife, PE, 50630-971, Brazil, almeidaatd@gmail.com, Adiel De Almeida Filho, Jonas Araujo De Almeida, Ana Paula Costa

FITradeoff is a Flexible and Interactive Tradeoff elicitation procedure for multicriteria additive models in MAVT scope. The classical tradeoff procedure is one of the approaches with strongest theoretical foundation. However, behavioral studies have shown inconsistencies of DM during elicitation. The FITradeoff reduces DM's effort in the process, by using partial information, thereby contributing for reducing inconsistencies. It is implemented in a DSS, which is illustrated by applications.

2 - An Enhanced "Election Machine" for the Finnish Parliamentary Elections: Theory and Implementation

Jyrki Wallenius, Professor, Aalto University School of Business, Runeberginkatu 22-24, Helsinki, Finland, jyrki.wallenius@aalto.fi, Tommi Pajala, Akram Dehnokhalaji, Pekka Korhonen, Pekka Malo, Ankur Sinha

Web-based questionnaires to match candidates' and voters' views play an important role in Finland. We have collaborated with Helsingin Sanomat, who runs the most influential of such questionnaires, to enhance and further develop it. Our algorithm was tested in last April's Parliamentary Elections. We describe our algorithm and the feedback.

3 - Multicriteria and Multiobjective Models for Risk, Reliability and Maintenance Context

Rodrigo J P Ferreira, Assistant Professor, Universidade Federal de Pernambuco, Av. Professor Moraes Rego, 1235., Recife, PE, 50670-901, Brazil, rodjpf@gmail.com, Adiel T De Almeida, Cristiano A V Cavalcante, Marcelo H Alencar, Adiel De Almeida Filho, Thalles V Garcez

The use of multiple criteria and multiobjective models in risk, reliability and maintenance research has increased in recent years. These models may affect the strategic results of any organization, as well as, human life and the environment. In such situations, optimal solutions for one objective function cannot be suitable. These issues are presented according to the reference Multicriteria and Multiobjective Models for Risk, Reliability and Maintenance Decision Analysis.

4 - Constructive Preference Learning in Value-driven Multiple Criteria Sorting

Roman Slowinski, Prof., Poznan University of Technology, Pl. Marii Skłodowskiej-Curie 5, Poznan, PL, 60-965, Poland, roman.slowinski@cs.put.poznan.pl, Milosz Kadzinski, Krzysztof Ciomek

We present an interactive preference learning technique for multiple criteria sorting driven by a set of additive value functions compatible with a rich preference information acquired from the user. This information may include: (1) imprecise assignment examples, (2) desired class cardinalities, and (3) assignment-based pairwise comparisons. The output results are necessary and possible assignments, and extreme class cardinalities.

■ TB28

28-Room 405, Marriott

Empirical Market Design

Cluster: Auctions

Invited Session

Chair: Peng Shi, MIT Operations Research Center, 1 Amherst Street, E40-149, Cambridge, MA, 02139, United States of America, pengshi@mit.edu

1 - Market Congestion and Application Costs

John Horton, Assistant Professor, NYU Stern School of Business, 44 West Fourth Street, Kaufman Management Center, New York, NY, 10012, United States of America, John.Horton@stern.nyu.edu, Ramesh Johari, Dana Chandler

We report the results of an experimental intervention that increased the cost of applying to vacancies in an online labor market by requiring workers to answer

questions about the job. Although the ordeal positively selected candidates, it was the information in the answers that mattered for match formation. Although the overall number of matches and speed to fill a vacancy was unchanged, employers engaged in less recruiting activities and formed higher quality matches.

2 - Experiments as Instruments: Heterogeneous Position Effects in Sponsored Search Auctions

Justin Rao, Researcher, Microsoft Research, 641 Avenue of Americas, New York, NY, 10014, United States of America, Justin.Rao@microsoft.com, Matthew Goldman

The Generalized Second Price auction has been shown to achieve an efficient allocation and favorable revenue properties provided the causal impact of ad position on user click probabilities is a constant the scaling factor for all ads. We develop a novel method to re-purpose internal business experimentation at a major search engine and we strongly reject the conventional multiplicatively-separable model, instead finding substantial heterogeneity of the causal impact of position on CTR.

3 - Optimal Design of Two-sided Market Platforms: An Empirical Case Study of Ebay

Brent Hickman, Assistant Professor Of Economics, University of Chicago, 1226 E 59th St, Chicago, IL, 60637, United States of America, hickmanbr@uchicago.edu, Joern Boehnke, Aaron Bodoh-creed

We investigate design of platform markets that house many auctions over time. We combine a unique dataset with a model of bidding where the option value of re-entering the market creates incentive for buyers to shade bids below private valuations in the current period. We show the model is identified using the Bellman equation for a representative bidder. We estimate the model and investigate the degree to which eBay is able to reduce transaction costs and approach the efficient allocation.

4 - Stability of Demand Models Across Policy Reforms: An Empirical Study with Boston Public Schools

Peng Shi, MIT Operations Research Center, 1 Amherst Street, E40-149, Cambridge, MA, 02139, United States of America, pengshi@mit.edu, Parag Pathak

In counterfactual analysis using demand modelling, an important but seldom checked assumption is that the proposed reform does not affect the demand model. We validate this assumption across a major school choice reform in Boston in 2014. To control for post-analysis bias, we precommit to forecasts before the reform. We find that while our prediction of the number of applicants were off, the logit and mixed-logit demand models we fit were stable before and after the reform.

■ TB29

29-Room 406, Marriott

Applications of Analytics II

Sponsor: Analytics

Sponsored Session

Chair: Tarun Mohan Lal, Mayo Clinic, mohanlal.tarun@mayo.edu

1 - Combating Attrition through New Developments in Transaction Analytics and Customer Dialogue

Gerald Fahner, Analytic Science Senior Director, FICO, 181 Metro Drive, San Jose, United States of America, gerald.fahner@fico.com

"Silent" attrition remains a costly problem requiring fast detection and insight to create effective retention offers. Our credit card case study shows how ensemble models instrumented with low-latency transaction features rapidly detect card-level and merchant category-level attrition. We explain our models and relate performance to profitability. We show how to boost persuasiveness of offers by customer dialogues to learn their preferences. Using a simulation we illustrate the value of dialogue.

2 - How Bringing Decision Optimization to the Cloud Will Democratize Optimization

Susara Van Den Heever, IBM France, 1681 Route des Dolines, France, svdheever@fr.ibm.com, Xavier Ceugniet, Alain Chabrier, Stéphane Michel

Even though Decision Optimization has been used effectively across industries for decades, it remains under-utilized. Complexity and costs are often cited as barriers to wider adoption. The emergence of cloud computing, as well as the renewed emphasis on cognitive analytics platforms, breaks down these barriers to bring the benefits of optimization to a wider audience. We will demonstrate this vision through a case study involving IBM Decision Optimization on Cloud, and IBM Watson Analytics.

3 - An Approach to Estimating Customer Lifetime Values for Apartment Tenants

Jian Wang, Vice President, Research & Development, The Rainmaker Group, 4550 North Point Parkway, Alpharetta, GA, 30022, United States of America, jwang@letitrain.com

Estimating tenant lifetime values is important for apartment revenue management. We propose a heuristic approach to predicting renewal likelihoods and estimating tenant lifetime values. We then present empirical results based on real apartment data.

■ TB30

30-Room 407, Marriott

Intelligent Agents and Systems

Contributed Session

Chair: Mohsen Moghaddam, PhD Candidate, Purdue University, 1155 Anthrop Dr., Apt. 9, West Lafayette, IN, 47906, United States of America, mmoghadd@purdue.edu

1 - Optimizing Physician to Patient Consults using Robot-based Virtual Systems

Henry Ibekwe, Post Doctoral Researcher, Independent, Richmond, United States of America, hibekwe1@gmail.com

The delivery of quality healthcare for chronically ill patients is burdened by the limited resources available to physicians and healthcare facilities. We propose the use of virtual-presence autonomous robot systems to optimize the physician to patient consultation by minimizing the patient wait-time and maximizing the number of physician consults given limited resources. We formulate a robot-patient interaction model as a stochastic process and solve using discrete-time dynamic programming.

2 - A Study on the Influence of Trust and Distrust Ratings in Social Networks on Cold Start Users

Sanjog Ray, Assistant Professor, Indian Institute of Management Indore, Rau Pithampur Road, Indore, 453331, India, sanjogr@iimind.ac.in

This study examines how cold start users get influenced by the trust and distrust scores of other users in a social network. We examine the users trusted by cold start users on the basis of critical parameters: number of trust statements, number of distrust statements, and number of items rated. We base our findings on our analysis of the real life Epinions dataset. Our analysis has implications for design of trust aware recommender systems for cold start users.

3 - Analyzing Inventory Policies in Multi-stage Automatic Manufacturing Systems

Barin Nag, Professor, Towson University, Department of E-Business & Technology Ma, Towson, MD, 21252, United States of America, bnag@towson.edu, Dong-qing Yao, Sungchul Hong

In a multi-stage manufacturing system each stage fills demand from any combination of buffer inventory or production. Lowest inventory levels may not be lowest cost, with contradictions arising from the costs of delays of physical production, backlogs, breakdowns, and bottlenecks. We study best performance inventory policies using varied production architectures.

4 - A Modeling Framework of Cyber-Physical Systems

Ashutosh Nayak, Student, Purdue University, 318 N Salisbury St, Apt. 8, West Lafayette, IN, 47906, United States of America, nayak2@purdue.edu, Shimon Y. Nof, Seokcheon Lee, Rodrigo Levalle

Effective modelling of CPS is a big challenge. In this work, we propose a resource sharing based framework for CPS aimed at maximizing its utility. This framework represents CPS as a network of tasks and resources characterized by utility functions and overlapping resource communities. A distributed control approach backed by utility aggregation function is considered for optimality and stability. Its implementation is illustrated through two examples: Smart factory and multi-robot system.

5 - Collaborative Networked V-organizations: Design & Integration

Mohsen Moghaddam, PhD Candidate, Purdue University, 1155 Anthrop Dr., Apt. 9, West Lafayette, IN, 47906, United States of America, mmoghadd@purdue.edu, Shimon Y. Nof

Modern distributed, networked, and collaborative organizations of humans/machines/firms enable systematic integration of distributed resources for processing dynamic/diverse tasks. We design collaborative networked v-Organizations by integrating physical (location of resources) and virtual (allocation of tasks) dimensions, for higher service level, stability, and utilization. A mixed-integer program and a tabu search are developed for modeling and optimization purposes, respectively.

■ TB31

31-Room 408, Marriott

Connected Vehicle Analytics

Sponsor: Data Mining

Sponsored Session

Chair: Juan Li, Member of Research Staff, Xerox Innovation Group, 800 Phillips Road, 128-27E, Webster, NY, 14580, United States of America, Juan.Li@xerox.com

1 - A System for Estimating Traffic Congestion Measures in a Network using GPS Smartphone

Charles Chung, Vp Products, Brisk Synergies, 295 Hagey Blvd, 1st Flr, Waterloo, Canada, charles.chung@brisksynergies.com

A smartphone app is developed for logging route data. A platform is then built for mapping traffic congestion using speed indicators average speed and speed differential at the link level. The results demonstrate the feasibility and huge potential our data collection system that can be implemented in any city and sets the growth for real-time applications for connected vehicles.

2 - Online Travel Mode Identification with Smartphones

Qing He, Assistant Professor, SUNY Buffalo, 313 Bell Hall, Buffalo, NY, 14051, United States of America, qinghe@buffalo.edu, Xing Su, Hernan Caceres, Hanghang Tong

We propose an online classification algorithm to detect user's travel mode using mobile phone sensors. Our application is built on the latest Android smartphone with multimodality sensors. By applying a hierarchical classification method, we achieve high accuracy in a binary classification wheelers/non-wheelers travel mode, and all six travel modes.

3 - Locating Heterogeneous Traffic Sensors to Improve Network Surveillance Benefit

Xuechi Zhang, Graduate Research Assistant, University of Maryland, 0147C Eng Lab Bld, University of Maryland, College Park, MD, 20742, United States of America, zhangxc90@gmail.com, Ali Haghani

Optimal placement of traffic sensors is significant to improve urban mobility. In this study, a mathematical optimization model of deploying heterogeneous sensors (i.e. Bluetooth sensor and loop detector) to large-scale traffic network is proposed. Maximizing real-time information report reliability and coverage are chosen as dual objectives. In addition, the effect of real-time GPS-based probe vehicle data is also considered. A case study in Washington D.C. area is conducted for demonstration.

4 - Inferring Trajectories for Partial Observations

Juan Li, Member of Research Staff, Xerox Innovation Group, 800 Phillips Road, 128-27E, Webster, NY, 14580, United States of America, Juan.Li@xerox.com, Moshe Lichman, Padhraic Smyth

The amount of spatial trajectory data is growing fast with the rapid increased availability of GPS-embedded vehicles. The trajectory data is mixed with high and low sampling rate with partial observations. In this study, we aim to build probabilistic models to infer possible traversed route for low sampling rate vehicle trajectory data.

■ TB32

32-Room 409, Marriott

Business Analytics in Higher Education Industry

Sponsor: Analytics

Sponsored Session

Chair: Roger Gung, Director, Business Analytics & Operations Research, University of Phoenix, 3137 E Elwood St, Phoenix, AZ, 85034, United States of America, roger.gung@phoenix.edu

1 - Marketing Mix Optimization

Roger Gung, Director, Business Analytics & Operations Research, University of Phoenix, 3137 E Elwood St, Phoenix, AZ, 85034, United States of America, roger.gung@phoenix.edu

Marketing spend allocation drives the volume of new marketing inquiries (NMI) and enrollments. Two-stage non-linear regression models were built to formulate NMI channels with respect to marketing spends which were defined as either endogenous, exogenous or instrument variables. The optimization model was formed by aggregating all NMI channels' regression models into one objective function. The optimal spend allocation was then derived from the model every quarter to guide marketing strategies.

2 - Contact Center Qualifying Transfer Rate Modeling and Analysis

Jie Yu, Operations Research Scientist, University of Phoenix,
3137 E Elwood St, Phoenix, AZ, 85034, United States of America,
jie.yu@phoenix.edu, Roger Gung, Lin Wang

Impact analysis on transferring marketing inquiries to qualifying leads for potential enrollments and the performance of contact center agents are crucial to contact center and enrollment operations. An impact analysis was conducted on transfer rate with drivers including speed to lead, lead source, time of request as well as program level. A mixed effect logistic regression model was built to rank agents' performance in terms of expected transfer rate with given marketing inquiries. The model was also employed to evaluate the impact of reducing contact center and enrollment operating hours.

3 - Enrollment Service Contact Strategy Optimization

Pan Hu, Operations Research Scientist, University of Phoenix,
3137 E Elwood St, Phoenix, AZ, 85034, United States of America,
pan.hu@phoenix.edu, Yun Ouyang, Jie Yu, Lin Wang,
Roger Gung

This project is to study how contact behaviors of enrollment representatives influence enrollment progression of higher education pursuers. To better serve the needs of potential students, it is critical to communicate effectively by bringing up right topics in the best timing. We examined a list of conversation topics suggested in the internal guideline of University of Phoenix for enrollment representatives, and identified the best contact strategy using statistical models.

■ TB33

33-Room 410, Marriott

Joint Session HAS/MSOM-Healthcare: Modeling Applications for Emergency Departments

Sponsor: Health Applications

Sponsored Session

Chair: Sean Barnes, University of Maryland, 4352 Van Munching Hall,
University of Maryland, College Park, MD, 20742,
United States of America, sbarnes@rhsmith.umd.edu

1 - Review of Queueing Theory Applied to Emergency Departments with Comparable Simulation Studies

Summer (Xia) Hu, PhD Student, University of Maryland,
Department of Mathematics, College Park, United States of
America, xhu64@umd.edu, Sean Barnes, Bruce Golden

Queueing Theory (QT) is an important tool for Emergency Department (ED) design and management. By reviewing all papers with ED QT analysis or applications since 1972, this survey examines the contributions of QT to modeling EDs and identify its benefits and limitations when compared to discrete-event simulation (DES) under similar ED operational settings. Our results indicate that the combination of queueing and DES methods can be a powerful approach to better ED modelling.

2 - Using Simulation to Assess the Impact of an Observation Unit in a Pediatric Emergency Department

Mark Grum, University of Michigan, 1205 Beal Avenue, Ann
Arbor, MI, 48109, United States of America, mgrum@umich.edu,
Gabriel Zayas-Caban, Michelle Macy, Allison Cator, Amy Cohn

Observation units (OUs) provide an alternative disposition decision for ED patients who may benefit from further observation, such as those are not ill enough to be admitted, but not well enough to be discharged. Patients can be placed in an OU for monitoring, diagnostic evaluation, and/or treatment prior to disposition. In this talk, we discuss our approaches (e.g. simulation) for assessing the impact of an OU in the Pediatric ED at the University of Michigan.

3 - Operational Causes of Patients Leaving Before Treatment is Completed in Emergency Departments

David Anderson, Assistant Professor, Baruch,
davidryberganderson@gmail.com, Bruce Golden, Edward Wasil,
Laura Pimentel, Jon Mark Hirshon

Patients leaving before treatment (LBTC) is completed is an indicator of poor Emergency Department performance. Contrary to previous research, volume is not the main driver of patients leaving before treatment is complete. First provider time and lengths of treatment are much more strongly associated with LBTC rate. We show that operational factors such as treatment time and staffing decisions play a role in waiting time and, thus, in determining the LBTC rate.

4 - Strategies for Ebola Containment: A Biological-behavioral-operational Modeling Decision Framework

Eva Lee, Georgia Tech, Atlanta, GA, eva.lee@gatech.edu

This work is joint with CDC. We present a computational decision modeling framework that integrates an agent-based biological disease spread model, a dynamic network-based social-behavior model that captures human behavior and interaction, and a stochastic queueing model that describes treatment characteristics, day-to-day hospital and homecare processes, and resource usage. An optimization engine determines the minimum resource needed to contain the Ebola epidemic in W. Africa.

■ TB34

34-Room 411, Marriott

Data-driven Modeling and Analysis of Health Care Systems

Sponsor: Health Applications

Sponsored Session

Chair: Anil Aswani, UC Berkeley, 4141 Etcheverry Hall, Berkeley, CA,
94720-1777, United States of America, aaswani@berkeley.edu

1 - Constructing Behavioral Models for Personalized Weight Loss Interventions using Integer Programming

Yonatan Mintz, Graduate Student, UC Berkeley, 1822 Francisco
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ymintz@berkeley.edu, Philip Kaminsky, Yoshimi Fukuoka,
Anil Aswani, Elena Flowers

In this paper we describe two (a machine learning and a utility maximization) models for weight loss using clinical trial data. We believe these quantitative models of behavior change can be used to provide personalized interventions, improve adherence and lower costs of current weight loss programs. Given the high prevalence of obesity, these results provide significant insight into more effective approaches to implement weight loss programs.

2 - Modeling Treatment Adherence Behavior in the Treatment of Obstructive Sleep Apnea

Yuncheol Kang, Pennsylvania State University, 236 Leonhard
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kang.yuncheol@gmail.com, Paul Griffin, Vittal Prabhu,
Amy Sawyer

We target patients who suffered from Obstructive Sleep Apnea (OSA) and their treatment behaviors when using Continuous Positive Airway Pressure (CPAP) devices. We model underlying dynamics and patterns of patient treatment behavior using Markov models as a basis for designing effective and economical intervention. Also we suggest a guideline for designing a cost-effective intervention to economically treat the patients.

3 - Inverse Optimization with Noisy Data

Auyon Siddiq, UC Berkeley, 4141 Etcheverry Hall, University of
California, Berkeley, Berkeley, 94720, United States of America,
auyon.siddiq@berkeley.edu, Zuo-jun Max Shen, Anil Aswani

We present an approach for inverse parametric optimization with noisy solution data for convex forward problems. The proposed method yields well-behaved estimates that attain risk consistency or parameter estimation consistency under reasonable conditions. While the formulation is non-convex in general, we provide an approximation algorithm that yields consistent estimates for a class of quadratic programs. Numerical results show competitive performance with state-of-the-art techniques.

4 - Quantifying the Resilience of Hospital Unit Management under High Workloads

Mo Zhou, PhD Student, UC-Berkeley, 4470 Etcheverry Hall,
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mzhou@berkeley.edu, Anne Miller, Anil Aswani, Jason Slagle,
Daniel France

Hospital unit shifts with high admissions/discharges (ADTs) and low nurse-to-patient ratios (NPRs) increase mortality. Nurse managers promote unit resilience, and we quantify this using time series and network analysis of hourly phone calls, ADTs, and NPRs over 2 years from an Intensive Care Unit. Statistical variable selection assessed variable dependency, and time-series estimation demonstrated the validity of phone calls as a resilience measure. Future studies will elucidate adaptive limits.

■ TB35

35-Room 412, Marriott

Using Technology to Enhance Guest Experiences and Performance in Hospitality Management

Cluster: Hospitality, Tourism, and Healthcare

Invited Session

Chair: Alex Susskind, Cornell University, 350 Statler Hall, School of Hotel Administration, Ithaca, NY, 14853, United States of America, ams76@cornell.edu

1 - Picturing Hotels: Attributes of Hotel Images That Attract Consumer Attention Online

Stephani K. A. Robson, Senior Lecturer, Cornell University, 255 Statler Hall, Ithaca, NY, 14853, United States of America, skr4@cornell.edu, Breffni Noone

Images have been shown to be an important element in the online hotel choice process. This exploratory study uses eye tracking technology to investigate the attributes of hotel images that attract consumers' eye fixations during a naturalistic search for lodging, with implications for hotel marketing strategies.

2 - The Connection Between Restaurant Performance and Customer-facing Technology in Restaurants

Alex Susskind, Cornell University, 350 Statler Hall, School of Hotel Administration, Ithaca, NY, 14853, United States of America, ams76@cornell.edu

In this study, the relationship between customer-facing technology, customer satisfaction and restaurant performance are examined. The findings suggest that the use of customer-facing technology in a full-service restaurant experience is positively connected to customers' satisfaction with their service experience in the restaurant, higher average spending in the restaurant and a higher tip percentage paid to the servers.

3 - Does Customer-facing Technology Reduce Service Time in Restaurants?

Ben Curry, Data Scientist, Ela Carte, Ela Carte Headquarters, San Francisco, CA, United States of America, bcurry@elacarte.com

Looking at how table turn time and service labor usage was affected by customers' use of customer facing technology in restaurants, I found that customer-facing technology notably reduced table turn time when customers ordered their meals through the table top device; that figure increased more for customers who ordered their meals and settled their bills using the table-top devices.

■ TB36

36-Room 413, Marriott

Disaster Relief and Humanitarian Logistics

Sponsor: Public Sector OR

Sponsored Session

Chair: Chris Zobel, Professor, Virginia Tech, Business Info. Technology, 880 W. Campus Dr., Suite 1007, Blacksburg, VA, 24061-0235, United States of America, czobel@vt.edu

Co-Chair: Andrew Arnette, Assistant Professor Of Decision Sciences And Governor Geringer Scholar, University of Wyoming, 1000 E. University Ave, Laramie, WY, 82071, United States of America, aarnette@uwyo.edu

1 - Management of Blood Supplies During Humanitarian Crises

Cigdem Gonul Kochan, Ohio Northern University, 525 South Main Street, Ada, OH, 45810, United States of America, c-kochan@onu.edu, Shailesh Kulkarni, David R. Nowicki

This study presents a combined problem of allocating and routing the available blood supplies at the central blood bank to a given set of hospitals with uncertain demand. We develop two multi-product newsvendor (MPNP) –traveling salesman (TSP) models. We examine and compare the results of both models.

2 - A Markov Decision Process Model for Equitable Distribution of Supplies under Uncertainty

Lauren Davis, North Carolina A&T State University, 1601 E. Market St., Greensboro, NC, United States of America, lbdavis@ncat.edu, Sefakor Fianu

Food banks are one of many non-profit organizations assisting in the fight against hunger. Most of the food distributed by the food bank comes from donations which are received from various sources in uncertain quantities at random points in time. We present a finite horizon decision-making model that determines the optimal allocation of supplies to demand locations (charitable agencies) given stochastic supply.

3 - Exploring a Community's Perception of Resilience and its Effect on Public Policy

Roberta Russell, Professor, Virginia Tech, 1007 Pamplin Hall, 0235, Blacksburg, VA, 24060, United States of America, rrussell@vt.edu, Yuhong Li, Michelle Seref

Resilience has been used in many disciplines to describe the ability of an entity to withstand the effects of a disaster, to bounce back from a disaster, or to change and adapt to a new reality post-disaster. This research uses text mining to explore the use of resilience and related terms in newspaper and other media to describe disasters and subsequent recovery efforts. Particular views of resilience are correlated with community actions related to building resilience for the next disaster.

4 - Improving Resource Pre-positioning to Support Disaster Relief Operations

Andrew Arnette, Assistant Professor Of Decision Sciences and Governor Geringer Scholar, University of Wyoming, 1000 E. University Ave, Laramie, WY, 82071, United States of America, aarnette@uwyo.edu, Chris Zobel

This research seeks to address a need for improving asset location modeling for opening overnight shelters in response to natural disasters. Such pre-positioning is crucial for organizations that provide immediate relief to impacted populations, and we discuss a mathematical programming approach that improves on previous attempts to determine more optimal placements for a combination of resources.

■ TB37

37-Room 414, Marriott

Health Care Modeling and Optimization X

Contributed Session

Chair: Songnian Zhao, Student, Kansas State University, 1600 Hillcrest Dr., Apt 4, Manhattan, KS, 66502, United States of America, songnian@ksu.edu

1 - Use of Simulation-optimization Technique in Operating Room Scheduling

Musa Demirtas, Research And Teaching Assistant, Western New England University, 1215 Wilbraham Road, Springfield, MA, 01119, United States of America, demirtasmusa@gmail.com, Mohammad Dehghani, Thomas K. Keyser

In hospitals, operating Rooms (ORs) are the most important and costly departments, and generate a big portion of revenues. This study focuses on maximization of ORs utilization and minimization of inpatients' length of stay to decrease costs and increase patients' satisfaction. Since the arrival of emergency patients may disrupt the schedule, we developed a reactive simulation-optimization model to schedules that optimally allocate limited resources to multiple ORs.

2 - Optimal Delivery and Pickup Planning for Patients with Chronic Diseases using Drones

Seon Jin Kim, University of Houston, Dept. of Industrial Engineering, Houston, TX, 77204, United States of America, sonjin64@gmail.com, Gino Lim, Jaeyoung Cho

Patients with chronic diseases are required to visit clinics for a routine health exam. The cost of chronic diseases has been increasing every year, which became a burden to patients, government, and health insurance companies. We present a robust optimization model to reduce healthcare costs and improve quality of healthcare service using drones. The model finds optimal routes of drones to deliver medicine and pickup necessary samples to analyze patients' health.

3 - Application of Theory of Constraints in Blood Banking

Harshal Lowalekar, Assistant Professor, Indian Institute of Management Indore, Rau-Pithampur Road, Indore, MP, 453556, India, harshal@iimdr.ac.in

We discuss the application of the Theory of Constraints Thinking Processes (TOCTP) methodology in managing inventory at blood banks. Using the Thinking Processes approach the root-cause behind the common inventory problems at blood banks like high shortage and wastage of blood products, high operating expenses and low revenue levels is identified. A TOC based solution is then proposed to address the root-cause.

4 - Study of Optimal Control Strategies for Visceral Leishmaniasis

Songnian Zhao, Student, Kansas State University, 1600 Hillcrest Dr., Apt. 4, Manhattan, KS, 66502, United States of America, songnian@ksu.edu, Chih-hang Wu, Yan Kuang, David Ben-ariel

Visceral Leishmaniasis (VL) is a vector-borne disease which is transmitted by sandflies and it is the second-largest parasitic killer after Malaria. Mathematical models were proposed to assist in the control of spread of VL; however, quantitative conditions for the control of VL transmission are not studied. This paper develops a general mathematical model for VL disease transmission system, performs bifurcation analysis to discuss control conditions, and calculates optimal control strategies.

5 - The Advent of the Intelligent Electronic Health Record

John Glaser, Siemens Healthcare, Malvern, PA,
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We've made great progress in embedding the Electronic Health Record (EHR) in our healthcare processes, with use reaching unprecedented rates. Now, we're poised to take it the next level with the intelligent EHR. The intelligent EHR will look very similar to the traditional system – one can still look up patient results and history and write prescriptions but the application will move past transactional functions. The intelligent EHR will be characterized by sophisticated and flexible decision support, rules engines, process monitoring engines, intelligent displays of important patient data, access to knowledge resources, the ability to collect data from multiple care settings through a health information exchange, and tools that enable provider collaboration. The advent of the intelligent EHR will be necessary if healthcare is to effectively address challenges such as those generated by payment reform and managing the care of chronically ill populations.

■ TB38

38-Room 415, Marriott

Queueing Models I

Contributed Session

Chair: Kaan Kuzu, Assistant Professor, University of Wisconsin-Milwaukee, Lubar School of Business, 3202 N. Maryland Ave., Milwaukee, WI, 53221, United States of America, kuzu@uwm.edu

1 - Optimum Staffing of an Outbound Call Center

Doron Feuer, California Polytechnic State University, Pomona,
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doronfeuer@gmail.com, Saar Yaffe, Saeideh Fallah-Fini

This paper couples regression analysis, Markov chain, and queueing theory techniques and develops a reliable model for optimum staffing of an outbound call center constrained by irregular inbound lead volume. By tracking trends of incoming calls throughout the call center our algorithm predicts the optimum level of staff required to ensure dialing requirements while minimizing wasted agent time.

2 - Optimal Control of a Queue under Overflow Probability Constraint

Abdolghani Ebrahimi, Research Assistant, Iowa State University,
225 Washington Ave, Unit 2, Ames, IA, 50010, United States of
America, gebrahimi91@gmail.com, Arka Ghosh

We develop an optimal policy that minimizes the long-run average cost in a queue system when you have an overflow probability constraint. The queue has a limited buffer size. As our constraint we define long-run average time that the buffer is full less than a number. Our objective is to find the optimal policy. We solve the problem for two cases; one with bounded space and the other with unbounded space.

3 - Analysis of Priority-Based Ticket Queue Data

Kaan Kuzu, Assistant Professor, University of Wisconsin-Milwaukee, Lubar School of Business, 3202 N. Maryland Ave., Milwaukee, WI, 53221, United States of America,
kuzu@uwm.edu, Refik Soyer

We analyze the transactional data from a bank's priority-based ticket queue system and estimate the distributions of inter-arrival and service times based on customer category, day of the week and time intervals in a day. We also predict the customers' patience times for each customer category and day of the week, and develop the corresponding abandonment probabilities using logistic regression models.

■ TB39

39-Room 100, CC

Risks Management in Operations/Marketing

Cluster: Operations/Marketing Interface

Invited Session

Chair: Osman Aydas, Instructor & PhD Candidate, University of Wisconsin-Milwaukee, 3202 N Maryland Ave., Milwaukee WI 53211, United States of America, otaydas@uwm.edu

1 - Global Supply Chain Social Responsibility: An Agency Theory Perspective

Xingxing Zu, Morgan State University, 1700 E Cold Spring Lane,
Department of Information Science & Syst, Baltimore, MD,
United States of America, Xingxing.zu@morgan.edu,
Ziping Wang, Yu Xia

This study examines global supply chain social responsibility from a dyad perspective based on agency theory. We analyze how the characteristics of buyer-supplier relationship affect the effectiveness of two different management

approaches – outcome-based management versus behavior-based management. The relationship characteristics include the length of the relationship, goal conflict between the buyer and the supplier, and the risk aversion of the two parties.

2 - Nurse Allocation Policy Evaluation and Analysis of Admissions in an Intensive Care Unit

Osman Aydas, Instructor & PhD Candidate, University of Wisconsin-Milwaukee, 3202 N Maryland Ave., Milwaukee, WI, 53211, United States of America, otaydas@uwm.edu, Kaan Kuzu, Anthony Ross

Nurse staffing is a crucial step in providing quality healthcare. Many patient care units, including Intensive Care Units, have problems in accurately estimating the number of nurses to use on a daily basis. We evaluate the existing staff allocation system of an intensive care unit using clinical operational data and develop a prediction model for estimating the number of admissions to the unit.

3 - Coordinating Contracts for an Express Service Supply Chain

Juzhi Zhang, University of Science & Technology of China, No.96,
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zjuzhi@mail.ustc.edu.cn, Gou Qinglong, Xiaohang Yue

This paper studies the mismatch problem of an express service supply chain, in which the express company delivers the product from online retailer to consumers. We show that displaying information on delivery capacity can decrease consumers' belief on delay risk and increase the centralized supply chain's profit, but it may not be feasible because consumers may not believe it. We then design some contracts to make the supply chain achieve the profit under information display.

4 - Appraisal Viewpoint Disseminate and Evolution Analysis Online Transaction

Xiening Wang, Associate Professor, DongBei University of Finance and Economics, China, No 217, JianShan Street, Shahekou Distri,
Dalian, LN, 116025, China, wangxiening@163.com

Through feature analysis and algorithm analysis, this paper researches the disseminate and evolution of online transaction appraisal view during consumption. The conversion rules of consumer view tendency is proposed, by describing the viewpoint tendency of network users and combining the clustering properties of the network transactions appraisal viewpoint. It analyzes the e-commerce transactions appraisal of the cellular migration model based on small world network effects.

■ TB40

40- Room 101, CC

Operations/Sustainability

Contributed Session

Chair: Xin Wang, Carnegie Mellon University, 5000 Forbes Ave,
Pittsburgh, PA, 15213, United States of America,
xinwang1@andrew.cmu.edu

1 - Analysis on the Link Between Corporate Social and Financial Performance of Korean Business Groups

Donghyup Woo, Doctoral Candidate, State University of New York at Buffalo, 326 Jacobs Management Center, University at Buffalo SUNY, Buffalo, NY, 14260, United States of America,
dwoo@buffalo.edu, Nallan Suresh

This research identifies contextual relationships between social responsibility and financial performance in countries transitioning to developed economies. Using Korean data, it explores how business group affiliation "Chaebol" influences strategy and social responsiveness. We test the hypothesis that "Chaebol firms" show strong positive relationship due to institutional pressure and legitimacy issues.

2 - Do Sustainability Practices Really Help?

Hung-yao Liu, ESC Rennes School of Business, 2 Rue Robert
d'Arbrissel CS 76522, Rennes, France, hungyao.liu@gmail.com,
Rohit Nishant

We utilize an extensive dataset on the resource consumption of different firms to investigate the effectiveness of various sustainability practices (i.e., pollution prevention, product stewardship, clean technology, and sustainability vision) as conceptualized in Hart's "sustainability portfolio", embedded in the Natural Resource Based View (NRBV). We seek to understand which sustainability practices help firms achieve resource efficiency.

3 - Building Temperature Control with User Feedback and Energy Optimization

John Wen, Professor, Rensselaer Polytechnic Institute, CII 5015,
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wenj@rpi.edu

Buildings are occupied by multiple occupants with different comfort preferences in a shared space. This paper proposes a distributed incentive based strategy to balance the user comfort feedback and building energy optimization. We establish the convergence of the proposed algorithm to the optimal temperature set-point that minimizes the total energy cost and the aggregate discomfort of all occupants.

4 - Green Technology Innovations, Adoption, and Regulation

Xin Wang, Carnegie Mellon University, 5000 Forbes Ave,
Pittsburgh, PA, 15213, United States of America,
xinwang1@andrew.cmu.edu, Alan Scheller-wolf

When a government is considering tightening a standard on a pollutant, their decision often is influenced by the number of firms being able to meet the tightened standard, because a higher number indicates a more feasible standard. We study how such regulation may affect a firm's incentive to develop a new technology to reduce a pollutant. We find that stricter regulation may discourage a firm to develop a new technology, but may encourage other firms to adopt the technology once it is invented.

■ TB41

41-Room 102A, CC

ED Operations Management

Sponsor: Manufacturing & Service Oper
Mgmt/Healthcare Operations
Sponsored Session

Chair: Vedat Verter, James McGill Professor, Desautels Faculty of Management, McGill University, 1001 Sherbrooke Street West, Montreal, QC, H3A 1G5, Canada, vedat.verter@mcgill.ca

1 - Specialist Care in Rural Hospitals: from Emergency Department Consultation to Ward Discharge

Michael Klein, PhD Candidate, McGill University,
Desautels Faculty of Management, Montreal, Canada,
michael.klein2@mail.mcgill.ca, Vedat Verter, Brian G. Moses,
Hughie F. Fraser

Patients often wait for admission to inpatient wards, boarding on stretchers in hallways. These delays are the key contributor to Emergency Department (ED) crowding, resulting in adverse effects including higher mortality. We consider the ED boarding problem from the perspective of specialists. We focus on Internal Medicine at two hospitals in Nova Scotia, Canada. We propose a stochastic dynamic programming model to analyze current practice and identify strategies for improvement.

2 - Impact of Coordination and Information Sharing in Urban Incident Response

Jonathan Helm, Indiana University Bloomington,
1309 E. Tenth Street, Bloomington, IN, United States of America,
helmj@indiana.edu, Alex Mills, Andres Jola-sanchez,
Mohan Tatikonda, Bobby Courtney

Following a disaster in an urban area, on-scene responders must decide how to distribute casualties among hospitals. This is typically done without information (real-time or otherwise) about hospital capacities, ED and inpatient. We study a new type of organization, called a healthcare coalition, and use real data to study what types of information this organization should share with responders after a multiple casualty incident to improve response.

3 - Optimal Admission/Discharge Criteria for Patients with Heart Failure in Observation Units

Sanket Bhat, McGill University, 1001 Sherbrooke Street West,
Room 520, Montreal, QC, H3A 1G5, Canada,
sanket.bhat@mcgill.ca, Beste Kucukyazici, Rick Mah

Although more than 80% of the patients presented to Emergency Departments with symptoms related to acute decompensated heart failure (ADHF) are hospitalized, the majority of patients are not in need of an acute intervention beyond decongestion. These patients could be managed in observation units and be discharged without hospitalization. We develop a stochastic model that dynamically assess the risk levels of ADHF patients, and determine criteria to optimally discharge, observe, or admit them.

4 - A Data-driven Stochastic Model of an Emergency Department

Xiaopei Zhang, Columbia University, 1 Morningside Drive,
Apt. 1710, New York, NY, 10025, United States of America,
xz2363@columbia.edu, Ward Whitt

We explore arrival and length-of-stay (LoS) data from an Israeli Emergency Department. We fit a time-varying two-class (hospitalized or not) infinite-server queueing model with nonhomogeneous Poisson arrivals, where the arrival rate/admission/LoS is periodic over a week/day/day. Departures after long LoS tend to occur at midnight.

■ TB42

42-Room 102B, CC

Joint Session MSOM-Health/HAS: Global Health Delivery

Sponsor: Manufacturing & Service Oper
Mgmt/Healthcare Operations
Sponsored Session

Chair: Jonas Jonasson, Student, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, jjonasson@london.edu

1 - Demand vs. Supply-side Investment in Humanitarian Operations

Karthik V. Natarajan, Assistant Professor, University of Minnesota, 321 19th Avenue South, 3-150, Minneapolis, MN,
United States of America, knataraj@umn.edu,
Jayashankar Swaminathan

Both supply- and demand-side constraints impact program coverage in humanitarian settings. We first study the problem of identifying the optimal mix of supply- and demand-side investments faced by a budget-constrained organization in a centralized setting. We then consider a decentralized setting and identify the optimal performance-based contract to mobilize demand. In addition, we also compare the performance of the optimal contract against three contracts frequently used in practice.

2 - Assessing the Impact of U.S. Food Assistance Delivery Policies on Child Mortality in Sub-Saharan Africa

Alex Nikulkov, Stanford GSB, 655 Knight Way, Stanford, CA,
94305, United States of America, nikulkov@stanford.edu,
Lawrence Wein

The U.S. is one of the few countries in the world that delivers its food assistance via transoceanic shipments of commodity-based in-kind food, which is more costly and less timely than cash-based assistance. Using household survey data, geospatial data and supply chain modeling, we estimate that child mortality in sub-Saharan Africa can be reduced by 16.2% if the U.S. switches entirely to cash-based interventions.

3 - How Good are Uniform Co-Payments in Increasing Market Consumption?

Gonzalo Romero, Rotman School of Management, 105 St. George Street, Toronto, Canada, Gonzalo.Romero@rotman.utoronto.ca,
Retsef Levi, Georgia Perakis

We analyze the problem of a central planner allocating co-payment subsidies to competing heterogeneous firms, under an endogenous market response and a budget constraint. We present the first worst-case performance guarantees in maximizing market consumption for the frequently implemented policy of uniform co-payments. Namely, allocating the same co-payment to each firm is guaranteed to induce a significant fraction of the optimal market consumption, even if the firms are highly heterogeneous.

4 - Deployment Guidelines for Community Health Workers in Sub-Saharan Africa

Jonas Jonasson, Student, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, jjonasson@london.edu,
Anne Liu, Sarang Deo, Jérémie Gallien, Carri Chan

Community health workers (CHWs) are increasingly important to the delivery of health care in many African countries. Leveraging an extensive dataset featuring time, clinical findings and GPS information for CHW visits in Ghana, we develop a stochastic model describing the health dynamics of a population served by a time-constrained CHW. This model supports the design of managerial guidelines for the patient prioritization, catchment area assignment and task profile definition in a CHW operation.

■ **TB43**

43-Room 103A, CC

Choice Modeling and Assortment Optimization

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Vineet Goyal, Columbia University IEOR department, 500 West 120th Street, 304 Mudd, New York, NY, 10027, United States of America, vg2277@columbia.edu

1 - Approximation Algorithms for Dynamic Assortment Optimization Models

Ali Aouad, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA, 02139, United States of America, aaouad@mit.edu, Danny Segev, Retsef Levi

We study the joint assortment and inventory management problem, where demand consists in a random sequence of heterogeneous customers. Although the problem is hard in general, we provide the first polynomial time algorithms that attain constant approximations, for variants proposed in previous literature as well as more general choice models. In addition, our algorithms provide practical means for solving large-scale instances and for incorporating more realistic constraints.

2 - Capacity Constrained Assortment Optimization under the Markov Chain Based Choice Model

Chun Ye, Columbia University IEOR department, 500 West 120th Street, Mudd 315, New York, NY, 10027, United States of America, cy2214@columbia.edu, Danny Segev, Vineet Goyal, Antoine Desir

We consider a capacity constrained assortment optimization problem under the Markov Chain based choice model proposed by Blanchet et al. We first show that even severely-restricted special cases are APX-hard. We then present a constant factor approximation for the general problem. Our algorithm is based on a "local-ratio" method that allows us to transform a non-linear revenue function into a linear function over appropriately modified item prices.

3 - Assortment Optimization under a Random Swap Based Distribution over Permutations Model

Antoine Desir, Columbia University IEOR department, 500 West 120th Street, Mudd 315, New York, NY, 10027, United States of America, ad2918@columbia.edu, Vineet Goyal, Danny Segev

We consider a special class of distribution over permutations model based on modeling the consumer preferences by a random number of random swaps from a small set of fixed preference lists. This model is motivated from practical applications where preferences of "similar" consumers differ in a small number of products. We present polynomial time approximation schemes for capacity constrained assortment optimization problem under the random swap based distribution over permutation model.

4 - Design of an Optimal Membership Promotion Policy with Experiments

Spyros Zoumpoulis, Insead, spyros.zoumpoulis@insead.edu, Duncan Simester, Artem Timoshenko

Deciding what customer to target with what type of membership promotion is among the most important decisions that wholesale clubs face. We use the results of a large-scale membership promotion field experiment involving multiple types of membership promotions to propose various promotion policies, each relying on a different algorithm for customer segmentation. We then evaluate the performance of the proposed policies as implemented in a large-scale field test.

■ **TB44**

44-Room 103B, CC

Machine Learning in Operations

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Srikanth Jagabathula, NYU, 44 West Fourth Street, New York, United States of America, sjagabat@stern.nyu.edu

1 - Prediction vs Prescription in Data-driven Pricing

Nathan Kallus, MIT, 77 Massachusetts Ave., E40-149, Cambridge, MA, 02139, United States of America, kallus@mit.edu, Dimitris Bertsimas

We study the problem of data-driven pricing and show that a naive but common predictive approach leaves money on the table. We bound missed revenue relative to the prescriptive optimum, which we show is unidentifiable from data. We provide conditions for identifiability and appropriate pricing schemes. A new hypothesis test shows that predictive approaches are practically insufficient while parametric approaches often suffice but only if they take into account the problem's prescriptive nature.

2 - The Big Data Newsvendor: Practical Insights from Machine Learning

Gah-Yi Vahn, Assistant Professor, London Business School, Sussex Place, Regent's Park, London, NW1 4SA, United Kingdom, gvahn@london.edu, Cynthia Rudin

We study the newsvendor problem when one has n observations of p features related to the demand as well as demand data. Both low- and high-dimensional data are considered. We propose Machine Learning (ML) and Kernel Optimization (KO) approaches, and derive tight bounds on their performance. In a nurse staffing case study we find that the best KO and ML results beat best practice by 23% and 24% respectively.

3 - Applying Machine Learning to Revenue Management at Groupon

David Simchi-levi, Professor, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, dslevi@mit.edu, Alexander Weinstein, He Wang, Wang Chi Cheung

We propose a new data-driven pricing algorithm for online retailers, which learns customer demand from online transaction data. Our method first generates multiple demand functions using a clustering algorithm, and then learns on the fly which demand function is more likely to be correct. We will also discuss some field experiment result through collaborating with Groupon, a large daily deal website.

4 - Demand Forecasting when Customers Consider, Then Choose

Ying Liu, Stern School of Business, New York University, 44 West 4th Street, KMC 8-154, New York, NY, 10012, United States of America, yliu2@stern.nyu.edu, Srikanth Jagabathula

We consider the problem of demand forecasting when customers choose by first forming a consideration set and then choosing the most preferred product from the consideration set. The consideration set is sampled from a general model over subsets. We propose techniques to estimate such models from purchase transaction data.

■ **TB45**

45-Room 103C, CC

Revenue Management for Marketing

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: John Turner, Assistant Professor, University of California, Irvine, Room SB2 338, The Paul Merage School of Business, Irvine, CA, 92697-3125, United States of America, john.turner@uci.edu

1 - Scheduling of Guaranteed Targeted Display Advertising under Reach and Frequency Requirements

Ali Højat, University of California Irvine, Paul Merage School of Business, Irvine, CA, 92697, United States of America, hojjats@uci.edu, John Turner, Suleyman Cetintas, Jian Yang

We propose a novel mechanism for the scheduling of guaranteed targeted advertising in online media. We consider a new form of contract in which advertisers specify the number of unique individuals (reach) and the minimum number of times (frequency) each individual should be exposed. We further integrate a variety of new features such as desired diversity and pacing of ads over time or the number of competing brands seen by each individual. We perform extensive numerical tests on industry data.

2 - Transaction Attributes and Customer Valuation

Michael Braun, Associate Professor Of Marketing, Southern Methodist University, 6212 Bishop Blvd., Fincher 309, Dallas, TX, 75275, United States of America, braunm@smu.edu, Eli Stein, David Schweidel

We propose a model of customer value and marketing ROI that incorporates transaction-specific attributes and unobserved heterogeneity. From this model, one can estimate an upper bound on the amount to invest in retaining a customer. This amount depends on the recency and frequency of past customer purchases. Using data from a B2B service provider, we estimate the revenue lost by the firm when it fails to deliver a customer's requested level of service.

3 - Auctions with Dynamic Costly Information Acquisition

Negin Golrezaei, Auctions With Dynamic Costly Information Acquisition, University of Southern California, Bridge Memorial Hall, 3670 Trousdale Parkway, Los Angeles, CA, 90089, United States of America, golrezae@usc.edu, Hamid Nazerzadeh

We study the mechanism design problem for the seller of an indivisible good in a setting where buyers can purchase the additional information and refine their valuations for the good. This is motivated by information structures in online advertising where advertisers can target users using cookie-matching services. For this setting, we propose a rich class of dynamic mechanisms, called Sequential Weighted Second-Price, which encompasses the optimal and the efficient mechanisms as special cases.

4 - Learning, Revising, and Forgetting Multidimensional Contextual Features for Online Ad Selection

John Turner, Assistant Professor, University of California, Irvine, Room SB2 338, The Paul Merage School of Business, Irvine, CA, 92697-3125, United States of America, john.turner@uci.edu, Tianbing Xu, Amelia Regan, Yaming Yu

We study how best to match ads to viewers using high-dimensional contextual features (demographic, browsing behavior) to predict click-through probability. Using Thompson Sampling in a Bayesian framework, our model learns the importance of contextual features while adapting/forgetting over time, capturing changing individuals' tastes and shifts in the viewing population's composition.

■ TB46

46-Room 104A, CC

Service Models in MSOM

Sponsor: Manufacturing & Service Oper Mgmt/Service Operations
Sponsored Session

Chair: Opher Baron, University of Toronto, 105 St George St, Toronto, ON, Canada, opher.baron@rotman.utoronto.ca

1 - Worker Flexibility Training and Production Decision Rights

Gad Allon, Professor, Kellogg School of Management, Northwestern University, 2001 Sheridan Road, Evanston, IL, 60201, United States of America, g-allon@kellogg.northwestern.edu, Achal Bassamboo, Evan Barlow

We explore the interaction between production decision rights and workers' decisions on training to become flexible resources. Research on flexible resources is prevalent in the operations management literature. Human resources, however, are decision makers and have rights to decide on their own training levels. Many firms, however, have also given workers some production decision rights. We show how the workers' training decisions are affected by the identity of the production decision maker.

2 - Revenue Maximization for Cloud Computing Services

Cinar Kilcioglu, Columbia Business School, New York, NY, 10027, United States of America, ckilcioglu16@gsb.columbia.edu, Costis Maglaras

We study a stylized model of revenue maximization for cloud computing services, analyze price data traces from the biggest cloud service provider, Amazon, provide some possible explanation for price spikes based on intuitive asymptotic analysis arguments in systems with large scale capacity and large market potential, and ultimately study the revenue maximization problem faced by the service provider that operates in an infinite capacity system and in a market with multiple customer types.

3 - Admission and Discharge Decisions in Intensive Care Units

Huiyin Ouyang, UNC Department of Statistics & Operations Research, 318 Hanes Hall, CB# 3260, Chapel Hill, NC, 27599-3260, United States of America, ouyang5@live.unc.edu, Serhan Ziya, Nilay Argon

We formulate a MDP model for admission decisions in an ICU where patients' health conditions change over time according to Markovian probabilities. We find that the optimal decision can depend on the mix of patients in the ICU and provide an analytic characterization of the optimal policy. We also identify conditions under which the optimal policy is state-independent.

4 - Tandem Queues with Reneging – Analysis and Insights

Jianfu Wang, Assistant Professor, Nanyang Business School, NTU, 50 Nanyang Avenue, NTU, Singapore, Singapore, wangjf@ntu.edu.sg, Opher Baron, Oded Berman, Hossein Abouee Mehrizi

This paper considers tandem queueing systems with reneging. We develop a new technique to solve two dimensional Markov Chains with non-repeating structure. Our technique can be applied to additional settings and used to derive different service level measures. We demonstrate this technique on a two-station tandem queueing model with reneging, which has been considered analytically intractable.

■ TB47

47-Room 104B, CC

Supply Chain Social Responsibility

Sponsor: Manufacturing & Service Oper Mgmt/Sustainable Operations

Sponsored Session

Chair: Robert Swinney, Associate Professor, Duke University, 100 Fuqua Dr, Durham, NC, 27708, United States of America, robert.swinney@duke.edu

1 - Supply Chain Social and Environmental Performance: Measurement, Improvement and Disclosure

Basak Kalkanci, Georgia Institute of Technology, 800 W Peachtree St. NW, Atlanta, GA, United States of America, Basak.Kalkanci@scheller.gatech.edu, Erica Plambeck

Firms are beginning to measure the social and environmental impacts associated with their products and (in a few cases) report those impacts to investors and consumers. Supply chain strategy and structure influence a firm's costs and benefits from impact measurement, reduction and disclosure. We evaluate how a mandate for disclosure affect impacts, firm expected profit, and its valuation by investors.

2 - Impact of Supply Chain Transparency on Sustainability under NGO Scrutiny

Shi Chen, Assistant Professor, University of Washington, Michael G. Foster School of Business, University of Washington, Seattle, WA, 98195, United States of America, shichen@uw.edu, Qinqin Zhang, Yong-Pin Zhou

We study the use of supply chain transparency as an effective tool to mitigate supply chain sustainability issues, and in particular, whether the buyer should reveal her supplier list, knowing that revealed suppliers could face a different level of NGO scrutiny than the unrevealed ones. We incorporate the strategic interactions among a buyer, her suppliers, and the independent NGOs.

3 - Responsible Sourcing via Vertical Integration and Horizontal Sourcing

Adem Orsdemir, Assistant Professor, University of California Riverside, School of Business Administration, Anderson Hall, Riverside, CA, 92507, United States of America, adem.orsdemir@ucr.edu, Bin Hu, Vinayak Deshpande

Vertical integration is a viable way to achieve responsible sourcing. In a competitive setting, we analyze a firm's integration and responsible sourcing decisions. We find that demand externality and possibility of supplying the competitor may fundamentally change firms' behaviors. Furthermore, high probability of violation detection may discourage responsible sourcing.

4 - Investing in Supply Chain Transparency for Social Responsibility

Leon Valdes, lvaldes@mit.edu, Tim Kraft, Karen Zheng

We study a manufacturer's decisions when the social responsibility performance of his supplier cannot be perfectly observed. The manufacturer can invest to increase the transparency of his supply chain and the performance of his supplier. An NGO may communicate to consumers the true level of social responsibility, potentially decreasing profits.

■ TB48

48-Room 105A, CC

Operational Issues in Agriculture

Sponsor: Manufacturing & Service Oper Mgmt/iFORM

Sponsored Session

Chair: Onur Boyabatli, Assistant Professor of Operations Management, Singapore Management University, 50 Stamford Road 04-01, Lee Kong Chian School of Business, Singapore, 178899, Singapore, oboyabatli@smu.edu.sg

1 - Agricultural Cooperative Pricing of Premium Product

Burak Kazaz, Associate Professor, Syracuse University, 721 University Avenue, Syracuse, NY, 13244, United States of America, bkazaz@syr.edu, Scott Webster, Nur Ayvaz-cavdaroglu

We consider the problem of price-setting by a cooperative for an agricultural product with the following characteristics: (1) the open-market price for the product depends on yield and on quality and (2) the quality of the product is influenced by farmer investments over the growing season. We identify a simple pricing scheme that shows potential to improve performance, and we characterize the drivers and the magnitude of performance improvement.

2 - Planning for Product Substitution in Seed Business

Saurabh Bansal, Assistant Professor, Penn State University,
405 Business Building, University Park, PA, 16802,
United States of America, sub32@psu.edu

We present new analytical results to manage seed substitution in the agribusiness domain, and discuss results of an empirical case study in collaboration with an industry partner.

3 - Government Intervention and Crop Diversification in Agricultural Supply Chains

Duygu Gunaydin Akkaya, Stanford GSB, 655 Knight Way,
Stanford, CA, 94305, United States of America,
duygug@stanford.edu, Kostas Bimpikis, Hau Lee

Agricultural supply chains face immense risks including yield and market price uncertainty. In order to mitigate these risks, farmers can engage in crop diversification. Governments also take a role in supporting farmers' income and implement various subsidies to alleviate poverty in the farmer population. We study how interventions and diversification practices impact the supply chain in the presence of random yield and endogenous market price.

4 - Corn or Soybean: Dynamic Farmland Allocation under Uncertainty

Onur Boyabatli, Assistant Professor of Operations Management,
Singapore Management University, 50 Stamford Road 04-01, Lee
Kong Chian School of Business, Singapore, 178899, Singapore,
oboyabatli@smu.edu.sg, Javad Nasiry, Yangfang Zhou

This paper studies the farmland allocation decision of a farmer between two crops in a multi-period framework. In each period, the farmer chooses the allocation in the presence of revenue uncertainty, and crop rotation benefits across periods. We characterize the optimal policy and investigate the impact of revenue uncertainty. We propose a heuristic allocation policy which is near-optimal.

■ TB49

49-Room 105B, CC

Retail Operations

Sponsor: Manufacturing & Service Oper Mgmt/Supply Chain
Sponsored Session

Chair: Chris Parker, Pennsylvania State University, 411 Business
Building, University Park, PA, 16802, United States of America,
chris.parker@psu.edu

1 - Supply Chain Structure and Multimarket Competition

O. Cem Ozturk, Assistant Professor Of Marketing, Georgia
Institute of Technology, 800 West Peachtree St. NW., Atlanta, GA,
30308, United States of America,
cem.ozturk@scheller.gatech.edu, Necati Tereyagoglu

We study the role of supply chain structure in determining competitive intensity when manufacturers and retailers encounter in multiple markets. Our theoretical model shows how the differences in supply network overlap across multiple markets lead to higher retail prices. Using an extensive scanner data set, we find empirical support for the analytical results. These findings show the importance of supply chain structure in assessing multimarket competition among firms.

2 - Value of Downward Substitution under Stochastic Prices

Fehmi Tanrisever, Bilkent University, Bilkent, Ankara, Turkey,
tanrisever@bilkent.edu.tr, Zumbul Atan, Junchi Tan

Downward substitution as a form of operational flexibility has received significant academic attention. The literature on downward substitution follows the main stream inventory literature and assumes uncertain demand and/or yield and explores the value of substitution flexibility. They, however, assume fixed prices which may distort the analysis in many industries where prices may fluctuate. In this paper, we explore the effect of price uncertainty on the value of downward substitution.

3 - Supply Chain Contracts that Prevent Information Leakage

Yiwei Chen, Assistant Professor, Renmin University of China, NO.
59 Zhongguancun Street, Beijing, China, chenyiwei@rbs.org.cn,
Ozalp Ozer

We study a supply chain with one supplier and two competing retailers (incumbent and entrant). The incumbent has better but imprecise private forecast. We explore general conditions that a wide range of contracts need to satisfy to prevent the supplier from leaking the incumbent's private forecast to the entrant. We define two groups of contracts based on how the supplier and retailers share inventory risks. We find only these two groups of contracts may avoid information leakage.

4 - Experience and Competition Effects in Penny Auctions

Chris Parker, Pennsylvania State University, 411 Business
Building, University Park, PA, 16802, United States of America,
chris.parker@psu.edu, Pranav Jindal, Tony Kwasnica,
Peter Newberry

The internet has created many new online retail opportunities. One such model is the penny auction, an ascending first-price auction where bidders pay a fee to bid and increase the price by a nominal amount. The winning bidder pays the auction price and receives the item with all other bidders receiving nothing. We utilize a detailed dataset from a penny auction company to investigate the effects of experience and competition on bidding behavior and auction outcomes.

■ TB50

50-Room 106A, CC

Value Chain Innovations in Developing Economies

Sponsor: Manufacturing & Service Operations Management
Sponsored Session

Chair: Saibal Ray, Professor, McGill University, 1001 Sherbrooke Street
West, Montreal, Canada, saibal.ray@mcgill.ca

Co-Chair: Fei Qin, Post-doc Research Fellow, McGill University,
Desautels Faculty of Management, Montreal, QC, Canada

1 - Milking the Quality Test: Improving the Milk Supply Chain under Competing Collection Intermediaries

Liyang Mu, Assistant Professor, University of Delaware,
20 Orchard Rd, Newark, 19716, United States of America,
muliying@udel.edu, Milind Dawande, Xianjun Geng,
Vijay Mookerjee

We examine the quality issues of milk — via deliberate adulteration by milk farmers — acquired by competing collection intermediaries in developing countries. Interestingly, some intuitive interventions such as providing collection stations with better infrastructure (e.g., refrigerators) or subsidizing testing costs could hurt the quality of milk in the presence of competition. The goal of this study is to provide recommendations that address the quality problem with minimal testing.

2 - Low Cost Cataract Surgery in India: What Can Western Health Systems Learn from it?

Harish Krishnan, Sauder School of Business, University of British
Columbia, Vancouver, Canada, Harish.Krishnan@sauder.ubc.ca

The Aravind Eye Care System (AECS) in India is known for its low-cost business model. However, few studies have done a detailed analysis of the cost structure of a cataract surgery at the AECS. This talk will present cost data from AECS and compare it to similar data at an eye hospital in Canada. The goal is to identify root causes of the cost differences between AECS and western health systems. The barriers to implementing AECS' innovations in the west will also be discussed.

3 - Multi-treatment Inventory Allocation in Humanitarian Health Settings under Funding Constraints

Jayashankar Swaminathan, UNC-Chapel Hill, 300 Kenan Drive,
Chapel Hill, NC, 27599, United States of America,
Jay_Swaminathan@kenan-flagler.unc.edu, Karthik V. Natarajan

We study the problem of allocating inventory procured using donor funding to patients in different health states over a finite horizon with the objective of minimizing the number of disease-adjusted life periods lost. The optimal policy is state-dependent and hence, we develop two heuristics for the allocation problem. We also provide analytical results and computational insights regarding how the funding level and funding timing impact program performance.

4 - Micro-entrepreneurship in Agri-food Supply Chains in Developing Economies

Fei Qin, McGill University, Desautels Faculty of Management,
Montreal, QC, H3A1G5, Canada, fei.qin@mcgill.ca,
Mehmet Gumus, Saibal Ray

Motivated by Veggie-Kart direct farm-to-food initiative for marginal farmers and retailers in developing economies, we examine the impact of supply chain innovations involving micro-entrepreneurs at both upstream and downstream stages, which compete with the traditional spot-market based channel in presence of supply uncertainty.

■ TB51

51-Room 106B, CC

Procurement Mechanisms

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Tharanga Rajapakshe, Assistant professor, University of Florida, W. University Ave, Gainesville, FL, 32611, United States of America, tharanga@ufl.edu

1 - Distressed Selling by Farmers: Model, Analysis, and Use in Policy-Making

Shivam Gupta, PhD Candidate, UT Dallas, NJ School of Management, 800 W. Campbell Rd., Richardson, TX, 75080, United States of America, sxl04920@utdallas.edu,
Ashutosh Sarkar, Ganesh Janakiraman, Milind Dawande

The surprising practice of distressed selling, where farmers sell produce to outside agents at prices much lower than the government's guaranteed price, is common in developing countries. We build a tractable stochastic DP model that captures the ground realities – limited and uncertain procurement capacity, high holding costs, and lack of affordable credit – that lead to distressed sales. Using real procurement data, we establish the accuracy of our model and develop useful policy suggestions.

2 - Coordinating Procurement Decisions in Multi-division Firms

Fang Fang, Ph. D. Candidate, University of Miami, 5250 University Drive, Coral Gables, FL, 33124, United States of America, f.fang@umiami.edu, Hari Natarajan

Central procurement organizations (CPO) of large firms must coordinate firm-wide procurement to leverage volume discounts from suppliers. Facing such a procurement coordination problem, we examine how a CPO can design internal prices to maximize firm-wide cost savings. Our analysis of commonly-used internal pricing rules shows interesting impacts on vendor selection, divisional participation, and gain allocation.

3 - Does Quality Knowledge Spillover at Shared Suppliers? – An Empirical Investigation

Suresh Muthulingam, Assistant Professor Of Supply Chain Management, SMEAL College of Business, The Pennsylvania State University, 460 Business Building, State College, PA, 16802, United States of America, sxm84@psu.edu, Anupam Agrawal

We study the spillover of quality knowledge across supply chains. We observe the quality performance of 191 suppliers who use the same facilities to manufacture similar products for two distinct businesses. We find that quality knowledge spills over under three conditions: (i) When quality efforts focus on organizational members; (ii) When quality efforts focus on output activities of suppliers; and (iii) When quality knowledge is developed at suppliers with low complexity.

4 - Contracting Between a Blood Bank and Hospitals

Anand Paul, University of Florida, 351 Stuzin Hall, Gainesville, FL, United States of America, paulaa@ufl.edu, Tharanga Rajapakshe

The supply of blood at a regional blood bank (RBB) is uncertain and often insufficient to satisfy the total demand for it. The RBB typically does not observe the demand at each hospital before determining the allocation policy. Inefficient allocation leads to shortages at hospitals which necessitates reallocation of blood and significant blood outdated cost. We make an analytical study of socially optimal contracting decisions of an RBB serving multiple hospitals.

■ TB52

52-Room 107A, CC

Marketing and Optimal Control

Sponsor: Marketing Science

Sponsored Session

Chair: Olivier Rubel, UC Davis, Graduate School of Management, One Shields Avenue, Davis, United States of America, orubel@ucdavis.edu

1 - Optimal Learning to Select the Best Alternative

Tony Ke, Assistant Professor, Marketing Department, MIT Sloan School of Management, 100 Main Street, E62-535, Cambridge, MA, 02142, United States of America, kete@mit.edu,
Miguel Villas-boas

A decision maker is deciding among several alternatives with uncertain payoffs and an outside option with known payoff. Before making a choice, he can purchase informative signals on each alternative. We solve for the decision maker's optimal learning as well as stopping problem, and discuss the implications.

2 - Automatic Feedback Control for Shunt Drainage in Hydrocephalus Patients

Kalyan Raman, Professor, Northwestern University, Medill School, Evanston, IL, United States of America, kalyaraman@gmail.com, Vijay Viswanathan

Excessive intracranial pressure (ICP) resulting from insufficient drainage of cerebrospinal fluid (CSF) leads to a neurological disorder called hydrocephalus, which is treated by implanting shunts to reduce ICP by draining excess CSF. We use non-linear control theory to develop a mathematical algorithm for a regulator to achieve shunt action that is significantly more sophisticated than that of a switch.

3 - Multiattribute Pricing

Thomas Weber, Associate Professor, EPFL, CDM-ODY 3.01, Station 5, Lausanne, VD, 1015, Switzerland, thomas.weber@epfl.ch

We provide a technique for constructing second-best multiattribute screening contracts in a general setting with one-dimensional types based on necessary optimality conditions. Our approach allows for type-dependent participation constraints and arbitrary risk profiles. As an example we discuss optimal insurance contracts.

4 - Dynamic Incentives in Sales Force Compensation

Olivier Rubel, UC Davis, Graduate School of Management, One Shields Avenue, Davis, CA, United States of America, orubel@ucdavis.edu, Ashutosh Prasad

We propose dynamic principal-agent model to investigate how to incentivize sales people when current selling efforts and carryover sales drive present sales. We show that the carryover effect increases not only expected sales, but also sales uncertainty. We then find that the manager incentivizes the high risk-aversion salesperson with a concave compensation and the low risk-aversion salesperson with a convex compensation.

■ TB53

53-Room 107B, CC

Behavioral Issues in the OM / Marketing Interface

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Ozalp Ozer, The University of Texas at Dallas, 800 West Campbell Road, Richardson, TX, United States of America, oozar@utdallas.edu

Co-Chair: Upender Subramanian, United States of America, upender@utdallas.edu

1 - Pricing Cause Marketing Products in the Presence of Social Comparison

Paola Mallucci, Assistant Professor of Marketing, University of Wisconsin at Madison, 4261 Grainger Hall, 975 University Ave, Madison, WI, 53706, United States of America, pmallucci@bus.wisc.edu, Tony Haitao Cui, George John

The broad takeaway from the literature on cause marketing campaigns, where firms donate to charities with purchase, is that they generally work well, because of "warm glow". We conjecture that far from creating only positive feelings, such firm donations can create discomfort by encouraging social comparison. We find that firms can find it profitable to exploit such discomfort even if it decreases consumers utility. Results apply in both monopoly and competition.

2 - Pricing and Quality Perception: Theory and Experiment

Karen Zheng, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, yanchong@mit.edu, Rim Hariss, Georgia Perakis, Wichinpong Sinchaisri

We study how a constant pricing strategy versus a markdown strategy may induce different perceptions of quality among consumers, and how a firm should take these quality perceptions into account when optimizing its pricing policy for competitive products. We empirically elicit the relationship between consumers' perceived quality and prices under either pricing strategy, and incorporate these relationships into our consumer model to analyze the firm's optimal pricing policy.

3 - Conflict of Interest and Market Structure in Multiplayer Games

Sung Ham, Assistant Professor of Marketing, George Washington University, 2201 G St. NW, Washington, DC, 20052, United States of America, sungham@gwu.edu, Jiabin Wu, Noah Lim

When a firm serves customers who compete with one another, a conflict of interest may arise. We develop a multi-player game where firms serve competing customers, and examine how the market structure faced by the firms impacts the extent to which conflicts of interest affect behavior. We test our theory using an incentive-aligned experiment and find that the decisions are consistent with the model predictions.

4 - The Behavioral Cost of Quality Nonconformance: Risk-averse and Experience-sampling Customers

Jordan Tong, Assistant Professor, University of Wisconsin at Madison, WI, United States of America, jordan.tong@wisc.edu, Greg Decroix

Why do customers purchase less when quality is inconsistent? A common explanation is that customers have risk-averse preferences: they inherently prefer less uncertainty. Another explanation, however, is that tendencies towards low-variance alternatives are due to a learning process from experience. We show that optimal pricing and promotion decisions can differ significantly depending on which explanation is modeled, thereby illuminating the costs of nonconformance and how to mitigate them.

■ TB54

54-Room 108A, CC

Approximations of Queueing Performance for Rapid Systems Design

Cluster: Tutorials

Invited Session

Chair: Ton Dieker, Columbia University, 500 W 120 St, New York, NY, United States of America, ton.dieker@ieor.columbia.edu

1 - Tutorial: Approximations of Queueing Performance for Rapid Systems Design

Ton Dieker, Columbia University, 500 W 120 St, New York, NY, United States of America, ton.dieker@ieor.columbia.edu, Steve Hackman

Recent advances in queueing analysis have yielded tractable approximations of performance metrics that can be used to quickly explore initial designs, to reduce computational burdens associated with simulation, or even to eliminate the need for simulation altogether. This TutORial takes you on an accessible tour of these recent methods, shows you how to apply them using numerical examples drawn from real applications, and discusses implementation challenges and potential opportunities.

■ TB55

55-Room 108B, CC

Stochastic Methods in Efficiency Analysis

Cluster: Data Envelopment Analysis

Invited Session

Chair: Ole Olesen, Professor, University of Southern Denmark, Campusvej 55, Odense, 5230, Denmark, ole@sam.sdu.dk

1 - Estimating Production Functions and Frontiers using Stochastic DEA

John Ruggiero, Professor, University of Dayton, Dayton, OH, United States of America, jruggiero1@udayton.edu

In this paper, we present two methods to estimate production functions and frontiers (deterministic and stochastic). We constrain the technology using the Afriat conditions and consider minimizing the sum of absolute and/or squared errors. We extend this method using locally weighted least squares in the spirit of loess (local regression.)

2 - Endogeneity in Stochastic Frontier Models

Artem Prokhorov, U Sydney, CIREQ, St. Petersburg State U, Business School, Sydney, NS, 2006, Australia, artem.b.prokhorov@gmail.com, Peter Schmidt, Christine Amsler

Stochastic frontier models are typically estimated by MLE or corrected OLS. The consistency of either estimator depends on exogeneity of the explanatory variables (inputs, in the production frontier setting). We will investigate the case that one or more of the inputs is endogenous, in the simultaneous equation sense of endogeneity. We will consider modifications of standard procedures under endogeneity for the stochastic frontier setting.

3 - Shape Constrained Kernel Weighted Least Squares for the Estimation of Production Functions

Andrew Johnson, Texas A&M, College Station, TX, United States of America, ajohnson@tamu.edu, Daisuke Yagi

This paper proposes a unifying model and estimator we call Shape Constrained Kernel-weighted Least Squares (SCKLS). We show the relationship between the SCKLS estimator and both the Convex Nonparametric Least Squares (CNLS) and Du's estimators. Specifically, the SCKLS estimator converges to the CNLS estimator as the bandwidth goes to zero. We compare the performance of the three estimators (SCKLS, CNLS, and Du's estimator) via Monte Carlo simulations.

4 - Two Different Approaches to Stochastic DEA

Ole Olesen, Professor, University of Southern Denmark, Campusvej 55, Odense, 5230, Denmark, ole@sam.sdu.dk, Niels Chr. Petersen

Focus is on different views on extending DEA to a stochastic setting. The management science framework does not focus to model performance using a statistical model based on a specific Data Generating Process (DGP). Some stochastic DEA models focus on replacing the observed input output observations with DMU specific distributions. The statistical framework insists on an axiomatic approach to a statistical model, including a specification of a DGP. We illustrate these differences.

■ TB56

56-Room 109A, CC

Multiple Stakeholders in NPD

Cluster: New Product Development

Invited Session

Chair: Niyazi Taneri, SUTD, 8 Somapah Rd, Singapore, Singapore, niyazitaneri@sutd.edu.sg

1 - The Role of Decision Rights in Collaborative Development Initiatives

Nektarios Oraipoulos, Cambridge Judge Business School, University of Cambridge, Trumpington St., Cambridge, United Kingdom, n.oraipoulos@jbs.cam.ac.uk, Vishal Agrawal

In this paper, we study initiatives for co-development of new products and technologies. In such settings, it may be difficult a priori to specify contracts contingent on the outcome. Therefore, we investigate the efficacy of different contractual structures, which instead specify the decision-making process.

2 - Structuring New Product Development Partnerships

Niyazi Taneri, SUTD, 8 Somapah Rd, Singapore, Singapore, niyazitaneri@sutd.edu.sg, Arnoud De Meyer

New product development partnerships involve a high degree of risk, information and incentive problems across various stakeholders. Partners structure their alliances to address such concerns. We identify factors that affect the structure of the partnership and the performance of the partnership.

3 - The Impact of Continuous Product Development and Customer Feedback on Mobile App Performance

Nilam Kaushik, University College London, University College London, London, United Kingdom, nilam.kaushik.13@ucl.ac.uk, Bilal Gokpinar

Mobile application development differs from traditional product development owing to low barriers of entry, the ability to provide continuous software updates, and ease of access to customer feedback. Using a dataset from the App Store, and drawing from a combination of text mining techniques and econometric methods, we investigate the impact of incorporating customer feedback on mobile app performance.

■ TB57

57-Room 109B, CC

Assorted Topics in Renewable Energy

Sponsor: ENRE – Energy II – Other (e.g., Policy, Natural Gas, Climate Change)

Sponsored Session

Chair: Anthony Papavasiliou, Université Catholique de Louvain, Voie du Roman Pays 34, Louvain la Neuve, Ou, 1348, Belgium, tpapva@hotmail.com

1 - A Controlled Approximation Scheme for Managing Hydroelectric Generation with Multiple Reservoirs

Bernard Lamond, Professor, Université Laval, Dep. Operations & Systemes de Decision, 2325, Rue de la Terrasse #2620, Quebec, QC, G1V 0A6, Canada, Bernard.Lamond@fsa.ulaval.ca, Pascal Lang, Pascal Cote, Luckny Zephyr

We present an approach for adaptive approximation of the value function in stochastic dynamic programming. We use a simplicial partition of the state space to construct a nonseparable piecewise affine approximation which is refined iteratively using lower and upper bounds on the value function. The proposed scheme is experimented numerically in the context of hydroelectric production across multiple reservoirs and power plants.

2 - Demand-side Power Procurement with Renewable Generation and Energy Storage

Soongeol Kwon, Texas A&M University, 3131 TAMU,
College Station, TX, 77843, United States of America,
soongeol@tamu.edu, Natarajan Gautam

We consider operational decisions to satisfy power demand while minimizing purchase cost over time-varying electricity prices. In our scenario, consumers use renewable sources to serve power demand and operate energy storage. We propose a two-stage stochastic optimization problem to control purchase, consumption and operations based on day-ahead and real-time procurement while responding to variability and uncertainty in power demand, renewable sources and electricity prices.

3 - Wind Speed Forecasting for Wind Parks: A Sequential Modeling Approach

Vignesh Subramanian, Dept. of Industrial and Management
Systems Engineering, University of South Florida, ENB118,
Tampa, FL, United States of America, vigneshs@mail.usf.edu,
Tapas K. Das

Inherently intermittent nature of wind energy makes it essential to accurately predict wind speed for reliable operation of power systems comprising wind generation. We propose a two-stage model. Stage I uses SVM to classify wind speed into three clusters: zero power, rated power, and continuous power. Stage II employs a Bayesian additive regression kernel (BARK) method to the continuous power cluster to estimate the wind speed. The model is tested on numerical weather prediction (NWP) data.

4 - Capacity Remuneration in the Belgian Electricity Market

Anthony Papavasiliou, Université Catholique de Louvain,
Voie du Roman Pays 34, Louvain la Neuve, Ou, 1348, Belgium,
tpapva@hotmail.com

Belgium experienced a serious shortage in capacity recently due to the unplanned outage of nuclear capacity. This has motivated an investigation of Belgian capacity remuneration mechanisms. In this presentation we compare the existing fixed reserve requirements mechanism with the introduction of operating reserve demand curves in reserve auctions.

■ TB58

58-Room 110A, CC

Topics in Nuclear Energy

Sponsor: ENRE – Energy II – Other (e.g., Policy, Natural Gas,
Climate Change)

Sponsored Session

Chair: Alexandra Newman, Professor, Colorado School of Mines,
Mechanical Engineering, Golden, CO, 80401, United States of America,
anewman@mines.edu

1 - Optimizing the Placement of Radioactive Isotope Measurement Devices in a Nuclear Fuel Cycle

Ben Johnson, PhD Student, Colorado School of Mines,
Golden, CO, 80401, United States of America,
bebjohns@mymail.mines.edu, Alexandra Newman, Jeffrey King

The purpose of nuclear safeguards is to prevent proliferation of radioactive material. Enhancing methods to detect potential proliferation will help reduce the increasing threat of malicious entities successfully obtaining nuclear material. We create a mixed integer program to determine how many, where, and which types of radioactive isotope measurement devices should be used in the nuclear fuel cycle to minimize the weighted sum of Type I and Type II measurement errors.

2 - Modeling Societal Disruption from Nuclear Accidents to Inform Regulatory Decision-making

Vicki Bier, Professor, University of Wisconsin - Madison, 1513
University Avenue, 53706A Mechanical Engineering Building,
Madison, WI, 53706, United States of America,
vicki.bier@wisc.edu, Michael Corradini, Caleb Roh, Shuji Liu,
Robert Youngblood

Nuclear regulation in the U.S. focuses on preventing radiation-related fatalities. However, recent experience shows that societal disruption from relocation can be considerable, arguably more significant than radiation-induced health effects. We have evaluated the population relocation that could occur after severe reactor accidents as a proxy for societal disruption, and argue that regulatory guidance should constrain societal disruption as well as radiation exposure.

3 - Economics of High-temperature Reactors for Industrial Cogeneration: A Utility's Perspective

Reinhard Madlener, RMadlener@eonerc.rwth-aachen.de, Jona
Hampe

This paper studies the economic potential of using HTRs for cogeneration of industrial process heat and electricity. We find that a reference case HTR can deliver cost-competitive process heat (at 200 °C), thus rendering the chemical and pulp & paper industries potential candidates. We use real options analysis to deal with uncertainty and the managerial flexibilities of the project. We also propose a model to calculate the option of switching between two different operation modes.

4 - Selecting the Optimum Nuclear Fuel Cycle Including Quasi-rational Opinions and Public Perception

Sama Bilbao Y Leon, Associate Professor, Virginia Commonwealth
University, 401 W Main St, Richmond, VA, 23284, United States
of America, sbilbao@vcu.edu,
John Swanson, Ishoc Salaam, Jonathan Hill

Although much work has been done to address the technological challenges associated with the management and ultimate disposal of used nuclear fuel, less attention has been given to public perception and acceptance of the selected fuel cycle. This work presents current progress in a decision making model based on Multi-Attribute Utility Theory that contains the fundamental objectives for both technical and non-technical factors.

■ TB59

59-Room 110B, CC

Fire Management 2: Landscape & Modeling

Sponsor: ENRE – Environment II – Forestry

Sponsored Session

Chair: Hailey Buckingham, hailey.buckingham@oregonstate.edu

1 - Timber Harvest and Fuel Treatment Decisions with Fire Risk

Chris Lauer, cjlaue@gmail.com, Claire Montgomery

This paper attempts to determine the optimal timing and location of fuel treatments and timber harvests for a multi-stand landscape, accounting for the spatial interactions that drive the fire behavior. An optimization method known as value iteration is used to solve the dynamic program. Outcomes for multiple land ownership configurations are explored.

2 - Integrating Wildfire Risk and Spread in a Cellular Forest Harvesting Model

Marc McDill, Pennsylvania State University, University Park, PA,
United States of America, mmdill@psu.edu, Susete Marques,
José Borges

We present a stochastic, cellular multi-objective forest harvest scheduling model incorporating a mechanistic model of fire risk probability based on the state of a cell and the probability of fire in neighboring cells. The model illustrates a potential approach to integrate management activities including fuel treatments and harvesting to address multiple objectives.

■ TB60

60-Room 111A, CC

Education II

Contributed Session

Chair: Omar Ben-ayed, Professor of Management, Qatar University,
Al Jameaa Street, P.O. Box 2713, Doha, 2713, Qatar,
omar.benayed@qu.edu.qa

1 - Challenges of Imbedding a Built-In OR/MS Paradigm among Engineering Graduates

Thong Goh, Professor, National University of Singapore,
1 Engineering Drive 2, Singapore, 117576, Singapore,
tng@nus.edu.sg

There are many OR/MS courses at various levels that undergraduates can take. However, many non-OR/MS disciplines may offer such courses as credit accumulators, with both teachers and students having them as a subject of learning and not something permanent that lasts into the students' subsequent working lives. This presentation discusses this issue with particular reference to engineering undergraduate education, and explore ways to alleviate the situation.

2 - Measuring Interculture Competence Among Business, Education and Social Work Students

Amarpreet Kohli, Assistant Professor, Farmingdale State College, SUNY, Farmingdale, NY, United States of America, kohlias@farmingdale.edu, Hermeet Kohli, Cheng Peng

Purpose of this interdisciplinary research was to measure the level of multicultural awareness, sensitivity to, and understanding of difference, and intercultural competence when working in diverse environments in the undergraduate and graduate Business, Education and Human Development, and Social Work students using the UDO (MGUD-S Survey). Convenient purposive sampling was utilized to invite students enrolled in these three schools to participate in web based descriptive survey research.

3 - Redesigning Qatar University Class Meeting Pattern to Improve Performance

Omar Ben-ayed, Professor Of Management, Qatar University, Al Jameaa Street, P.O. Box 2713, Doha, 2713, Qatar, omar.benayed@qu.edu.qa, Heba Younis, HEND Hammad

This study examines the existing class meeting pattern at Qatar University based on the strategic plan of the University in addition to the perception of students and faculty members. The study shows that there is a need for a new class meeting pater with two additional non-teaching half-days. A capacity analysis proves the feasibility of such a pattern. Accordingly, alternative class meeting patterns are proposed and one is selected based on technical, academic and cultural perspectives.

■ TB61

61-Room 111B, CC

Economics of Reverse Logistics and Sustainable Operations

Sponsor: ENRE – Environment I – Environment and Sustainability

Sponsored Session

Chair: Shouqiang Wang, Assistant Professor, Clemson University, 131D Sirrine Hall, Clemson, SC, 29672, United States of America, shouqiw@clemson.edu

1 - Versioning, Trade-ins and Refurbishing: An Integrative Analysis

Avinash Geda, University of Florida, 361B Stuzin Hall, Gainesville, FL, 32611, United States of America, avinashgeda@ufl.edu, Tharanga Rajapakshe, Asoo Vakharia

We consider a monopolist durable goods manufacturer who markets its products via a single retailer. In the first period, the manufacturer introduces first version of the product while he may introduce the second and refurbished versions of the product in the second period. We consider there exists a secondary market where consumers can resell the old products. We investigate the impact of introduction of a trade-in and refurbishing program on the product versioning decision of the manufacturer.

2 - Trade-Ins Versus Upgrades: A Behavioral Exploration

Mahdi Mahmoudzadeh, Georgia Institute of Technology, 800 W Peachtree ST NW, Atlanta, GA, United States of America, Mahdi.Mahmoudzadeh@scheller.gatech.edu, Beril Toktay, Basak Kalkanci

Understanding customers' behavior in selling positions or exchanging their products would help better manage replacement purchases and product return streams. We study trade-ins and upgrades, which so far have been assumed to be equivalent. We find that customers perceive trade-ins and upgrades differently; perceived importance of the quoted price for current product is more salient in trade-ins than in upgrades. Our results are useful to find dominant replacement offers and pricing strategies.

3 - Design and Technology Choice for Recycling: The Value of Collaboration and Capacity Ownership

Luyi Gui, Assistant Professor, UC Irvine, United States of America, luyig@exchange.uci.edu, Morvarid Rahmani, Atalay Atasu

Efficient and effective treatment of end-of-life products requires not only product design improvements but also advancement in recycling technologies. We analyze how Extended Producer Responsibility (EPR) legislation would affect incentives for improving product recyclability and processing technology. In particular, we take into account the mutually reinforcing effect between product and process improvements and explore the implication of such complementarity in EPR implementation.

4 - Inducing Environmental Disclosures: A Dynamic Mechanism Design Approach

Shouqiang Wang, Assistant Professor, Clemson University, 131D Sirrine Hall, Clemson, SC, 29672, United States of America, shouqiw@clemson.edu, Peng Sun, Francis De Véricourt

This paper studies the design of voluntary disclosure regulations that jointly uses inspections and monetary rewards. We formulate this problem in a dynamic mechanism design framework with state verification and obtain complete analytical solution.

■ TB62

62-Room 112A, CC

Aviation Applications

Contributed Session

Chair: Jinkun Lee, The Pennsylvania State University, 236 Leonhard, University Park, United States of America, jinkunlee@psu.edu

1 - An Airspace Sectorization Approach Based on Spectral Clustering and NSGA-II

Bang An, Tsinghua University, Room 616, Main Building, Beijing, China, ab13@mails.tsinghua.edu.cn, Peng Cheng, Xiang Zou

We propose an airspace sectorization approach based on spectral clustering and NSGA-II. With the method embedded in the constrained NSGA-II, all of the critical constraints can be easily handled. Besides, an initial sectorization method based on spectral clustering is proposed to generate the first generation of NSGA-II. We test our method on the high-altitude airspace controlled by Beijing Area Control Center. The results show that our method can obtain better solutions.

2 - A Preemptive Scheduling Model with Overtime Allocation for Minimum Weighted Tardiness

Fernando Jaramillo, University of Miami, 1251 Memorial Drive, Department of Industrial Engineering, Coral Gables, FL, 33146, United States of America, f.jaramillo2@umiami.edu, Busra Keles, Murat Erkoc

We develop a model and solution procedure for preemptive scheduling with overtime option. The problem is mainly motivated by the aviation MRO industry where late deliveries of overhaul orders are costly. Our model aims at minimizing the total cost of overtime and tardiness over a finite number of jobs with different weights, release dates and due dates. A multi-pass heuristic algorithm is proposed to solve the scheduling and capacity allocation problem.

3 - Optimal Learning Control of Drone Operation

Jinkun Lee, The Pennsylvania State University, 236 Leonhard, University Park, PA, United States of America, jinkunlee@psu.edu, Vittal Prabhu

An optimal learning control of individual delivery drone has been considered. This enables each drone to adapt its path for the minimum travel time according to its own repetitive experience of the dynamic environment. The estimated travel times of drones are fed back into the central server, and this server determines the proper number of drones to fulfill the delivery service level based on the accumulated real time demands during the previous drone operation time window.

4 - Integrating Taxi Planning and Gate Assignment

Angel Marin, Professor, Polytechnical University of Madrid, ETSI Aeronautica y Del Espacio, Plaza Cardenal Cisneros, 3, Madrid, MA, 28040, Spain, angel.marin@upm.es

In the presentation is studied the Taxi Planning and Gate Assignment Integration. These problems are considered under a binary multicommodity network flow, in the context of routing and scheduling models with additional Side Constraints (SC). The model is a multiobjective approach balancing conflictive objectives: airport throughput, travel time, delays, operation safety and costs, etc. The computational tests are realized on test airports, simulating actual ones.

■ TB64

64-Room 113A, CC

Panel Discusssion: A Heated Discussion on Decision Analysis and Systems Engineering

Sponsor: Decision Analysis

Sponsored Session

Chair: Ali Abbas, Professor Of Industrial And Systems Engineering And Public Policy And Director Of Create, University of Southern California, 3710 McClintock Avenue, RTH 314, Los Angeles, CA, United States of America, aliabbas@price.usc.edu

1 - The Need for a Sound Decision Making System

Moderator: Ali Abbas, Professor Of Industrial And Systems Engineering And Public Policy And Director Of Create, University of Southern California, 3710 McClintock Avenue, RTH 314, Los Angeles, CA, United States of America, aliabbas@price.usc.edu

This talk reflects on some widely used methods of multi-objective decision making in both public and private enterprises, and demonstrates the issues with their use and the need for a sound decision making system.

2 - Ethical Decision Analysis

Ronald Howard, Professor, Stanford University, 646 Tennyson Avenue, Palo Alto, CA, 94301, United States of America, rhoward@stanford.edu

Decision analysis is inherently amoral. Like fire or nuclear energy it can be used for good or ill. The decision analyst and the decision maker have the ethical responsibility for decisions. The decision maker for the choice of action and the decision analyst as a conspirator or accomplice in clarifying what is to be done. The daily news shows the consequences of abdicating ethical responsibility.

3 - There is No Rational Framework for Systems Engineering

George Hazelrigg, Deputy Division Director, National Science Foundation, Civil, Mech. & Mfg Innovation, 4201 Wilson Boulevard, Arlington, VA, 22230, United States of America, ghazelri@nsf.gov

Decision analysis for systems engineering is an oxymoron. Systems engineering requires teams of people, for which decision analysis does not apply. Failure to recognize this can lead to serious problems.

4 - Decision Analysis for Systems Engineering Trade-off Analyses

Greg Parnell, Professor, University of Arkansas, Department of Industrial Engineering, Fayetteville, AR, 72701, United States of America, gparnell@uark.edu

Critical systems decisions are made throughout the system life cycle. Decision analysis offers a sound foundation for developing a composite model of complex system alternatives, major uncertainties, and stakeholder values to provide insights to systems decision makers.

5 - Decision Analysis - Towards a Theoretical Foundation of Systems Engineering and Design

Chris Paredis, Program Director, National Science Foundation, 4201 Wilson Blvd, Arlington, VA, United States of America, cparedis@nsf.gov

In a rapidly changing global context, our approach for engineering large-scale, complex engineered systems must also adapt quickly. A theoretical foundation for systems engineering and design is needed to help guide this adaptation in a rigorous, systematic fashion. Decision analysis is an important cornerstone of this foundation.

■ TB65

65-Room 113B, CC

Modeling in Decision Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Jeffrey Keisler, University of Massachusetts Boston, 100 Morrissey Boulevard, Boston, MA, 02125, United States of America, Jeff.Keisler@umb.edu

1 - When Decision Analysis Serves to Connect a Network

Jeffrey Keisler, University of Massachusetts Boston, 100 Morrissey Boulevard, Boston, MA, 02125, United States of America, Jeff.Keisler@umb.edu

An organization may wish to construct analytic models combining contributions from different experts and stakeholders in order to guide decisions. We represent this as a network of agents with reporting relationships, each with a vocabulary, a knowledge base, potential observations. Is the network rich enough to ensure the decider's success? Recent results from mathematical logic give some answers and possible implications for decision consulting.

2 - How Little Do Models Tell Us?

Eva Regnier, Associate Professor, Naval Postgraduate School, 699 Dyer Road, Monterey, CA, 93943, United States of America, eregnier@nps.edu, Erin Baker

In arenas including weather forecasting and climate policy, simulation modeling is used to estimate uncertainty attributed to initial conditions. Model uncertainty (sometimes called structural uncertainty) is much harder to quantify. We outline a qualitative approach using Bayesian logic to answer the question: how much do model results tell us?

3 - Agile Modeling Focused on Decision Making

Max Henrion, CEO, Lumina Decision Systems, Inc, 26010 Highland Way, Los Gatos, CA, 95033, United States of America, henrion@lumina.com

Agile modeling borrows methods from agile software development, an alternative to the conventional approaches starting from formal requirements. Instead modelers start building a simple prototype, and refine it progressively, learning and improving as they go. Decision analysis and sensitivity analysis helps focus development on areas most decision-relevant.

■ TB66

66-Room 113C, CC

Delay Propagation and Robust Airline Operations

Sponsor: Aviation Applications

Sponsored Session

Chair: Milind Sohoni, Associate Professor Of Operations Management And Sr. Associate Dean Of Programs, Indian School of Business, Gachibowli, Indian School of Business, Gachibowli, Hyderabad, PL, 500032, India, milind_sohoni@isb.edu

1 - Improving Maintenance Robustness using a Route Adjustment Tail Assignment Problem

Stephen Maher, Zuse Institute Berlin, Takustr. 7, Berlin, BE, 14195, Germany, maher@zib.de, Guy Desaulniers, François Soumis

Maintenance planning is critical for airline operations. Daily schedule perturbations regularly prohibit aircraft from receiving maintenance as required. A robust approach employing one-day routes has been proposed, however, perturbations still affect the delivery of maintenance. A tail assignment problem that modifies routes to satisfy maintenance requirements is presented. This will demonstrate that route modifications are a necessary augmentation to a robust maintenance planning solution.

2 - Examining the Robustness of Airline Operations under Weather Disruptions

Donald Richardson, University of Michigan, Ann Arbor, MI, donalric@umich.edu, Luke Stumplos, George Tam, Amy Cohn, Chhavi Chaudhry

We have compiled a database containing twelve years' worth of flight data from the Bureau of Transportation Statistics. By connecting this data with hourly National Oceanic and Atmospheric Administration weather reports, we are able to analyze how the weather affects the relationship between planned airline schedules and the actual flight performance. The purpose of this research is to provide a foundation for better understanding the robustness of airline operations under weather disruptions.

3 - Data-driven Models for Robust Aircraft Routing

Lavanya Marla, Assistant Professor, University of Illinois at Urbana-Champaign, 104 S. Mathews Avenue, 216E, Urbana, IL, 61801, United States of America, lavanyam@illinois.edu, Vikrant Vaze

We address the issue of pro-actively building robust aircraft routings that are less vulnerable to uncertainty, by focusing on reducing delay propagation. We present a series of data-driven models drawn from the classes of Robust Optimization and Chance-Constrained Programming that generate solutions that (i) are faithful to implicit information in the underlying data, and (ii) are less fragile to disruption. We conclude with results from a real-world airline network to provide proof-of-concept.

4 - Can Time Buffers Lead to Delays? The Role of Operational Flexibility

Milind Sohoni, Associate Professor Of Operations Management And Sr. Associate Dean Of Programs, Indian School of Business, Gachibowli, Indian School of Business, Gachibowli, Hyderabad, PL, 500032, India, milind_sohoni@isb.edu, Sanjiv Erat

In operating systems where the feasible start time of activities is uncertain, the actual buffers for conducting the activities are distinct from scheduled buffers. We study how, and why, do these buffers affect operating performance? We propose a theoretical model and evaluate its empirical content and predictions using airline industry data. Our main result shows that both buffers impact performance and their effects are moderated by flexibility. Thus ex-ante plans must consider flexibility.

■ TB67

67-Room 201A, CC

Advances in Vehicle Routing Problem and its Variants

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Ibrahim Capar, The University of Alabama, Box 870226, Tuscaloosa, AL, United States of America, icapar@cba.ua.edu

1 - The Vehicle Routing Problem with Drones: A Worst-case Analysis

Xingyin Wang, University of Maryland, Mathematics department, University of Maryland, College Park, MD, 20742, United States of America, wangxy@umd.edu, Stefan Poikonen, Bruce Golden

We introduce the Vehicle Routing Problem with Drones (VRPD). A fleet of trucks equipped with drones delivers packages to customers. Drones can be dispatched from and picked up by the trucks at the depot or the customer locations. The objective is to minimize the maximum duration of the routes. We compare VRPD to the min-max Vehicle Routing Problem from a worst-case perspective and show that the maximum savings from using the drones depends on the number and the speed of the drones.

2 - Online and Open Vehicle Routing Problem with Split Delivery

Ibrahim Capar, The University of Alabama, Box 870226, Tuscaloosa, AL, United States of America, icapar@cba.ua.edu, Burcu Keskin

We consider an online, open vehicle routing problem with split deliveries. This type of problem is usual for companies that use common carriers with TL, LTL, or container services. We develop an integer programming model and propose a reduction technique to solve real life problem with commercial software. We investigate the effect of lead time on cost and outstanding orders and explore different policies to minimize total cost. We show more than eight percent savings compared to the literature.

3 - Distributionally Robust Adaptive Vehicle Routing

Arthur Flajolet, MIT, Operations Research Center, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA, 02139, United States of America, flajolet@mit.edu, Patrick Jaillet, Sebastien Blandin

We consider an adaptive solution to the vehicle routing problem with stochastic travel times with the objective of minimizing a risk function of the lateness. To mitigate the impact of the lack of information on the travel times, we develop a distributionally robust dynamic programming formulation for risk-averse travelers and illustrate the practicality of the approach with field data from the Singapore road network.

4 - A Metaheuristic for the Electric Vehicle Routing Problem with Recharging Stations and Time Windows

Site Wang, Graduate Student, Clemson University, 854 Issaqueena Trail, APT908, Central, SC, 29630, United States of America, sitew@clemson.edu, Eric Huang, Scott Mason

In this study, we consider electric vehicles and recharging stations in the vehicle routing problem with time windows. We examine two objectives for this problem, separately and in concert, to provide insights for the location-routing problem with time windows. Due to the problem's complexity, we demonstrate the efficacy of our two-phase metaheuristic that combines variable neighborhood search and Tabu search for practical-sized problems.

■ TB68

68-Room 201B, CC

TSL Invited Cluster Keynote Address

Sponsor: Transportation, Science and Logistics

Sponsored Session

Chair: Irina Dolinskaya, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, dolira@northwestern.edu

1 - Stochastic Vehicle Routing: An Overview and Some Research Directions

Michel Gendreau, Full Professor, École Polytechnique de Montréal, P.O. Box 6128, Station Centre-ville, Montreal, QC, H3C 3J7, Canada, michel.gendreau@cirrelt.ca

While Vehicle Routing Problems have now been studied extensively for more than 50 years, those in which some parameters are uncertain at the time where the routes are made have received significantly less attention, in spite of the fact that there are many real-life settings where key parameters are not known with certainty. In this talk, we will examine the main classes of Stochastic Vehicle Routing Problems: problems with stochastic demands, stochastic customers, and stochastic service or travel times. We will emphasize the main approaches for modeling and tackling uncertainty: a priori models, a posteriori approaches, and chance-constrained models. The end of the talk will devoted to a brief presentation of some interesting research directions in this area.

■ TB69

69-Room 201C, CC

Joint Session TSL/Public Sector: Health-care, Education, and Emergency Applications of Logistics

Sponsor: Transportation, Science and Logistics

Sponsored Session

Chair: Sung Hoon Chung, Binghamton University, P.O. Box 6000, Binghamton, NY, United States of America, chung@binghamton.edu

1 - Public Transportation Planning for Mass-Scale Evacuations

Rahul Swamy, Graduate Research Assistant, University at Buffalo (SUNY), 412 Bell Hall, Buffalo, NY, Jee Eun Kang, Rajan Batta

This research provides a public transportation planning strategy in an urban setting for evacuating population groups to safe locations before a mass-scale disaster. Under the objective of maximizing the number of evacuees, the proposed model first identifies pickup locations and then constructs special type of routing to serve a time-varying demand.

2 - Minimizing the Cost of Routing Blood Collection Vehicles

Okan Orsan Ozener, Ozyegin University, Cekmekoy, Istanbul, Turkey, orsan.ozener@ozyegin.edu.tr

We study the routing of blood collection vehicles to minimize the total routing costs. Donated blood has to be processed within a certain amount of time. We analyze the routing decisions and propose an integrated framework to minimize the total cost while collecting a pre-specified number of donations.

3 - A Heuristic for School Bus Routing of Special-education Students

Hernan Caceres, SUNY Buffalo, 342 Bell Hall, Buffalo, NY, United States of America, hernanan@buffalo.edu, Rajan Batta, Qing He

The problem of routing special-education students differs in many aspects with that of routing regular students. A bus can be configured to also support wheelchairs, students may be served differently depending on their disability, and they need to be picked up and dropped off in their homes. In our study we modeled a mixed integer program that accounts for these and other characteristics. We use column generation to find approximated solutions for real and benchmark instances.

4 - Disaster Relief Routing under Uncertainty: A Robust Optimization Approach

Sung Hoon Chung, Binghamton University, P.O. Box 6000, Binghamton, NY, United States of America, chung@binghamton.edu, Yinglei Li

We explicitly consider uncertainty in travel times when planning vehicle routes for delivering critical supplies to the affected population in need in the aftermath of a large disaster. In particular, we propose the robust optimization approach to minimize the impact of uncertainty and eventually to achieve enhanced resilience in the aftermath of disasters. We also explore several numerical methods and algorithms.

■ TB70

70-Room 202A, CC

Yard and Terminal Simulation

Sponsor: Railway Applications

Sponsored Session

Chair: Roger Baugher, President, TrAnalytics, LLC, 100 Villamouira Way, Johns Creek, GA, 30097, United States of America, rwbaugher@aol.com

1 - Exploiting Data to Create Yard and Terminal Replay Capabilities

Roger Baugher, President, TrAnalytics, LLC, 100 Villamouira Way, Johns Creek, GA, 30097, United States of America, rwbaugher@aol.com

Yard automation technology, GPS sensors, time lapse cameras and new low cost computer processors enable large amounts of yard operation data to be captured inexpensively. Processes can transform these data, and the yard's GIS data, into inputs for simulation, enabling the deployment of yard replay systems. With such a system, management can analyze operational failures, develop improved processes, train new employees, examine the impact of proposed capital improvements and more.

2 - Simulation Model for a Large Railroad Flat Switching Yard

Clark Cheng, Senior Director Operations Research, Norfolk Southern Railway, Atlanta, GA, 30309, United States of America, Clark.Cheng@nscorp.com, Rajesh Kalra, Mabby Amouie, Edward Lin

We will present a discrete-event simulation model for the largest railroad flat switching yard in the Western Hemisphere. The model is being used to evaluate yard capacity and improve yard operations and customer service.

3 - Conflict Avoidance in Yards and Terminals

Brigitte Jaumard, Professor And Concordia Research Chair On The Optimization Of Communication Networks, Concordia University, Computer Science and Software Eng., 1455 de Maisonneuve Blvd. West, Montreal, QC, H3G 1M8, Canada, bjaumard@cse.concordia.ca, Roger Baugher, Thai Hoa Le, Bertrand Simon

Activities of a rail yard focus on freight delivery and vehicle maintenance, while train movements are generally line-of-sight ones. Many of the yard activities share one or two connecting tracks for through traffic. While these tracks need to remain clear for through traffic, stopping yard activities on them to let a passenger train through may result in disruption to freight operations, and in conflicts. We will propose different mechanisms and tools in order to avoid conflicts.

4 - Applying Dynamic Simulation to Validate and Improve New Transloading Terminal Operations

Martin Franklin, Partner, MOSIMTEC LLC, 297 Herndon Parkway, Suite 301, Herndon, VA, 20170, United States of America, martin@mosimtec.com

A chemical manufacturing and handling company is expanding and re-configuring facilities to create a new interface point between rail transport and pipeline transport. The client recognized the need to apply modeling and simulation technology to represent the system in a dynamic environment, therein incorporating inherent variability, to validate the design and make informed decisions. Simulation analysis of the rail network and operators and related integration will also be reviewed.

■ TB72

72-Room 203A, CC

DDAS for Industrial and System Engineering Applications II

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Shiyu Zhou, Professor, University of Wisconsin-Madison, Department of Industrial and Systems Eng, 1513 University Avenue, Madison, WI, 53706, United States of America, shiyuzhou@wisc.edu

Co-Chair: Yu Ding, Professor, Texas A&M University, ETB 4016, MS 3131, College Station, YX, United States of America, yuding@iemail.tamu.edu

1 - Multi-stage Nanocrystal Growth Identifying and Modeling via in-situ TEM Video

YanJun Qian, PhD Candidate, TAMU, 1501 Harvey Rd, Apt. 806, College Station, TX, 77840, United States of America, qianyanjun09@gmail.com, Yu Ding, Jianhua Huang

While in-situ transmission electron microscopy technique has caught a lot of recent attention, one of the bottlenecks appears to be the lack of automated and

quantitative analytic tools. We introduce an automated tool suitable for analyzing the in-situ TEM videos. It learns and tracks the normalized particle size distribution and identifies the phase change points delineating the stages in nanocrystal growth. We furthermore produce a quantitative physical-based model.

2 - Cooperative Unmanned Vehicles for Vision-based Detection and Real-world Localization of Human Crowds

Sara Minaeian, The University of Arizona, 1127 E James E. Rogers Way, Room 111, Tucson, AZ, 85716, United States of America, minaeian@email.arizona.edu, Young-jun Son, Jian Liu

In crowd control using unmanned vehicles (UVs), the crowd detection and real-world localization are required to perform key functions such as tracking and motion planning. In this work, a team of UVs cooperates under a DDAMS framework to detect the moving crowds by applying computer-vision techniques and to localize them using a new perspective transformation. A simulation model is also developed for validation, and the experimental results reveal the effectiveness of the proposed approach.

3 - Fault Identifiability Analysis of Beam Structures using Dynamic Data-driven Approaches

Yuhang Liu, Research Assistant, University of Wisconsin-Madison, 1513 University Ave, ME3255, Madison, WI, 53706, United States of America, liu427@wisc.edu, Shiyu Zhou

In this research, we study the parameterization and localization identifiability of beam structures based on the dynamic response information. We show that the stiffness parameters can be locally identifiable in general cases for the collocated single input and single output system. The unique relationship between the damage location and the dynamic response are also investigated. The identifiable sensitivity is studied for practical damage identification.

■ TB73

73-Room 203B, CC

Joint Session QSR/Energy: Data Analytics in Energy Systems

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Eunshin Byon, Assistant Professor, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, ebyon@umich.edu

Co-Chair: Arash Pourhabib, Assistant Professor, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74078, United States of America, arash.pourhabib@okstate.edu

1 - Multi-Component Replacement in a Markov Modulated Environment

David Abdul-Malak, dta10@pitt.edu, Jeffrey Kharoufeh

In this talk we will present a model for jointly replacing multiple components that degrade in a shared, exogenous, Markov modulated environment. Continuous state variables and a high dimensional state space cause the problem to be computationally intractable. To overcome this complication, an approximate dynamic programming (ADP) approach is employed and illustrated through multiple numerical examples.

2 - Importance Sampling with a Novel Information Criterion for Efficient Reliability Evaluation

Youngjun Choe, PhD Candidate, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, yjchoe@umich.edu, Eunshin Byon

Importance sampling can significantly accelerate the rare event probability estimation. However, the theoretically optimal sampling requires some approximation in practice, such as the cross-entropy method. We extend the cross-entropy method by incorporating the expectation-maximization (EM) algorithm and deriving a model selection criterion analogous to Akaike information criterion. We apply the proposed method to the reliability evaluation of the wind turbine.

3 - Monitoring Performance of Wind Turbines Based on Power Curve Estimation

Hoon Hwangbo, PhD Student, Texas A&M University, College Station, TX, United States of America, hwhangbo@tamu.edu, Andrew Johnson, Yu Ding

Quantifying performance of a wind turbine is crucial for decision makings such as turbine upgrade or replacement. Yet, there is a lack of systematic ways to quantify a turbine's performance, while considering the diverse sources of variation in the energy generation. In this study, we estimate power curves and quantify performance of a wind turbine while controlling for some significant factors of variation. Using the measures we derive, we monitor performance change of a wind turbine over time.

4 - Wake Effect Characterization in Wind Power Systems

Mingdi You, PhD Candidate, University of Michigan, 1205 Beal Avenue, IOE 1773, Ann Arbor, MI, 48109, United States of America, mingdyou@umich.edu, Eunshin Byon, Jionghua (judy) Jin

The rapid growth of wind power underscores the need to understand the dynamic characteristics of wind turbine operations. Wind turbines in a wind farm exhibit heterogeneous power generations due to the wake effect. This study provides a computational framework for characterizing the wake effects via a data-driven approach by extending the Gaussian Markov Random field framework. The computational results show that this approach improves the prediction capability over other methods.

■ TB74

74-Room 204A, CC

System and Process Informatics in Additive Manufacturing (II)

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Linkan Bian, Assistant Professor, Mississippi State University, 260 McCain Building, Mississippi State, Starkville, MS, 39762, United States of America, bian@ise.msstate.edu

1 - Accelerated Bi-objective Process Optimization for Laser-based Additive Manufacturing (LBAM)

Amir M. Aboutaleb, Mississippi State University, 260 McCain Building, Mississippi State, MS, 39762, United States of America, aa1869@msstate.edu, Alaa Elwany, Scott M. Thompson, Linkan Bian, Nima Shamsaei, Mohammad Marufuzzaman

Material properties of fabricated parts via LBAM have demonstrated to either be correlated, interdependent or inconsistent with process parameters. In many cases the goal is optimize the LBAM process considering several material properties of interest as a multi-objective problem. We propose a novel methodology for leveraging current experimental data to guide and accelerate the bi-objective Design-of-Experiment process for Pareto Front approximation by the minimum number of experiments.

2 - Spatial Gaussian Process Models for Porosity Prediction in Selective Laser Melting

Alaa Elwany, Texas A&M University, 3131 TAMU, College Station, TX, United States of America, elwany@tamu.edu, Gustavo Tapia, Huiyan Sang

We develop a Gaussian process-based predictive model for predicting the porosity in metallic parts produced using Selective Laser Melting (SLM – a laser-based AM process). A case study is conducted to validate this predictive framework through predicting the porosity of 17-4 PH stainless steel manufacturing on a commercial SLM system.

3 - Automatic Feature Priority Assignment for Automated Production Processes

Ola Harryson, Professor, North Carolina State University, 400 Daniels Hall, 111 Lampe Dr, Raleigh, NC, 27606, United States of America, oaharrys@ncsu.edu, Richard Wysk, Sidharth Chaturvedi, Harshad Srinivasan

This work describes a system for the prioritization of features at the near-net production stage in order to minimize the effort required for any subsequent finish machining. Heuristics are used to assign weights to features based on value and produceability. A graph of feature relationships is used to modify the assigned weights based on design and tolerancing principles. An implementation of this system for use with the AIMS hybrid process is described and demonstrated with sample parts.

4 - Additive Manufacturing of Biomedical Implants: Feasibility Assessment via Supply-chain Cost Analysis

Adindu Emelogu, Mississippi State University, 260 McCain Building, Mississippi State, MS, 39762, United States of America, emeloguadindu@yahoo.com, Linkan Bian, Mohammad Marufuzzaman

We investigate the economic feasibility of fabricating biomedical implants close to hospitals by additive manufacturing (AM) instead of traditional manufacturers (TM) located far from point-of-use. We develop a stochastic mixed-integer programming model which helps to decide the location of AM centers and volume of product flows that minimize supply chain cost. A case study of hospitals in Mississippi, USA recommends AM only when the production cost of AM to TM ratio (ATR) reduces to 3 or less.

■ TB75

75-Room 204B, CC

IBM Research Best Student Paper Award II

Sponsor: Service Science

Sponsored Session

Chair: Ming-Hui Huang, National Taiwan University, Taiwan - ROC, huangmh@ntu.edu.tw

1 - Best Student Paper Competitive Presentation

Ming-Hui Huang, National Taiwan University, Taiwan - ROC, huangmh@ntu.edu.tw

Finalists of the IBM Research Best Student Paper Award present their research findings in front of a panel of judges. The judging panel will decide the order of winners, which will be announced during the business meeting of the Service Science Section at the Annual Conference.

2 - Online Network Revenue Management using Thompson Sampling

He Wang, MIT, Cambridge, MA, United States of America, wanghe@mit.edu, Kris Johnson Ferreira, David Simchi-Levi

Mobile apps have great potential to provide promising services to improve consumers' engagement and behaviors. Focusing on healthy eating, this study shows that an image-based professional support greatly improves consumer engagement and eating behaviors, while social media and a heuristic approach of self-management might have negative effects in some occasions. Mobile apps have great potential to provide promising services to improve consumers' engagement and behaviors. Focusing on healthy eating, this study shows that an image-based professional support greatly improves consumer engagement and eating behaviors, while social media and a heuristic approach of self-management might have negative effects in some occasions.

3 - How Environmental Certification Can Affect Performance in the Service Industry: Evidence from the Adoption of LEED Standards in the U.S. Hotel Industry

Matthew Walsman, Cornell University, Ithaca, NY United States of America, mcw237@cornell.edu, Suresh Muthulingam, Rohit Verma

This study uses a mixed method approach (difference-in-differences and multi-level modeling) to measure the impact of environmental certification (i.e. LEED certification) on financial performance in the US hospitality industry. We find that certification does contribute to higher revenue for the certifying hotel, relative to its competitors.

4 - Optimal Coinsurance Rates for a Heterogeneous Population under Inequality and Resource Constraints

Gregory J. Schell, Center for Naval Analyses, 3003 Washington Blvd, Arlington, VA, United States of America, schellg@cna.org, Rodney A. Hayward, Mariel Lavieri, Jeremy B. Sussman

We derive prescription coinsurance rates which maximize the health of a heterogeneous patient population. We analyze the problem as a bilevel optimization model where the lower level is a Markov decision process and the upper level is a resource allocation problem with constraints on expenditures and coinsurance inequality.

5 - Managing Rentals with Usage-Based Loss

Vincent Slaugh, Penn State University, University Park, PA, United States of America, vslaug@cmu.edu, Bahar Biller, Sridhar Tayur

We study the operation of a discrete-time stochastic rental system over a single selling season in which rental units may be purchased or damaged by customers. We provide structural results related to the expected profit function and the optimal policy for allocating rental units to meet customer demand. In an industrial use case motivated by a high-fashion dress rental business, we show significant value to accounting for inventory loss and using the optimal inventory recirculation rule.

■ TB76

76-Room 204C, CC

Advances in Simulation-based Optimization II

Sponsor: Simulation

Sponsored Session

Chair: Enlu Zhou, Assistant Professor, Georgia Institute of technology, 755 Ferst Drive, NW, Atlanta, United States of America, enlu.zhou@isye.gatech.edu

1 - A Set Approach to Simulation Optimization with Probabilistic Branch and Bound

Hao Huang, PhD Candidate, University of Washington, Industrial and Systems Engineering, Seattle, WA, 98195-2650, United States of America, haoh7493@uw.edu, Zelda Zabinsky

Probabilistic Branch and Bound (PBnB) is a partition-based random search simulation optimization algorithm for stochastic problems. PBnB determines a set of solutions through an estimated bound on the performance. For single objective problem, PBnB approximates a desirable level set with quantile estimation. In a multiple objective circumstance, PBnB considers a bound of the closeness to the efficient frontier and approximates the Pareto optimal set of solutions.

2 - A Model-based Approach to Multi-objective Optimization

Joshua Hale, Graduate Student, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, Atlanta, GA, 30332, United States of America, jhale32@gatech.edu, Enlu Zhou

We develop a model-based algorithm for the optimization of multiple objective functions that can only be assessed through black-box evaluation. The algorithm iteratively generates candidate solutions from a mixture distribution over the solution space and updates the mixture distribution based on the sampled solutions' domination count such that the future search is biased towards the set of Pareto optimal solutions. We demonstrate the performance of the proposed algorithm on benchmark problems.

3 - Simulation Optimization: Review and Exploration

Chun-hung Chen, George Mason University, 4400 University Drive, MS 4A6, SEOR Dept, GMU, Fairfax, VA, 22030, United States of America, cchen9@gmu.edu, Edward Huang, Jie Xu, Loo Hay Lee

Recent advances in simulation optimization research and explosive growth in computing power have made it possible to optimize complex stochastic systems that are otherwise intractable. We will review some recent developments. We will also discuss how simulation optimization can benefit from cloud computing and high-performance computing, its integration with big data analytics, and the value of simulation optimization to help address challenges in engineering design of complex systems.

4 - MO-MO2TOS for Multi Objective Multi Fidelity Simulation Optimization

Loo Hay Lee, National University of Singapore, Department of Industrial & Systems Engineering, Singapore, iseleelh@nus.edu.sg, Giulia Pedrielli, Chun-hung Chen, Ek Peng Chew, Haobin Li

In simulation-optimization, low fidelity models can be particularly useful. However, we need to account for their inaccuracy while searching for the optimum. In 2015, Xu et al. proposed MO2TOS, which exploits multiple fidelities to improve the simulation optimization procedure. We extend the approach proposing MO-MO2TOS for the multi-objective case, using the concepts of non-dominated sorting and crowding distance. Several interesting insights specific to the multi-objective case are drawn.

■ TB77

77-Room 300, CC

Logistics I

Contributed Session

Chair: Leily Farrokhhvar, Virginia Tech, 250 Durham Hall (0118), Blacksburg, VA, 24061, United States of America, leily@vt.edu

1 - Analysis of a New Dual-Command Operation in Puzzle-Based Storage Systems with Block Movement

Hu Yu, PhD Student, University of Science and Technology of China, Number 96, JinZhai Road, HeFei, China, yuhu0421@mail.ustc.edu.cn, Yugang Yu

Dual-command operation jointly performing storage and retrieval requests has been widely discussed in classical warehouse systems, but has been rarely studied in puzzle-based storage systems with block movement. We analytically derive the travel time of completing dual requests that randomly locate in the system. Comparison results with traditional dual-command operation in different scenarios show that significant reduction in the expected travel time is obtained in puzzle-based systems.

2 - Flexibility Analysis on a Supply Chain Contract using a Parametric Linear Programming Model

Eric Longomo, PhD student, University of Portsmouth, Lion Gate Building, Lion Terrace, Hampshire, Portsmouth, PO1 3HF, United Kingdom, eric.longomo@port.ac.uk, Xiang Song, Djamila Ouelhadj, Chengbin Chu

This study considers a multi-period Quantity Flexibility contract between a car manufacturer (buyer) and an external parts supplying company. The buyer -in concert with the supplier- aims to develop a policy -at strategic level, that determines the optimal nominal order quantity and variation rate underpinning the contract. The feasibility and convexity of the proposed LP model are examined. Simulations are carried out to evaluate the theoretical results.

3 - Assigning Non-Fixed Parts of a Delivery Area to Fixed Tours Serviced by Electric Vehicles

Sarah Ubbel, RWTH Aachen University, Kackertstraße 7, Aachen, Germany, ubber@dpor.rwth-aachen.de

We consider last mile distribution where a delivery area is operated by different tours. Parts of this area are serviced by fixed tours in a fixed sequence every day. Other parts are not assigned to fixed tours. To respond e.g. to variable battery ranges or to fluctuations in demand, it is useful to reassign daily the non-fixed parts to the tours, whereby the assignment must not significantly alter the usual delivery sequence. We have developed a model and a heuristic for solving this problem.

4 - Asset Allocation in the Industrial Gas Bulk Supply Chain

Leily Farrokhhvar, Virginia Tech, 250 Durham Hall (0118), Blacksburg, VA, 24061, United States of America, leily@vt.edu, Kimberly Ellis

We study an asset allocation problem in a vendor managed inventory system of an industrial gas distribution network where customer demands vary over time. The objective is to determine the preferred size of bulk tanks to assign to customer sites to minimize recurring gas distribution costs and initial tank installation costs while accommodating customers' time varying demand. The problem is modeled as a mixed-integer program and then solved using a periodically restricting heuristic approach.

■ TB78

78-Room 301, CC

Planning and Scheduling in Energy Applications

Contributed Session

Chair: Yanyi He, Senior Scientist, IBM, 1001 E Hillsdale Blvd, Foster City, Ca, 94404, United States of America, heyanyidaodao@gmail.com

1 - Stochastic and Robust Optimization of the Scheduling and Market Involvement for an Energy Producer

Ricardo Lima, KAUST, Thuwal, Saudi Arabia, ricardo.lima@kaust.edu.sa, Sabique Langodan, Ibrahim Hoteit, Antonio Conejo, Omar Knio

We will present three optimization methods based on stochastic programming, robust optimization, and a hybrid method for the scheduling and market involvement for an electricity producer. This producer operates a system with thermal, hydro, and wind sources. The wind power and the electricity prices are uncertain. The methods are implemented using parallel optimization runs. The computational performance, scheduling results, and the impact of risk management are presented and discussed.

2 - A Two-Echelon Wind Farm Layout Planning Model

Huan Long, City University of Hong Kong, Room 601, Nam Shan Estate, Hong Kong, China, hlong5-c@my.cityu.edu.hk, Zijun Zhang

In this paper, a two-echelon layout planning model is proposed to determine the optimal wind farm layout to maximize its expected power output. In the first echelon, a grid composed of identical cells is utilized to model the wind farm while the cell center is the potential slot. In the second echelon, the model for determining the optimal coordinate in a grid cell is formulated. The comparative analysis between the two-echelon planning model and the traditional grid/coordinate models is conducted.

3 - Demand Side Participation for a Major Consumer in a Co-optimized Electricity and Reserve Markets

Mahbubeh Habibian, Miss, University of Auckland, 6A-Short St, Auckland Central, Auckland, 1010, New Zealand, mhab735@aucklanduni.ac.nz, Golbon Zakeri, Anthony Downward

The paper probes demand side participation for a large consumer through demand response and offering in interruptible load reserve. Our model is a bi-level optimization problem that embeds the dispatch model, where electricity and reserve are co-optimized, as the lower level and the profit maximization problem for the consumer (over 2 sets of supply functions) as the upper level. The objective function is transformed into piecewise linear form via utilizing a new interpretation of offer stacks.

4 - Analysis of Best Practices for Energy Efficient Buildings through Building Energy Modeling in Design

Chung-suk Cho, Assistant Professor, Khalifa University, Al Saada St. and Muroor Rd., Abu Dhabi, 127788, United Arab Emirates, chung.cho@kustar.ac.ae, Young-ji Byon

Building energy performance modeling evaluates energy efficient design options. There are significant amount of misused opportunities of energy efficiency-related decisions that could be incorporated into the building design through quality building energy performance modeling. The best practice analysis will help optimize the building design and will allow the design team to prioritize investment in the strategies that will have the greatest effect on the building's energy use.

5 - Two-stage Optimal Demand Response with Battery Energy Storage Systems

Yanyi He, Senior Scientist, IBM, 1001 E Hillsdale Blvd, Foster City, CA, 94404, United States of America, heyanyidaodao@gmail.com, Zhaoyu Wang

Proposes a two-stage co-optimization framework for the planning and energy management of a customer with battery energy storage systems (BESSs) and demand response (DR) programs. The first stage is to assist a customer to select multiple DR programs to participate and install batteries to coordinate with the demand side management. The second stage is to perform energy management according the planning decisions, including dispatches of batteries, loads, and DGs.

■ TB79

79-Room 302, CC

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - Statistics.com - A Survey of Data Analytics Methods

Peter Bruce, Founder and President, The Institute for Statistics Education at Statistics.com

This workshop will survey the field of data analytics, reviewing both traditional statistical methods and machine learning methods, including predictive modeling, unsupervised learning, text mining, statistical inference, time series forecasting, recommender systems, network analytics, and more. It will be a broad brush treatment aimed at newcomers, as well as those with knowledge in one area who wish to understand where other analytic methods fit into the picture.

2 - River Logic - Code-free modeling for large-scale LP and MIP problems using Enterprise Optimizer

Eric Kelso, VP Product Management, River Logic

Enterprise Optimizer is a code-free, visual LP and MIP optimization modeling platform. Using EO's intuitive drag-and-drop interface, learn how to rapidly create integrated process and financial models. Also learn about EO's wizard-driven data integration, query designer, user-defined schema, dashboard builder, VBA integration, APIs and job automation component. Outputs demonstrated include detailed unit costs and audit-quality P&L, Balance Sheet and Cash Flow statements. The entire session will be spent discussing major features and showing real-world applications.

Tuesday, 12:30pm - 2:30pm

Exhibit Hall A

Tuesday Poster Session

Contributed Session

Chair: Min Wang, Drexel University, 3141 Chestnut Street, Philadelphia, PA, United States of America, mw638@drexel.edu

Co-Chair: Allen Holder, Rose-Hulman Mathematics, Terre Haute, IN, United States of America, holder@rose-hulman.edu

Co-Chair: Wenjing Shen, Drexel University, Philadelphia, PA, United States of America, ws84@drexel.edu

1 - Surgery Scheduling with Recovery Resources

Maya Bam, University of Michigan, Industrial and Operations Engineering, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, mbam@umich.edu, Mark Van Oyen, Mark Cowen, Brian Denton

Surgery scheduling is complicated by the post-anesthesia care unit, the typical recovery resource. Based on collaboration with a hospital, we present a novel, fast 2-phase heuristic that considers both surgery and recovery resources. We show that each phase of the heuristic has a tight provable worst-case performance bound. Moreover, the heuristic performs well compared to optimization based methods when evaluated under uncertainty using a discrete event simulation

model.

2 - Inventory Control with Unknown Demand and Nonperishable Product

Tingting Zhou, Rutgers University, 1 Washington Park, Newark, NJ, 07102, United States of America, tingzhou@rutgers.edu, Michael Katehakis, Jian Yang

We study an inventory control problem with unknown discrete demand distribution, focusing on the analysis of an adaptive algorithm based on empirical distributions and the newsvendor formula. When items are nonperishable, the algorithm can achieve a near square-root-of-T bound on its regret over the ideal case where demand distribution were known.

3 - Optimizing Information System Security Investments with Risk: Insights for Resource Allocation

Yueran Zhuo, PhD Candidate, University of Massachusetts Amherst, Isenberg School of Management, Amherst, MA, 01003, United States of America, yzhuo@som.umass.edu, Senay Solak

Information security has become an integral component of a firm's business success, and thus investing on information security countermeasures is an important decision problem for many businesses. We use a portfolio approach to study the optimal investment decisions of a firm, where the uncertainty of information security environment is captured through a stochastic programming framework. Results cast managerial insights for information security investment planning by a firm.

4 - Adaptive Decision-Making of Breast Cancer Mammography Screening: A Heuristic-Based Regression Model

Fan Wang, University of Arkansas, Fayetteville, AR, United States of America, fxw005@uark.edu, Shengfan Zhang

The American Cancer Society currently recommends all U.S. women undergo routine mammography screenings beginning at age 40. However, due to the potential harms associated with screening mammography, such as overdiagnosis and unnecessary work-ups, the best strategy to design an appropriate breast cancer mammography screening schedule remains controversial. This study presents a mammography screening decision model that aims to identify an adaptive screening strategy while considering disadvantages of mammography. We present a two-stage decision framework: (1) age-specific breast cancer risk estimation, and (2) annual mammography screening decision-making based on the estimated risk. The results suggest that the optimal combinations of independent variables used in risk estimation are not the same across age groups. Our optimal decisions outperform the existing mammography screening guidelines in terms of the average loss of life expectancy. While most earlier studies improved the breast cancer screening decisions by offering lifetime screening schedules, our proposed model provides an adaptive screening decision aid by age. Since whether a woman should receive a mammogram is determined based on her breast cancer risk at her current age, our "on-line" screening policy is adaptive to a woman's latest health status, which causes less bias in reflecting the individual risk of every woman.

5 - Optimization of Netting Scheme in Large-scale Payment Network

Shuzhen Chen, University of Science & Technology of China, No. 98, Jinzhai Road, Hefei, China, csz@mail.ustc.edu.cn

As netting becomes combined with real-time settlement, an efficient netting method is required to deal with the large-scale payment network. Network optimization may not be optimal due to repeated searching of shortest path. A new method is proposed to optimize the netting process by assembling payments in two specific routes. It can minimize the amount of total payments for the whole network and ensure unchanged net payment for each bank. Moreover, it has polynomial time-complexity.

6 - Wasserstein Metric and the Distributionally Robust TSP

Mehdi Behrooz, University of Minnesota, Minneapolis, MN, United States of America, behro040@umn.edu, John Gunnar Carlsson

Recent research on the robust and stochastic travelling salesman problem and the vehicle routing problem has seen many different approaches for describing the region of uncertainty, such as taking convex combinations of observed demand vectors or imposing constraints on the moments of the spatial demand distribution. One approach that has been used outside the transportation sector is the use of statistical metrics that describe a distance function between two probability distributions. In this paper, we consider a distributionally robust version of the Euclidean travelling salesman problem in which we compute the worst-case spatial distribution of demand against all distributions whose earth mover's distance to an observed demand distribution is bounded from above. This constraint allows us to circumvent common overestimation that arises when other procedures are used, such as fixing the center of mass and the covariance matrix of the distribution.

7 - Intersection of a Tree Network for the Single Refueling Station Location Problem

Sang Jin Kweon, PhD Student, The Pennsylvania State University, 310 Leonhard Building, State College, PA, 16802, United States of America, svk5333@psu.edu

An intersection is the vertex whose degree is greater than two in the network. In this talk, we consider intersections and develop the methodology that determines the continuous interval of the potential locations for a single alternative-fuel refueling station on a tree network, with an objective of maximizing the amount of traffic flows in round trips per time unit captured by the station.

8 - Intelligent Tutoring Systems: Future Paradigm of Educational Environments

Alireza Farasat, University at Buffalo (SUNY), 4433 Chestnut Ridge Rd Apt. 7, Amherst, NY, 14228, United States of America, afarasat@buffalo.edu, Alexander Nikolaev

Educational systems have witnessed a substantial transition from traditional educational methods mainly using text books, lectures, etc. to newly developed systems which are artificial intelligent-based systems and personally tailored to the learners. We have developed a web-based tool, Crowdlearning which concentrates on creating an intelligent system that learns to interact with students and motivates them to more actively participate in the learning process by proposing their own problems.

9 - Optimized Scheduling of Sequential Resource Allocation Systems

Ran Li, PhD Student, Georgia Institute of Technology, 755 Ferst Drive NW, Atlanta, GA, 30332, United States of America, rli63@gatech.edu, Spyros Reveliotis

We consider the scheduling problem of allocating finite reusable resources to concurrent sequential processes. This problem also involves the logical issue of deadlock avoidance. Our approach is based on the formal model of the generalized stochastic Petri-net. Special emphasis is placed on the representational and computational complexity of the proposed methods, which are controlled through (i) a pertinent (re-)definition of the target policy spaces, and (ii) simulation optimization.

10 - Operation Research for Data Mining: An Application to Medical Diagnosis

Shahab Derhami, Auburn University, 3301 Shelby Center, Auburn, GA, 36849, United States of America, sderhami@auburn.edu

Fuzzy rule based classification systems (FRBCSs) have been successfully employed as a data mining technique where the goal is to discover the hidden knowledge in a data set and develop an accurate classification model. Despite various heuristic approaches that have been proposed to learn fuzzy rules for these systems, no exact optimization approach has been developed for this problem. We propose integer programming models to learn fuzzy rules for a FRBCS used for medical diagnosis purpose.

11 - Forecasting Surges in the Hospital Emergency Department (ED)

Alexander Gutfraind, Chief Healthcare Data Scientist, Uptake Technologies, 600 W. Chicago Avenue, Chicago, IL, 60654, United States of America, sasha.gutfraind@uptake.com, Nelson Bowers, Jim Herzog, Madeline Jannotta, Ilan Kreimont, Adam Mcelhinney

A major hospital system in the Chicago metro area experiences large unexpected surges in its Emergency Department (ED).

Using five years of ED admissions we predict ED surges and improve scheduling of staff.

Data indicates the time of arrival, rooming and discharge and acuity. Total arrivals per day cannot be predicted accurately with epidemiological climatological, calendar variables but the state of the ED could be predicted 1-4 hours in advance with high accuracy using VAR methods.

12 - A New Measure for Testing Independence

Qingcong Yuan, Graduate Student, University of Kentucky, 300 Alumni Drive Apt. 166, Lexington, KY, 40503, United States of America, qingcong.yuan@uky.edu, Xiangrong Yin

We introduce a new measure for testing independence between two random vectors. Our measure differs from that of distance covariance, by using expected conditional difference of characteristic functions. We propose one empirical version by slicing on one of the random vectors. This empirical measure is based on certain Euclidean distance. Its properties, asymptotics and applications in testing independence are discussed. Implementation and Monte Carlo results are also presented.

13 - Graph Based Non-isometric Curve to Surface Matching for Local Calibration

Babak Farmanesh, PhD Student, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74078-5016, United States of America, babak.farmanesh@okstate.edu, Balabhaskar Balasundaram, Arash Pourhabib

Calibration refers to the process of adjusting parameters of a computer simulation so that the simulation responses match the corresponding physical responses.

Calibration can be interpreted as a curve to surface matching problem. We propose a graph-theoretic non-isometric matching approach to solve this problem using the graph shortest path algorithm in one-dimensional spaces. For higher dimensional spaces, we introduce the generalized shortest path concept to solve the matching problem.

14 - Location and Coverage Models for Preventing Attacks to Interurban Transportation Networks

Ramón Auad, Associate Professor, Universidad Católica del Norte, Of. 318, Bldg. Y1, 0610 Angamos Avenue, Antofagasta, 1240000, Chile, rauad@ucn.cl, Rajan Batta

We develop a binary integer programming model to solve this problem, whose objective is to maximize the expected vehicle coverage across the network over a time horizon, using decomposition heuristics. To introduce a measure of equity, we propose two sets of time constraints, considering total vehicle coverage, inequity and network coverage. We explore scalability of the model for excessively large instances. All of these features are applied to a case study in Northern Israel.

15 - An Information-based Framework for Incorporating Travel Time Uncertainty in Transportation Modeling

Jiangbo Yu, University of California, Irvine, 4101 Palo Verde Rd, Irvine, CA, 92617, United States of America, jiangby@uci.edu, Jay Jayakrishnan

This paper proposes a modeling framework aimed at systematically incorporating perceived uncertainty into decision making. The model uses theoretically sound concepts from information theory, communication, and cognitive science. Potential applications and implications are identified and demonstrated with examples.

16 - Database of Identified Poly and Mono ADP-ribosylated Proteins

Charul Agrawal, Undergraduate Student, Indian Institute of Technology (IIT) Delhi, Room No ED-16, Himadri Hostel, Hauz Khas, New Delhi, 110016, India, agrawalcharul09@gmail.com

Poly(ADP-ribose) polymerase (PARP) is a family of enzymes with 17 known members regulating post translational modification of proteins by attaching a single ADP ribose unit (MARylation) or a chain of ADP ribose (PARylation). In this study we have attempted to identify all proteins known to be modified by PARPs and the methods as well as drugs used in such studies. Our study aims to create the first ever tool for characterizing these modifications.

17 - Configuring Ecommerce Driven Supply Chains in the FMCG Sector

Stanley Lim, PhD Candidate, Cambridge University, Department of Engineering, 17 Charles Babbage Road, Cambridge, United Kingdom, wtsfl2@cam.ac.uk

Omnichannel has become the engine of growth in retailing. However, it remains unclear as to how distribution networks should be configured. This research will shed light through a framework development, and by drawing theories from supply chain configuration, resource based view, and transaction cost economics. Case study approach is adopted to identify the critical factors driving operational choices and seeks to elaborate the relationships between configuration, capability and performance.

18 - Benchmarking Construction and Improvement Heuristics for Classification using Markov Blankets

Daniel Gartner, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, dgartner@andrew.cmu.edu, Rema Padman

This study examines construction heuristics in connection with a tabu search-based improvement heuristic for classification in high dimensional data sets. Using the UCI machine learning data repository containing benchmark instances in e.g. health care, we evaluate computation times and information about the evolution of the Markov blanket graphical models in each phase of the heuristics. We compare the performance of the approaches using evaluation measures such as classification accuracy.

19 - A Sim-heuristic Algorithm for Robust Vehicle Routing Problems with Stochastic Demand

Abdulwahab Almutairi, Technology, 9 Horizon Building, Portsmouth, PO4 8EW, United Kingdom, abdulwahab.m.almutairi@gmail.com

We consider the VRPSD in which customers' demands are stochastic. We propose to model and solve the VRPSD by developing a robust optimisation model with a sim-heuristic solution method to minimise the cost while satisfying all demands. The method combines MCS with CWS in order to efficiently solve the VRPSD combinatorial optimisation problem. The results are generating very good quality solutions compared to those in the literature.

20 - Rocket Stage Optimization in Kerbal Space Program

Nathan Arrowsmith, Rochester Institute of Technology,
2800 Butternut Lane, Canandaigua, NY, 14424,
United States of America, nea4305@rit.edu

Kerbal Space Program is a space exploration simulation game. Players design, launch, and fly multi-stage rockets using a variety of parts. The performance of these vehicles is governed by a realistic physics engine. A model was developed which minimizes the total mass of each rocket stage by choosing motor and fuel tank combinations which accurately satisfy the Tsiolkovsky Rocket Equation. By iteratively solving this problem, the lowest mass or least expensive multi-stage rocket can be determined.

21 - Investigation of the Effect of Location, Built Environment and Urban Forms on Customer Satisfaction

Homa Atefyekta, Sharif University of Technology, No.14, 5th St.,
South Piruzan st, Tehran, 1466643479, Iran,
homa.atefyekta@gmail.com, Hamed Ahangari, Hoda Atef Yekta

In this study we examine the effect of location factors, urban forms, transportation accessibilities, and built environment on the customer satisfaction and business success in restaurant market. We investigated these relationships in two different geographical areas: the US and Iran by using Yelp and Fidelity data respectively. The results of this study could be helpful for urban policy makers to improve the urban livability and business entrepreneurs to enhance the odd of their success.

22 - What do Equity Hedge Funds Really do? Evidence in the QE Period

Geum Il Bae, KAIST, 291, Daehak-ro, Yuseong-gu, Daejeon,
Korea, Republic of, gi_bae@kaist.ac.kr, Sun Young Park,
Woo Chang Kim

We examine why the hedge fund industry has experienced a slump during the "Quantitative Easing (QE)" period. We analyze the risk-adjusted performances of equity hedge funds in the pre-crisis, crisis, and QE periods. We show that the disappeared alpha is the main reason for the inferior performance of hedge fund industry these days, and reduction in exposure to systematic risks further explains the underperformance of hedge funds in the QE period.

23 - NEOS Server: State-of-the-art Solvers for Numerical Optimization

Rosemary T. Berger, University of Wisconsin - Madison, 330 N.
Orchard St., Madison, WI, 53715, United States of America,
rosemary.t.berger@gmail.com, Michael Ferris, Jeff Linderoth

The NEOS Server is a free internet-based service for solving numerical optimization problems. Hosted by WID at the University of Wisconsin in Madison, the NEOS Server provides access to more than 60 state-of-the-art solvers in more than a dozen optimization categories. Solvers run on distributed high-performance machines enabled by the HTCondor software. We describe recent enhancements to the NEOS Server and highlight new interactive optimization cases studies available on the NEOS Guide.

24 - Provable Submodular Function Minimization via Wolfe's Algorithm

Deeparnab Chakrabarty, Dr, Microsoft, 9 Lavelle Road,
Bangalore, India, deeparnab@gmail.com

Submodular function minimization (SFM) is an essential paradigm which appears in many areas such as large scale learning and computer vision. The Fujishige-Wolfe Algorithm is agreed to be the fastest empirical SFM algorithm. Despite its good practical performance, very little is known about Wolfe's minimum norm algorithm theoretically. In this paper we give the first polynomial time convergence analysis of Fujishige-Wolfe's algorithm.

25 - Stochastic PDE-constrained Optimization of Vibrations of a Plate under a Piecewise-linear Current

Dmitry Chernikov, The University of Iowa, 1010 W Benton St.
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scher.de@gmail.com, Pavlo Krokhmal, Olesya Zhupanska

In this work a two-stage stochastic PDE-constrained optimization framework is applied to the problem of vibration control of a thin composite plate in the presence of electromagnetic field. The electric current is assumed to be of a piecewise-linear form. We compute the gradient of the objective function using adjoint numerical differentiation method. The value of the objective function is calculated by solving the governing PDEs, and a black-box approach is used for the minimization problem.

26 - Assessing Kernel-based Anomaly Detection Algorithms

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Sungzoon Cho

Anomaly detection is the process of finding items which do not comply with the normal pattern of the data set. Although kernel-based approaches seem to be promising for detecting anomalies, they have not been compared in a systematic way. In this study, we generated numerous well-calibrated benchmark data set and use them to evaluate the performance of various kernel-based anomaly detection algorithms. The effect of kernel parameters will also be empirically investigated.

27 - Simulation Analysis of Chaotic Storage Policies in Amazon Class Fulfillment Centers

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We evaluate storage policies in Amazon Class Fulfillment (ACF) Centers that primarily serve internet retail. In classical warehouses a SKU is stored in few fixed locations, no comingling, in bulk volumes and long interval supply. In a chaotic policy each SKU is stored in any location, comingled, closer to retail volumes and frequent supply. In an ACF fulfillment time is the primary objective. We use a simulator model to analyze and present the relative performance for given levels of workforce.

28 - Spatial-temporal Coverage Evaluation Methodology for Multi-satellite Embedded Sensors

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Diogo Maciel Almeida, Maria Jose Pinto

The intent of this research is to propose an optimized coverage model for satellite systems and support the decision-making process related to choosing the best satellites in a scenario of interest. The appropriate satellites are those whose sensors are able to visualize and identify targets. The decision model proposed trades off between temporal resolution and the coverage area extension, but also considers the cost to obtain the image and the resolution provided by the different sensors.

29 - Stochastic Optimization Methods for Nurse Staffing in Inpatient Settings

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In this study, we use Queueing Theory and discrete-event simulation techniques to determine nurse-staffing strategies that minimize staffing costs and ensure timely delivery of nursing care to patients while accounting for the heterogeneity in patients' acuity and staff skill levels.

30 - A Systems Dynamics Model for Flight Test Knowledge Management

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Coronel Av Jose A.A. Amarante, 01, Putim, Sao Jose dos Campos,
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The research investigated how Knowledge Management (KM), in a Brazilian Air Force (BAF) flight test environment can be represented via a Systems Dynamics Model. A documental research regarding the flight test environment KM was done and a questionnaire was submitted to identify KM characteristics.

31 - A Supply Chain Network Equilibrium Model with Carbon Capacity and Social Responsibility

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fufei1980@163.com, Lin Zhu, Xiangxiang Huang, Xiaogan Jiang

This paper investigates a three-tier supply chain network equilibrium problem. We first relate the decision makers' social responsibility with transaction decisions under the desired carbon capacity. Then we formulate the optimality of this problem as a monotone variational inequality. Next, we propose a self adaptive projection-based prediction—correction algorithm to solve the proposed model. Finally, we report the numerical results and give some analysis on the equilibrium solution.

32 - How to Catch a Black Swan

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Projects are increasingly complex. We use risk-based management to address complexity. Risk identification is the most important step in risk management because risks that are unidentified are implicitly assumed. Group dynamics such as silent dissent and group-think are weaknesses in team-based risk identification. The PreMortem technique makes it safe for the team to address risks that may otherwise go unidentified.

33 - Cost-effectiveness Analysis of Immunosuppression Therapy in Primary Deceased Donor Renal Transplantation

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Mehmet Ayvaci, Bekir Tanriover, Michael Hahsler

The primary cure for patients with end stage renal disease (ESRD) is kidney transplantation. In this study, we evaluate the cost-effectiveness of three common immunosuppressive induction therapies, alemtuzumab, thymoglobulin, and IL2RB as well as a no-induction strategy, from Medicare's perspective. Using non-parametric bootstrapping method, we calculate the incremental cost-effectiveness ratios for comparing the available strategies.

34 - The Effect of High Socioeconomic Inequalities on Public Education Efficiency

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A model is proposed to capture the full picture of educational efficiency in an emerging country. Because of regional discrepancies, the model uses variables related to education and to socioeconomic inequalities. The empirical results are based on data from 5,129 Brazilian municipalities and the correlation factor between the HDI-M and the educational efficiency score indicates that the HDI-M index could not capture the discrepancies of a country with high levels of socioeconomic inequality.

35 - Improving Scheduling and Control of the OHTC Controller in Wafer Fab AMHS Systems

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John Hasenbein

Automated Material Handling Systems (AMHS) in wafer fabs have complex requirements. Thus, a larger number of AMHS vehicles are now required to pick-up and transport these lots within the production facility. This has increased vehicular traffic jams and the wait time for lots requiring pick-up and delivery. Hence, to increase the system throughput, we present improved routing algorithms for the over hoist transport control (OHTC) system.

36 - An Adaptive Large Neighborhood Search Heuristic for the Inventory Routing Problem with Time Windows

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This research models an integrated distribution and inventory control problem (IRP) which is faced by a retail chain in the US. Currently, a direct shipping policy with time window constraints is used for replenishing stores. This paper develops an Adaptive Large Neighborhood Search Heuristic to determine the optimal timing and magnitudes of deliveries to stores. The optimal plan considers direct shipping policy as well as options combining deliveries for multiple stores into a single route.

37 - Forecasting-based Truck Wait Time Reduction at Logistic Nodes

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Truck wait times at logistic nodes such as container depots, packing facilities or terminals cause delays in transport chains and traffic congestion. Truck companies and nodes experience economical losses due to vehicle idle times and a lack of planning reliability regarding routes, personnel or machinery, respectively. In this work we present a flexible forecasting-based real world approach using artificial neural networks to predict both, the truck wait times and the arrival rates at the nodes.

38 - Impact of Overbooking in Appointment Scheduling of Primary Care Services

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No-shows and late cancellations not only reduce the providers' utilization, but also results in long waiting time for other patients. Overbooking has the potential to mitigate these negative impacts. However, excess overbooking may lead to even longer waiting times for patients and prolonged working days for the care team. We use a mathematical model to evaluate the benefit of overbooking and develop a scheduling policy that reduces patients' waiting time, and increase provider's utility.

39 - Research on Combination of Container Yard Allocation and Automatic Lifted Vehicle Path Optimization

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This paper brings in a new type of automatic transport machinery—automatic lifted vehicle which has the ability to lift container from the floor or put it down on the floor. Meanwhile, a mixed integer programming model is established to ensure that all the containers handled as far as possible in the time window. The model also considers the problem of allocating blocks to discharge containers and optimizing path of automatic lifted vehicle.

40 - Shipping Commodities Between a Container Terminal and Different Destination Zones using Heavy Trucks

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The cost model for shipping commodities by truck developed by Hussein M. (2010) is extended to consider the impact of tollway policies on truck route selection for shipping containers of specific commodity groups near a container terminal. A path-finding model is built for this purpose. The values of time were used to mimic the truck's choices to ship containers of different commodities

between a container terminal and different facilities.

41 - Network Motif Analysis for an Infrastructure System Against Vulnerability

Jing Jiang, PhD, Shanghai Jiao Tong University, Shanghai, China,
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A motif-based evolutionary perspective is provided for infrastructure network design. First, a multi-objective vulnerability-cost model is proposed to optimize network structure. Secondly, an evolutionary algorithm is developed. Thirdly, a network is tested by structure analysis, and motifs are traced during the evolutionary process. Finally, Western States Power Grid is analyzed. Results have revealed some principles in network design towards lower cascading vulnerability and construction cost.

42 - Patient Reaction to Healthcare Data Breaches

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Management, Nashville, TN, United States of America,
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We investigate consumer reaction to data breaches. Using a propensity score matching technique, we analyze a matched sample of U.S. hospitals. We investigate how breaches affect subsequent outpatient visits and admissions, accounting for geographically-based competition. We find that the cumulative effect of multiple breaches significantly decreases outpatient visits and admissions.

43 - Enhancing Distribution Performance through Improved Relationship Quality and Logistics Integration

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Prior research has argued that business relationship quality mediated by logistics integration has shown positively related to distribution service performance. Hence, firms attempt to achieve higher levels of logistics service and distribution service performance through logistics integration. This study examines relationship quality and logistics integration to understand how the two factors are linked to distribution service performance.

44 - Smart Logistics: Distributed Control of On-demand Green Transportation Services

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We develop a strategic decision-making framework for on-demand delivery services, considering both operational and environmental performance explained by Just-In-Time delivery service, fuel consumption, and carbon emissions. The optimal policies based on the Markov decision process are established to make admission plans of delivery requests, and an integrated dynamic algorithm for admission control and route scheduling is developed.

45 - Extreme-point Search Heuristics For Interval-flow Generalized Network Problems

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Interval-flow generalized networks are a new extension of the classic generalized network formulation that adds a conditional lower bound constraint on the arcs. An interval-pivoting heuristic that exploits the quasi-tree-forest basis structure to explore extreme points is developed and computational testing is presented.

46 - Hedge Fund Leverage Choice under Time-inconsistent Preference

Bo Liu, University of Electronic Science and Technology of China,
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We show that time inconsistency preference discourages the manager from underinvesting because of the high liquidation risk. The payment of incentive fees may induce the irrational manager to be more aggressive and to overinvest. The naive manager is more conservative than the sophisticated manager and prefers a lower leverage level in normal times. Interestingly, investors are not sensitive to the manager's irrational investment behavior.

47 - New Assay Implementation Planning at Clinical Laboratory

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wliu8@mdanderson.org, Cindy Lewing, Bedia Barkoh,
Pramod Mehta, Mark Routbort, Humin Lu, Justin Villarreal,
Raja Luthra, Keyur Pravincha Patel, Geeta S Mantha,
Mylene Bole, Haobo Yang, David Garcia, Zou Zhuang

Implementation of a new complex laboratory assay at our high-volume and high-complexity clinical Molecular Diagnostics Laboratory was facilitated by application of multiple engineering approaches including workflow assessment, historical volume-based demand prediction, IT solution, and resource allocation. The new assay implementation is expected to be successful with minimal workflow interruptions, no patient care interruptions, low implementation cost and optimal resource utilization.

48 - Big Data Analytics for Singapore Public Train System

Nang Laik Ma, Senior Lecturer, SIM University, 461 Clementi Road, Singapore, 599491, Singapore, nlma@unisim.edu.sg, Beng Yee Wong

This paper focus on capacity planning of the Singapore public transport system. We analyse the commuters' travelling patterns from historical transactions data. Secondly, by simulating train schedule and capacity constraints, the model mimicked the real-world situations to generate the waiting time for each commuter. Finally, a web-based visualization tool is created to provide the average waiting time for the next train at the station to enhance the commuter's experience.

49 - Hospital Residents Problem: A Survey Including a New Variant

Kaitlyn Manley, College of Charleston, 66 George St, Charleston, SC, 29424, United States of America, manleykm@g.cofc.edu, Tyler Perini, Amy Langville

We survey several variations of the Stable Matching Problem, including the Hospital Residents Problem used to assign American medical residents to hospitals. We also present a new variation of the stable matching problem that uses an binary integer linear program to determine the minimum number of interviews that hospitals should conduct in order to still maximize the number of residents assigned.

50 - Exploring the Multi-objective Portfolio Tradespace

Simon Miller, Graduate Student, Penn State Applied Research Lab, P.O. Box 30, State College, PA, 16804, United States of America, ses224@arl.psu.edu, Gary Stump, Sara Lego, Michael Yukish

Faced with strategic choices, senior decision makers must often make trades to meet competing requirements. In collaboration with the U.S. Army, ARL has developed tools and methods to treat large scale, multi-objective optimization problems for binary portfolios with dynamic constraints. Methodology and implementation schema for real-world cases are presented, highlighting the ability to balance a combinatorial explosion of parameters in complex trades spaces with the need for timely decisions.

51 - Experimental Designs for Metal Detectors at Large Venues

Christie Nelson, Rutgers University, CCICADA, 4th Floor, CoRE building, 96 Frelinghuysen Rd, Piscataway, NJ, 08854, United States of America, christie.l.nelson.phd@gmail.com, Paul Kantor, John Edman, Vijay Chaudhary

Walk-through metal detectors (WTMDs) are being used increasingly more as a security measure at large events, particularly at stadiums. Currently, WTMDs are tested using a robotic tester which tests metallic objects at level heights by sending them straight through at a constant speed. However, this is not a proper representation of how a person would enter the WTMD. We will show that the way a person walks through the WTMD impacts detection rate through our experimental results.

52 - Leading Metrics for Progress Measurement and Performance Assessment in Construction Projects

Resulali Orgut, Graduate Research Assistant, North Carolina State University, Dept. of Civil, Cons. and Env. Eng., 2510 Stinson Dr., 222 Mann Hall, Raleigh, NC, 27695, United States of America, reorgut@ncsu.edu, Jin Zhu, Mostafa Batouli, Ali Mostafavi, Edward Jaselskis

Progress measurement and performance assessment are critical to the management of construction projects. We perform statistical analyses to highlight key indicators for successful construction project controls by using data collected through an online survey from 27 companies. We analyze core metrics commonly used in the construction industry to develop guidelines for improving their reliability and recommend practices for interpreting metrics and indicators.

53 - Toward Consistent and Efficient Anomaly Detection in Hyperspectral Imagery

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This research will showcase development of an approach to making an unsupervised anomaly detector for Hyperspectral Imagery (HSI). The algorithm is developed to be robust to different image scenes, different sensors, and noisy spectral bands. Specifically, fusion of spectral, spatial, and Signal-to-Noise information is used, in combination with a factor analysis approach, to identify anomalies. The algorithm is shown to be desirable when compared to current state-of-the-art techniques.

54 - Comprehensive Performance Evaluation of High-gravity Carbonation Process in the Steelmaking Industry

Shu-Yuan Pan, National Taiwan University, No 71 Chou-Shan Rd., Taipei, 10673, Taiwan - ROC, d00541004@ntu.edu.tw, Pen-chi Chiang

An integrated portfolio of multi-waste treatment (steelmaking slag and wastewater) combined with CO₂ capture in the steelmaking industry can be achieved by the high-gravity carbonation (i.e., HiGCarb) process using a rotating packed bed (RPB). In this study, the HiGCarb process was comprehensively

evaluated according to engineering, environmental, and economic (3E) criteria using a cradle-to-gate life-cycle approach.

55 - Analysis on the Effect of Energy Efficient Technologies in Industry Sector using Times Model

Sang Yong Park, Senior Researcher, Korea Institute of Energy Research, Yuseong-gu, Gajeong-ro 152, Daejeon, 305-343, Korea, Republic of, gspeed@kier.re.kr, Jong Chul Hong, Nyunbae Park, Boyeong Yun

The South Korea established energy policy which is focusing demand management rather than energy supply to secure a stable energy supply and to cope with climate change efficiently through 2nd national energy basic plan in 2014. This research developed energy system model which can analyze the effect of energy efficient technologies on demand management based on TIMES(The Integrated MARKAL-EFOM System) model and conducted case study on industry sector in Korea.

56 - The Humility Project: NMF and Other Matrix Factorizations for Textual Analysis

Tyler Perini, Student, College of Charleston, 66 George St, Charleston, SC, 29424, United States of America, perinita@g.cofc.edu, Amy Langville

This is one of the first studies on the use of matrix decompositions as the primary engine for describing and predicting psychological characteristics in a corpus of language data. With text parsing tools, large written samples are parsed into a sparse matrix. A low-rank matrix factorization of a weighted version of this matrix is then used to determine which documents are humble and which are not humble. Three factorizations, the SVD, NMF, and weighted NMF, are compared.

57 - Distributed Online Modified Greedy Algorithm for Networked Storage Operation under Uncertainty

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The optimal control of energy storage networks in stochastic environments is an important open problem. This paper provides an efficient algorithm to solve this problem with performance guarantees. A sub-optimality bound for the algorithm is derived which can be minimized by solving a semidefinite program. Distributed implementation is derived based on alternating method of multipliers. Numerical examples verify our theoretical performance bounds and demonstrate the scalability of the algorithm.

58 - Should Retailers Adopt 3d Printing?

Sharareh Rajaei Dehkordi, PhD Candidate, New Jersey Institute of Technology, University Heights, Newark, NJ, 07102, United States of America, sr552@njit.edu, Wenbo Cai

Should retailers provide 3D printing services in addition to the traditional off-the-shelf product? We answer the question by examining retailers' optimal joint decisions on his inventory management policy and pricing scheme while considering consumers' heterogeneous preferences for self-designed, 3D printed products vs. off-the-shelf products. We use a multi-server queue with limited capacity to capture customers' production selection process and its impact on the retailer's expected profit.

59 - Stochastic Network Design with Decision-dependent Uncertainties

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Little research has been conducted on stochastic network design problems in which the probability distribution of future random events is affected by prior actions. However, such problems are ubiquitous and important. For example, planned reinforcements of a power network directly influence which nodes are more likely to fail. We present a stochastic two-stage programming model with decision-dependent uncertainties, discussing solution methods for the associated unique computational challenges.

60 - Scheduling Part-time Employees with Interactive Optimization

Robert Rose, President, Optimal Decisions LLC, 4 Kirby Lane, Franklin Park, NJ, 08823, United States of America, robertl.rose@verizon.net

Many employee scheduling problems are very challenging: they are hard combinatorial optimization problems that contain multiple objectives and 'soft' constraints. Such problems do not lend themselves to a pure optimization approach. A 'Human Centered' approach, will be described: an initial schedule is generated analytically through a series of heuristic procedures, and a final schedule is produced using an interactive graphics module. A prototype scheduling program will be demonstrated.

61 - Fast, Provable Algorithms for Isotonic Regression in All Lp-norms (to Appear At NIPS 2015)

Sushant Sachdeva, Postdoctoral Associate, Yale University, Yale Institute of Network Sciences, P O Box 208263, New Haven, CT, 06520, United States of America, sachdevasushant@gmail.com, Rasmus Kyng, Anup Rao

Given a directed acyclic graph G , and values y on the vertices, the Isotonic Regression of y is a vector x that respects the partial ordering given by G , and minimizes $\|x - y\|_p$, for a given norm. We present improved algorithms for Isotonic Regression for all weighted L_p norms, with rigorous performance guarantees. Our algorithms combine interior point methods with provable fast solvers for the associated linear systems. The algorithms are practical and lend themselves to fast implementations.

62 - Mathematical Modelling and Analysis of New Zealand Legislation Network

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In 2015 the concept of Legislation Network is proposed as a mathematical tool for studying the current and future status of the legislation system in European Union. Unlike perhaps the relations between documents are at least as important as the content. This type of network has some novel features which make it an excellent test case for new network science tools.

63 - Deadhead Selection Strategies for Crew Recovery

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Crew recovery is the problem of minimizing the impact of a disruption to an airline by getting disrupted crews back on plan while minimizing incurred costs. Deadheads are flights that transport crew members as passengers and are a critical part of crew recovery. Consideration of all available deadheads to recovery makes problem sizes prohibitive. We present a few deadhead selection strategies that significantly improve solution quality without impacting run-time for real-world scenarios.

64 - Talk is Cheap - Action is Expensive

Simone Schmid, University of Chemnitz, Huebschmannstrasse 24, Chemnitz, 09112, Germany, simone.schmid@wirtschaft.tu-chemnitz.de, Peter Pawlowsky

Adequate response to uncertain and unpredictable environmental changes requires innovative, agile, and adaptive team competencies. We use an interdisciplinary approach to assess and evaluate team competencies. From theory and previous research we derive indicators and test these by training teams accordingly. Experimental groups were given theoretical and practical trainings with regard to these team competencies. Control groups acted as usual. A succeeding standardized simulation in a high fidelity simulation environment showed significant effects with regard to team performance. From these results we propose behavioral markers for team competencies that can be used to assess team performance in critical situations.

65 - Euro/Roadef Challenge

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The French OR Society (ROADEF) along with EURO, periodically organizes an OR challenge dedicated to industrial applications. This year, Air Liquide proposes the challenge problem concerning an IRP for the bulk distribution of liquefied gases. The challenge is open to everyone and will be presented during the EURO 2015 in Glasgow, Scotland in July 2015 and the results will be announced at EURO 2016 in Poznan, Poland. Prizes totaling 20,000 Euros will be awarded to the best teams.

66 - Usability Evaluation of a Mobile App to Reduce Congestive Heart Failure (CHF) Readmissions

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Congestive Heart Failure (CHF) is a major chronic condition affecting more than 5 million people in the US. CHF readmissions is one of the major contributors to the burgeoning healthcare cost. In our study, we evaluate factors associated with the usability and acceptability of a mobile application intended to reduce CHF readmissions. A fixed protocol was developed which included Think Aloud Protocol, Quiz and a Questionnaire. Qualitative and quantitative analyses were performed.

67 - An Optimization Approach to Warehouse Line Striping

Sudharshana Srinivasan, Research Scientist, Altria Client Services, 601 E. Jackson St., Richmond, VA, 23219, United States of America, sudharshana.srinivasan@altria.com, David Kane

We present a mixed-integer programming model to optimize product storage at an industrial warehouse, while adhering to safety standards stipulated by the county and the business. The model is applied to a tobacco warehouse and the results provide a storage solution comparable to current practice with an improved operational efficiency. The model recommends more walking aisles to facilitate increased spacing and airflow around the product; both of which are valued business objectives.

68 - Testing the Applicability of Genetic Algorithms for Simulation-based Healthcare Optimization

Cory Stasko, MIT, 4 Garden Court, Apt. #4, Cambridge, MA, 02138, United States of America, cstasko@mit.edu

We apply genetic algorithms to three distinct cases of highly non-linear healthcare optimization problems. In the first problem, OR schedules are designed to minimize downstream bottlenecks. The second problem involves network management for an accountable care organization. The third problem involves promoting the spread of ideas among connected professionals. In each case, the objective (fitness) function is the output of a simulation, and a brute force solution search is not feasible.

69 - How Do We Capture the Potential Risk of Intravenous Drug Infusion using Alert Data?

Wan-ting Su, Graduate Student, Purdue University, 3376 Peppermill Drive, West Lafayette, IN, 47906, United States of America, su333@purdue.edu, Poching Delaurentis, Mark Lehto

The use of smart infusion pumps is one such mechanism in ensuring the safety of medication infusions in clinical settings. We aim to utilize the data of different alert types from the Infusion Pump Informatics system to capture averted or potential medication errors and define and determine the overall risk of potential harm within a certain period of time in a medical facility. Our analysis can be used as a measure in improving intravenous medication safety and infusion drug-delivery process.

70 - Developing Freeway Demand Estimation Alternatives with Mixed Integer Linear Programming

Joseph Trask, North Carolina State University, 909 Capability Drive, Raleigh, NC, United States of America, jltrask@ncsu.edu, Behzad Aghdashi, John Baugh, Nagui Roupail

This research presents a Mixed Integer Linear Programming optimization model for traffic demand estimation based on the methodology developed in the Highway Capacity Manual (HCM). Due to a lack of uniqueness for solution demand sets, a Modeling to Generate Alternatives (MGA) approach is developed to investigate the wide ranges of optimal solution sets. These solution sets can be compared through their effects on intermediate performance measures and sensitivity analysis.

71 - Batch Testing of a Series System

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We consider the problem of determining the correct value of an AND function when it is costly to learn the values of its variables, with the minimum expected cost. We refer to a subset of variables whose values can be learnt at the same time a meta-test. The cost of learning the values of the variables in a meta-test includes a fixed cost plus the costs of the tests in the meta-test.

72 - Shape-preserving L1 Spline Fits: Calculation and Capability

Ziteng Wang, Department of Industrial and Systems Engineering, North Carolina State University, 3120 Walnut Creek Parkway, Apt. E, Raleigh, NC, 27606, United States of America, zwang23@ncsu.edu, Tiantian Nie, Shu-chen Fang

L1 spline fits have been developed over the past decades to approximate multi-scale data and have been shown to preserve shapes well. Local approaches are designed for efficient calculation. Quantitative measures are proposed to evaluate the shape-preserving capability of different types of L1 spline fits.

73 - Evolutionary Optimization Tools of Nanostructures for Solar Cells

Baomin Wang, University of Pittsburgh, 1048 Benedum Hall 3700 O'Hara Street, Pittsburgh, PA, 15261, United States of America, baw57@pitt.edu

Simulation plays a significant role in optimizing solar cell efficiency. Current used optimization is exhaust search, only feasible for small group of parameters, 3 or 4. But for 7 or 8, it takes months. In this work, we integrate genetic algorithm with FDTD methods to optimize the nanostructure. This evolutionary method can decrease the simulation time to 1/6 of original time. This work demonstrates the ability of genetic algorithm technique to quickly search through a large parameter space.

74 - Surgical Operations Scheduling with Machine Eligibility and Resource Constraint

Shan Wang, Shanghai Jiaotong University, 704 West 180th Street, First Floor, #4, New York City, NY, 10033, United States of America, wangshan_731@sjtu.edu.cn, Guohua Wan, Huiqiao Su

We study a problem in surgical operations scheduling and model it as a resource-constrained machine scheduling problem with eligibility restriction to minimize the makespan. By decomposing it into two subproblems, we develop effective heuristic algorithms to solve the problem. We test the proposed algorithms on randomly generated instances as well as real data set from a large hospital. The numerical results show the effectiveness and potential practical value of the models and the algorithms.

75 - Optimizing System-Level Preventative Maintenance Cost of Multistate Series-Parallel Systems

Sallamar Worrell, The George Washington University, 3117 Icehouse Place, Bryans Road, MD, 20616, United States of America, skaw7@gwu.edu, James Moreland Jr., Steve Doskey

Maintenance costs for complex systems are often overpaid due to the lack of maintenance harmony between the individual subsystems. The research in this study proposes the use of a new meta-heuristic optimization method, the Grey Wolf Optimizer algorithm developed by Mirjalili and Lewis, to identify the optimal system-level maintenance strategy for multistate series-parallel systems and aims to produce better results than the methods previously applied to this problem in published literature.

76 - Predicting Digital Currency Price from Social and Traditional Media

Peng Xie, Georgia Institute of Technology, Room 907, 100 10th Street, Atlanta, GA, 30309, United States of America, peng.xie@scheller.gatech.edu

Using daily Bitcoin price data and Bitcoin Forum discussion, we try to understand if social media can affect Bitcoin price and how long does it take. We use the percentage of negative words as the measure of the article sentiment. The results show that social media can affect price. However, for information sources focusing on speculation, the effects on prices are immediate. In contrast, information concerning fundamentals impacts prices in a longer holding period.

77 - The Dimensions of Supervision-subordinate Relationship

Liuqing Yang, Xi'an Jiaotong University, No.28, Xianning West Road, Xi'an, China, yqlq2011@stu.xjtu.edu.cn, Qiaozhuan Liang

Subordinate can form distinguishable social exchange relationships with their immediate supervisor. The exchange resources differ between organizational and personal. Based on the taxonomy, social exchange relationship can development a construct of four dimensions: work, flatter, private, selfless. Various dimension have different impact on performance as a mediator or intervening variable. The construct can explain the puzzle of relationship between social exchange relationship and performance.

78 - Counterfeits, Anti-counterfeit Technology and Monitoring Strategy

Shiqing Yao, The Chinese University of Hong Kong, 9/F, Cheng Yu Tung Building, No.12 Chak Cheung Street, Shatin, N.T., Hong Kong, Hong Kong - PRC, sqyaochuk@gmail.com, Kaijie Zhu

We consider an authentic company that sells its products to a customer market. In the same market, a counterfeiter may sell its low-quality counterfeits. The authentic company can put effort into developing an anti-counterfeit technology to distinguish its products from counterfeits while the authority can monitor the market and outlaw counterfeiting localities. We derive the company's optimal decision on its anti-counterfeit effort and highlight its difference from conventional wisdom.

79 - Optimization of Area Traffic Control: A Binary Mixed Integer Linear Programming Approach

Zhao Zhang, Research Assistant, Tsinghua University, Room 615, Shunde Building, Haidian District, Beijing, 100084, China, zzaxx@tsinghua.edu.cn

This paper proposes a model aims at optimizing area traffic control. We use network total delay as the objective in the model. In this research, cell transmission model is used to discretize research time into many intervals and signal coordination, lane settings, phase, start of green and green split can be optimized simultaneously. The model is linear in nature and can be solved by standard branch and bound algorithm.

80 - Identify Naturally Occurring Healthcare Provider Referral Networks for Diabetic Patients

Yuchen Zheng, PhD Student, Georgia Institute of Technology, Atlanta, GA, 30032, United States of America, richardzyc@gatech.edu, Kun Lin, Jeremy Pickreign, Thomas White, Gigi Yuen

The pioneer Accountable Care Organizations (ACOs), where doctors voluntarily form groups to deliver coordinated quality care, saved Medicare \$400 million in two years. To improve ACOs design, we utilize past care patterns and adopt modularity maximization to detect pre-existing referral networks for diabetic patients, within which doctors share patients frequently. We further identify the

driving forces of the underlying community structures and understand the relation to cost and utilization.

81 - Real-time Heat Exchanger Efficiency Monitoring

Yousif Abualsoud, Saudi Aramco, Al-Midra, Dhahran, Saudi Arabia, yousif.abualsoud@aramco.com

Saudi Aramco Engineering Services developed a systematic model to calculate shell and tube heat exchangers efficiency in real time using data analytics technique. Monitoring the heat exchanger efficiency in real time supports the decisions making to plan for turnaround time by detecting the failure time proactively. Moreover, it provides the field engineers continuous monitoring to energy consumer and highlights the wasted energy locations, quantity and cost.

82 - A Decision-analytic Approach to Inferring Preference from Choice Behavior

Matthew D. Wood, Research Psychologist, US Army Engineer Research & Development Center, Concord, MA, United States of America, Matthew.D.Wood@usace.army.mil, Matthew Bates, Danielle M. Beeler, Jeffrey M. Keisler

Decision making in resource management requires consideration of multiple conflicting objectives. Traditional elicitation methods (e.g., swing weighting) work well with clearly defined problem spaces and effects between decisions and consequences. In more complex domains, an inferential approach is needed to estimate preference using system feedback over samples with subject-matter experts. We describe a decision analysis game with an environmental case study problem.

83 - Artificial Variability and Case Mix in Relation to Patient Flow at a Hospital Outpatient Clinic

Monique Bakker, City University of Hong Kong, Hong Kong, 999077, Hong Kong-PRC, moniquebakker121@gmail.com

We aim to improve the patient flow through first, second, and nth visits to a specialist outpatient clinic and elective surgery. We investigate variability in key resource availability (i.e. the specialists) in relation to case mix decisions, sub-specialization restrictions, and resource allocation: how is indirect wait time (or access time). We use Discrete Event Simulation to schedule patients under a broad and realistic set of rules and restrictions to compare alternate scenarios.

Tuesday, 1:30pm - 3:00pm**TC01**

01-Room 301, Marriott

Logistics and Operations Research

Sponsor: Military Applications

Sponsored Session

Chair: Andrew Hall, COL, U.S. Army, 4760 40th St N, Arlington, Va, United States of America, AndrewOscarH@aol.com

1 - Scheduling the Transition of the C-130 Aircraft Fleet to a New Maintenance Process

Melissa Bowers, mrbowers@utk.edu, Bogdan Bichescu, Kenneth Gilbert, Anurag Agarwal, Doug Keene

The US Air Force is tasked to increase aircraft availability through a new initiative, the High Velocity Maintenance program, which seeks to increase availability of aircraft to the US military through a reduction in the time an aircraft spends on the ground undergoing planned maintenance. The transition of a fleet of aircraft from the standard process to shorter HVM cycles is a complex task that requires careful planning. A mixed-integer programming approach is used to generate a schedule which maintains a constant annual workload and yields lower flow times and work-in-process levels.

2 - Learning and Bayesian Updating in Made-to-order (MTO) Production

Keith Womer, Professor, University of Missouri - St. Louis, One University Blvd, St. Louis, MO, 63121, United States of America, womerk@umsl.edu, Jeffrey Camm, Haitao Li, Colin Osterman, Rajesh Radhakrishnan

The case of production planning for made-to-order (MTO) manufacturing. We minimize expected discounted cost by controlling production rate. A dynamic and adaptive approach to estimate the effects of learning and to optimize next period production is developed. This approach offers a closed-loop solution through stochastic dynamic programming. The approach is illustrated using data from the Black Hawk Helicopter Program.

3 - Retail Inventory Optimization for the U.S. Navy

Javier Salmeron, Naval Postgraduate School, Operations Research Dept., GL-214, Monterey, CA, 93943, United States of America, jsalmero@nps.edu, Emily Craparo

We present a mixed-integer linear model to guide retail (site-based demand level) inventory decisions for the Naval Supply Systems Command (NAVSUP), Weapons Systems Support. An (s,Q) model optimizes reorder points and order quantities for thousands of items in order to minimize deviations from target fill rates, with demand uncertainty, budget and order quantity constraints. We compare branch-and-bound with Lagrangian relaxation solutions, and our results with those from other NAVSUP tools.

TC02

02-Room 302, Marriott

Network Applications in Homeland Security

Cluster: Homeland Security

Invited Session

Chair: Thomas Sharkey, Rensselaer Polytechnic Institute, 110 8th Street, Troy, NY, 12180, United States of America, sharkt@rpi.edu

1 - Novel Bilevel Programming Approaches for Interdicting Multi-tiered Illegal Supply Chains

N. Orkun Baycik, Rensselaer Polytechnic Institute, 110 8th Street, Center for Industrial Innovation, Troy, NY, 12180, United States of America, baycin@rpi.edu, Thomas Sharkey, Chase Rainwater

We study a resource allocation problem faced by law enforcement in arresting criminals in the drug flow and information flow networks. The objective of law enforcement is to minimize the maximum amount of drugs reaching end users. There exist interdependencies between the networks which leads to a network interdiction problem with a discrete inner problem. We apply a novel dual-based reformulation technique to solve an equivalent single-level problem and present computational results.

2 - Bi-level Stochastic Network Interdiction Model for Deployment of Cyber-security Countermeasures

Apurba Nandi, Mississippi State University, P.O. Box 9542, Mississippi State University, Mississippi State, MS, 39762, United States of America, akn77@msstate.edu, Hugh Medal

We study how best to deploy cyber-security countermeasures to protect a cyber-network against attacks. We propose a bi-level stochastic network interdiction model capturing the interaction between the attacker and the defender as a sequential stackelberg game played on an attack graph. We consider that the attacker's knowledge about the topology of the attack graph, and the attacker's and the defender's knowledge about each other's actions are uncertain. We develop algorithm to solve the model.

3 - Vitality Measures for Multigraphs with Applications to Communications Networks

Sarah Nurre, Assistant Professor, Air Force Institute of Technology, 2950 Hobson Way, WPAFB, OH, 45433, United States of America, Sarah.Nurre@afit.edu, Christopher Hergenreter

We consider the problem of determining the most vital arcs to protect within a multigraph, such as a communications network. Traditional vitality measures are insufficient as they often examine single arc failures which have no impact on multigraphs due to parallel arcs between pairs of nodes. Herein, we propose and examine set based vitality measures for multigraphs. We perform and present the results of promising computational results multi-mode military communications networks.

4 - Efficient Resilience Optimization of Interdependent Networks

Andres Gonzalez, Rice University, 6100 Main Street, MS-318, Ryon 203, Houston, TX, 77005, United States of America, andres.gonzalez@rice.edu, Leonardo Dueñas-osorio, Andres Medaglia, Mauricio Sánchez-silva

MIP models of the Interdependent Network Design Problem (INDP) have proved to be effective tools to study and improve the resilience of systems of interdependent infrastructure networks. Nevertheless, these MIP models have limited scalability for large realistic systems. In this work, we present an enhanced methodology to optimize the resilience of interdependent networks, based on the joint use of decomposition techniques and efficient reformulations of the INDP models.

TC03

03-Room 303, Marriott

Inventory Management I

Contributed Session

Chair: Jun-yeon Lee, California State University, Northridge, 18111 Nordhoff St, Northridge, CA, 91330-8378, United States of America, junyeon.lee@csun.edu

1 - Forecasting of Demand Tail Distribution for Inventory Optimization

Antony Joseph, Staff Data Scientist, Walmart Labs, 1001 National Avenue, Apt. 107, San Bruno, CA, 94066, United States of America, AJoseph0@walmartlabs.com

We discuss a novel technique for forecasting demand tail distribution for items in the Walmart e-commerce inventory. The methodology first estimates the quantiles of the demand distribution, followed by fitting a parametric distribution using a suitable metric. The method is seen to be robust to high observed variability in demand. Performance of the proposed approach is assessed using Supply Chain metrics such as Weeks of Supply and Met Demand.

2 - Strategic Safety Stocks under Guaranteed Service and Constrained Service Models

Ton De Kok, TU Eindhoven, Paviljoen E.04, P.O. Box 513, Eindhoven, Netherlands, a.g.d.kok@tue.nl

In this presentation we discuss our findings on a set of real-life supply chains concerning the positioning of safety stocks in the supply chain. We compare the results from models under the guaranteed service assumption and under the constrained service assumption. The latter assumption follows the classical Clark and Scarf model for serial multi-echelon systems. Furthermore, we discuss some implications of the guaranteed service assumption in case of a bounded demand formulation.

3 - Scarcity Effect on Dual-channel Supply Chain

Baoshan Liu, PhD Student, Huazhong University of Science and Technology, School of Management, 1037 Luoyu Road, Wuhan, China, liubaooshan@qq.com, Shihua Ma

We consider manufacturer's dual-channel sale system where customers get the product the direct channel with limited quantity. The limited quantity of the direct channel releases a scarcity message that consumers will increase their purchasing desire. Both the manufacturer and the retailer choose their own decision variable to maximize their respective profits considering scarcity effect. We model the problem using Stackelberg games and try to find the best solution from different perspectives.

4 - An Optimal Inventory Replenishment Considering Product Life Cycle

Shunichi Ohmori, Assistant Professor, Waseda University, Room 51-15-05, Okubo 3-4-1, Shinjuku, Tokyo, 169-8555, Japan, ohmori0406@gmail.com, Kazuho Yoshimoto

We consider a problem of determining initial and replenishment order quantities that minimize the cost of lost sales, inventory holding cost, fixed ordering cost, and obsolete inventory subject to stochastic demands. We model this problem as a multi-stage problem where the demands and prices of products lie in some uncertainty set depending on their life cycle. We develop a dynamic programming method to solve this problem.

5 - Vendor-managed Inventory with a Time-dependent Stockout Penalty

Jun-yeon Lee, California State University, Northridge, CA, 18111 Nordhoff St, Northridge, CA, 91330-8378, United States of America, junyeon.lee@csun.edu

We examine the problem of designing a vendor-managed inventory (VMI) contract with a time-dependent stockout penalty in a stochastic (Q, r) inventory system, in which the supplier is charged a stockout penalty that depends on the length of the time during which stockouts occur at the customer. The customer chooses the stockout penalty and offers the VMI contract to the supplier, and the supplier can accept or reject the contract. We examine the optimal behaviors of the two parties.

■ TC04

04-Room 304, Marriott

Social Media Analytics Best Papers Finalist Competition

Cluster: Social Media Analytics

Invited Session

Chair: Theodore Allen, Associate Professor, The Ohio State University, 1971 Neil Avenue, 210 Baker Systems, Columbus, OH, 43221, United States of America, allen.515@osu.edu

1 - Social Media Analytics: The Effectiveness of Marketing Strategies in Online Social Media

Vilma Todri, PhD Candidate In Information Systems, NYU, 44 W 4th St, KMC Room 8-181, New York, NY, 10012, United States of America, vtodri@stern.nyu.edu, Panagiotis Adamopoulos

This paper studies a novel social media venture and seeks to understand the effectiveness of marketing strategies in social media platforms by evaluating their impact on participating brands. We use a real-world data set and employ a promising research approach combining econometric with predictive modeling techniques.

2 - Predicting Crowd Behavior with Big Public Data

Nathan Kallus, MIT, 77 Massachusetts Ave., E40-149, Cambridge, MA, 02139, United States of America, kallus@mit.edu

We present efforts to predict the occurrence, specific timeframe, and location of crowd actions before they occur based on public data collected from over 300,000 open content web sources in 7 languages, from all over the world, ranging from mainstream news to government publications to blogs and social media.

3 - Participation vs. Effectiveness of Paid Endorsers in Social Advertising Campaigns: A Field Experiment

Jing Peng, The Wharton School, University of Pennsylvania, 3730 Walnut Street Suite 500, Philadelphia, PA, 19104, United States of America, jingpeng@wharton.upenn.edu, Christophe Van den Bulte

We investigate the participation and effectiveness of paid endorsers in viral-for-hire social advertising. Specifically, we investigate (i) how financial incentives affect potential endorsers' participation and effectiveness in generating online engagements (likes, comments, and retweets), and (ii) which network characteristics and prior engagement characteristics are associated with participation and effectiveness. We conduct a large scale field experiment with an invitation design in which we manipulate both financial incentives and the soft eligibility requirement to participate in the campaign. The latter provides a strong and valid instrument to separate participation from outcomes effects. Since likes, comments, and retweets are count variables, and since potential endorsers can self-select to participate in multiple campaigns we ran, we use a Poisson lognormal model with sample selection and correlated random effects to analyze variations in participation and effectiveness. There are three main findings. (1) Financial incentive did not affect either participation or effectiveness. (2) Potential endorsers more likely to participate are often less effective. (3) Which characteristics are associated with effectiveness depends on whether success is measured in likes, comments, or retweets. Our findings provide new insights on how marketers can improve social advertising campaigns by better targeting and incenting potential endorsers.

4 - A Visual Monitoring Technique Based on Importance Score and Twitter Feeds

Zhenhuan Sui, Graduate Research Assistant, The Ohio State University, 2501 Gardenia Drive, Columbus, Oh, 43235, United States of America, sui.19@osu.edu, David Milam, Theodore Allen

We propose a visual monitoring technique based on topic models, a point system, and Twitter feeds for monitoring. The method generates a chart showing the important and trending topics that are discussed over a given time period which is illustrate the methodology using cyber-security cases.

■ TC05

05-Room 305, Marriott

Social Media Impact

Cluster: Social Media Analytics

Invited Session

Chair: Les Servi, The MITRE Corporation, 202 Burlington Road, Bedford, MA, United States of America, lservi@mitre.org

1 - Big Data Means Big PR: A Review of News Coverage of Big Data in the Popular Press

Amir Gandomi, Assistant Professor, Ryerson University, 350 Victoria Street, Toronto, ON, M5B 2K3, Canada, agandomi@ryerson.ca, Murtaza Haider

In this paper, we undertake a content analysis of the news feed regarding big data analytics. We develop a corpus of related news items. We code the corpus and prepare it for analysis by the Natural Language Processing (NLP) algorithms. Our purpose is to conduct a systematic analysis of the news contents to determine the primary themes being projected by the proponents of big data. We will explore ways to identify real value content that may help to draw meaningful inferences.

2 - Modeling Message Dissemination in Social Media for Emergency Communication

Justin Yates, Professor, Francis Marion University, 4822 E Palmetto St, Florence, SC, United States of America, jyates@fmarion.edu, Xin Ma

We introduce the Single-network Multi-message Social Media Message Dissemination Problem (SM-SMMDP) as a discrete optimization model to examine message dissemination in social media and to explore message dissemination strategies for government and non-government emergency management agencies. We implement a detailed computational experiment on representative small-scale networks and discuss implications for real-world application.

3 - Analyzing and Predicting Threatening Language in #gamergate Tweets

Cheyenne Baird, Senior Linguistic Specialist, SAS Institute Inc., Boston Regional Office, Prudential Tower, 800 Boylston St., Suite 2200, Boston, MA, 02199, United States of America, Cheyenne.Baird@sas.com, Michael Wallis, Praveen Lakkaraju

Aggressive language in online communities can thrive, escalate, and signal palpable threat. This is apparent in #gamergate tweets. Using SAS Text Analytics, we will show how language transitions from negative sentiment to threatening language in #gamergate tweets, building a model to predict probable threat in social media.

■ TC06

06-Room 306, Marriott

Dynamics and Information in Commodity Markets

Sponsor: Financial Services

Sponsored Session

Chair: Richard Sowers, Professor, University of Illinois at Urbana-Champaign, Urbana, IL, 61801, United States of America, r-sowers@illinois.edu

1 - Model Uncertainty in Commodity Markets

Sebastian Jaimungal, University of Toronto, Department of Statistical Sciences, Toronto, Canada, sebastian.jaimungal@utoronto.ca, Ivaro Cartea, Zhen Qin

This paper studies the effect that model ambiguity in commodities have on the value of derivative contracts. The base model consists of three drivers: a mean-reverting diffusion, a mean-reverting jump, and a stochastic volatility component. We allow the agent to consider a wide class of alternate models, and penalize the differing components of the model individually. We demonstrate how agents alter their behavior in the presence of ambiguity and how derivatives and spreads are affected by it.

2 - Index Tracking with Futures

Brian Ward, Columbia University, New York, NY, bmw2150@columbia.edu, Tim Leung

Exchange Traded Funds (ETF) market continues to grow. Many ETFs are designed to track an index, and their leveraged benchmarks (2x, 3x, etc.) Since many of these indices are not directly traded, we consider tracking them using futures of various maturities. We do so both statically and dynamically, and backtest our strategies with empirical data.

3 - Investment in Commodities ETFs and Management of Contango

Andrew Papanicolaou, NYU Polytechnic, 6 Metrotech Center, Brooklyn, Ny, 11201, United States of America, apapanic.brown@gmail.com

The last two decades have seen growing investment in commodities markets. Commodities ETFs are popular but not a passive investment, as they will post losses in contango markets. The focus of this talk will be storable commodities, where uncertainty in the convenience yield reduces the Sharpe ratios. Losses are seen as an information premium, which is quantified through a Merton-type control problem.

4 - Speculative Oil

Anna Kruglova, Research Affiliate, MIT Center for Finance and Policy, 30 Memorial Drive, Cambridge, MA, 02142, United States of America, Kruglova@mit.edu, Andrei Kirilenko

The long-standing framework predicated on a premise that producers are the main drivers of energy prices, the so-called "hedging pressure" theory, has been shown to be less consistent with the empirical regularities present in the oil prices. We hypothesize that with the influx of financial investors, the last needed barrel is traded not between a hedger and a speculator, but between two speculators: a commodity trader and/or a bank. We use granular information on shipments of seaborne crude oil into the US during 2008-2012 to examine the industry structure and determine who holds the crude oil that supports the determination of prices in financial markets.

■ TC07

07-Room 307, Marriott

Systemic Risk: Methods and Models

Cluster: Risk Management

Invited Session

Chair: David Brown, Duke University Fuqua School of Business, 1 Towerview Rd, Durham, NC, United States of America, dbbrown@duke.edu

1 - Time-varying Systemic Risk: Evidence from a Dynamic Copula Model of CDS Spreads

Dong Hwan Oh, Economist, Federal Reserve Board, 20th Street and Constitution Avenue N.W., Washington, DC, 20551, United States of America, donghwan.oh@frb.gov, Andrew Patton

This paper proposes a new class of copula-based dynamic models for high-dimensional conditional distributions, facilitating the estimation of a wide variety of measures of systemic risk. We use the proposed new models to study a collection of daily credit default swap spreads on 100 U.S. firms. We find that while the probability of distress for individual firms has reduced since the financial crisis of 2008-09, the joint probability of distress is substantially higher now than in the pre-crisis.

2 - An Optimization View of Financial Systemic Risk Modeling

Nan Chen, Prof, Chinese University of Hong Kong, 709A William Mong Engineering Building, Hong Kong, Hong Kong - PRC, nchen@se.cuhk.edu.hk, Xin Liu, David D. Yao

We develop an optimization-based formulation on financial systemic risk. A partition algorithm is constructed to solve the problem. The sensitivity analysis helps us identify two multipliers to characterize the amplification effects caused by liability networks and market liquidity. The effects of policy intervention are also discussed in the paper.

3 - Optimal Capital Requirements in Interbank Networks with Fire Sales Externality

Jongsoo Hong, Duke University, 1 Towerview Rd, Durham, NC, 27707, United States of America, jongsoo.hong@duke.edu, David Brown

We consider an interbank network with fire sales externality and study the problem of optimally trading off between capital reserves and systemic risk. We find that the optimal capital requirements is a solution to a stochastic linear programming without fire sales externality and a stochastic mixed integer programming with fire sales externality. We offer an iterative algorithm that converges to the optimal. We demonstrate the methods on an example using data from a central bank.

■ TC08

08-Room 308, Marriott

Different Facets of Innovation: Product, Technology and Business Models

Cluster: Business Model Innovation

Invited Session

Chair: Serguei Netessine, Professor, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, Serguei.Netessine@insead.edu

1 - Identifying and Analyzing Styles in Design Patents

Tian Chan, INSEAD, TianHeong.CHAN@insead.edu, Jurgén Mihm, Manuel Sosa

We introduce an approach to identify styles (categories of product designs similar in form) among 400,000 US design patents. We combine state-of-the-art clustering techniques with experimental validation to create, for the first time, a dataset of styles. Building on this platform, we find that i) the level of turbulence (unpredictability of changes) in styles follows a U-shaped pattern to the level of turbulence in functionality, and ii) styles turbulence is increasing over time.

2 - Free Riding in Team Projects: The Role of the Leadership Style

Morvarid Rahmani, Assistant Professor, Georgia Tech, morvarid.rahmani@scheller.gatech.edu, Uday Karmarkar, Guillaume Roels

In order to remain innovative in today's global market, firms are increasingly organizing work around teams. In this paper, we investigate the role of the leadership style (autocratic or democratic) on free-riding in teams and characterize which leadership style is the most efficient depending on the project characteristics.

3 - Different Approaches to Crowdfunding: Kickstarter vs. Indiegogo

Simone Marinesi, Wharton, 562 Jon M. Huntsman Hall, 3730 Walnut St, Philadelphia, PA, 19104, United States of America, marinesi@wharton.upenn.edu, Karan Girotra

We compare the different modes of interaction between backers and creators offered in the two most famous crowdfunding platforms, and provide prescriptions on their implementation, taking the view of project creators.

4 - Are Good Idea Generators also Good at Evaluating Ideas

Otso Massala, INSEAD, 1 Ayer Rajah Avenue, Singapore, Singapore, Otso.MASSALA@insead.edu

Using data collected from a series of innovation tournaments we relate different business opportunity generation skills with evaluation skills. We find that prolific generators are worse evaluators while generators that produce high quality ideas tend to also be good at evaluating. We provide implications for design of innovation tournaments and innovative organizations.

■ TC09

09-Room 309, Marriott

Crowd Innovation

Sponsor: Technology, Innovation Management & Entrepreneurship
Sponsored Session

Chair: Mohamed Mostagir, Assistant Professor, University of Michigan Ross School of Business, 701 Tappan Ave, R5316, Ann Arbor, MI, 48109, United States of America, mosta@umich.edu

1 - Time-Based Crowdsourcing Contests

Ersin Korpeoglu, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, United States of America, ekorpeog@andrew.cmu.edu, Laurence Ales, Soo-Haeng Cho

We study a crowdsourcing contest wherein a seeker solicits a population of agents to solve a problem. Each agent's stochastic solution time depends on her effort and expertise. We show that it is optimal for the seeker to screen and compensate only the highest-expertise agents when their solution times are less uncertain, but a larger group of agents when they are highly uncertain. An agent's optimal compensation is based on her solution time and whether the seeker can observe agents' efforts.

2 - Payoffs in Contests

Kevin Boudreau, Harvard University and London Business School, Harvard Business School, Cambridge MA, United States of America, kboudreau@hbs.edu, Karim Lakhani, Nichale Menietti

Many tournament outcomes possess signaling value. In this article, the results of a field experiment on signaling incentives are presented. Using a structural model, we obtain estimates of the value of nominal prizes, as well as extra value associated with the contest. Signaling and cash values exhibit large interaction effects. In all conditions, the perceived value of the prizes differs from the nominal value. Competitors tend to undervalue small prizes and overvalue large prizes.

3 - Achieving Efficiency in Dynamic Contribution Games

George Georgiadis, Assistant Professor, Northwestern University, 2001 Sheridan Rd, Evanston, IL, 60208, United States of America, g-georgiadis@kellogg.northwestern.edu, Jaksa Cvitanic

We analyze a dynamic contribution game, in which a group of agents exert costly effort over time to make progress on a project that generates a lump-sum payoff once the cumulative effort reaches a pre-specified threshold. We characterize a budget balanced mechanism which overcomes the free-rider problem, and at every moment, induces each agent to exert the first-best effort level in a Markov Perfect Equilibrium. Applications include early-stage entrepreneurial ventures and joint R&D ventures.

4 - Creativity under Fire: The Effects of Competition on Creative Production

Daniel P. Gross, Post-doctoral Fellow, NBER/Harvard Business School, Soldiers Field Road, Boston, MA, 02163, United States of America, dgross@hbs.edu

This paper studies the incentive effects of competition on individuals' creative production. Using a sample of commercial logo design competitions, and a novel, content-based measure of originality, I find that competition has an inverted-U effect on creativity. The results reconcile conflicting evidence from an extensive literature on the effects of competition on innovation, with implications for R&D policy, competition policy, and organizations in creative or research industries.

■ TC10

10-Room 310, Marriott

e-Media and Health Care Practices

Sponsor: E-Business

Sponsored Session

Chair: Harpreet Singh, University of Texas at Dallas, 800 West Campbell Road, Richardson, United States of America, Harpreet@utdallas.edu

1 - Does the Adoption of EMR Systems Inflate Medicare Reimbursements?

Kartik Ganju, Temple University, Fox School of Business, Philadelphia, PA, United States of America, tuc67632@temple.edu, Hilal Atasoy, Paul Pavlou

We study if the adoption of the CPOE system is associated with an increase in the complexity of the case mix that hospitals report (upcoding). We use the staggered roll-out of the Recovery Audit Program as a natural experiment to assess the impact of the adoption of the CPOE systems on the case mix that a hospital reports. We find that the adoption of CPOE systems is associated with an increase in the reported case mix of hospitals but the Audit program has had an effect on reducing this.

2 - Profit Complementarities in Adopting Electronic Medical Records by U.S. Hospitals

Jianjing Lin, University of Arizona, 1130 E Helen St, Tucson, AZ, 85719, United States of America, jianjingl@email.arizona.edu

This paper tries to examine by how much hospitals' profit can be increased if they choose the locally market-leading vendor. Using a nationwide sample of U.S. hospitals from 2006 to 2010, I construct a dynamic oligopoly model and recover the model primitives with a classic approach in Economics. I find hospitals gain significant benefits from choosing the local leader and if hospitals were incentivized to choose such a technology, it would help improve the market coordination substantially.

3 - Get in Shape with Online Friends: Obesity and Social Networks

Behnaz Bojd, University of Washington, Seattle WA, United States of America, behnaz@uw.edu, Yong Tan, Lu Yan

Obesity is one of the most prevalent health problems in the world. Individuals suffering from this condition may use online social networks to get medical information or emotional support. In this study, we examine the effects of online social networking on individual weight-loss behavior, using a unique data set from a platform where people can track their weight, seek food and fitness information, share experiences, find buddies, and participate in different challenges.

4 - Digital Word-of-mouth and Consumer Demand for Credence Services: Evidence from a Natural Experiment

Aishwarya Deep Shukla, PhD Student, University of Maryland, College Park, 3330C R H Smith School of Business, College Park, 20742, United States of America, adshukla@rhsmith.umd.edu, Ritu Agarwal, Gordon Gao

This paper examines the impact of online word-of-mouth on consumer demand for credence services. We utilize a natural experiment setting from one of the largest physician appointment booking platforms in India, when the website made the doctor "recommendations" visible to users. In addition, we explore the long term effect of this visibility of recommendations in the context of matching the severity of the patient to the skill of the doctor.

■ TC11

11-Franklin 1, Marriott

Advances in Discrete Optimization

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Gustavo Angulo, Assistant Professor, Pontificia Universidad Católica de Chile, Vicuña Mackenna 4860, Macul, Santiago, 7820436, Chile, gangulo@ing.puc.cl

1 - Optimization over Structured Subsets of Positive Semidefinite Matrices via Column Generation

Sanjeeb Dash, IBM Research, Yorktown Heights, NY, United States of America, sanjeebd@us.ibm.com, Amir Ali Ahmadi, Georgina Hall

We describe LP and SOCP algorithms that optimize over some structured subsets of the cone of positive semidefinite matrices (PSD cone) in an iterative fashion via column generation, starting with an initial linear approximation of the PSD cone given by Ahmadi and Majumdar (2014). We apply our techniques to sum-of-squares programming for nonconvex polynomial optimization problems, and to a copositive programming relaxation of the stable set problem.

2 - Cutting Planes from Extended LP Formulations

Merve Bodur, UW-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, mbodur@wisc.edu, Sanjeeb Dash, Oktay Gunluk

For mixed-integer sets, we study extended formulations of their LP relaxations. We show that applying split cuts to such extended formulations can be more effective than applying split cuts to the original formulation. For any 0-1 mixed-integer set with n integer and k continuous variables, we construct an extended formulation with $2n+k-1$ variables whose split closure is integral. We extend this to general mixed-integer sets and construct the best extended formulation with respect to split cuts.

3 - Robust (MONOTONE) Submodular Function Maximization

Rajan Udhwani, ORC, MIT, 70 Pacific Street, 324C, Cambridge, MA, 02139, United States of America, rudhwani@mit.edu, James Orlin, Andreas Schulz

Consider two common instances of monotone submodular function maximization with cardinality constraint, feature selection (machine learning) and sensor placement. In both, it is often the case that out of the chosen set of features (sensors), some may be corrupt (may fail). Thus, we would like our chosen set to be robust to removal of some elements. We consider a previously known formulation of this problem and give the first constant factor approximation algorithms.

4 - On a Semicontinuous Relaxation of Fixed-charge Network Flow Problems

Gustavo Angulo, Assistant Professor, Pontificia Universidad Católica de Chile, Vicuña Mackenna 4860, Macul, Santiago, 7820436, Chile, gangulo@ing.puc.cl

Usual formulations of fixed-charge network flow problems make use of binary variables to indicate whether an arc is open or not, and to impose lower and upper bounds on the flow whenever an arc is used. We propose a relaxation where both binary and flow variables are treated as unbounded semicontinuous variables. We derive a complete linear description of the convex hull of this relaxation and show the tractability of the associated separation problem.

■ TC12

12-Franklin 2, Marriott

Optimization Integer Programming I

Contributed Session

Chair: John Chinneck, Professor, Carleton University, Systems and Computer Engineering, 1125 Colonel By Drive, Ottawa, ON, K1S5B6, Canada, chinneck@sce.carleton.ca

1 - School Districting Problem (SDP) Framed as a Spatial Optimization Model/mixed Integer Program

Shawn Helm, Senior Manager, Portland Public Schools, 501 North Dixon Street, Portland, OR, 97227-1807, United States of America, shelm@pps.net, Will Kearney, Sahan Disnayake

SDPs assign neighborhoods to schools given physical, demographic, and policy constraints. We control capacity; compactness; contiguity; amount of demographic change. Users specify class size; grade band; neighborhood capture assumptions; room uses; which current assignments are retained. The integrated framework uses real GIS data from Portland Public Schools and available solvers to identify best school-neighborhood assignments; solves model to display results and inform boundary decisions.

2 - Facility Location Problem with Appointment Scheduling in Healthcare

Mengnan Chen, University of Central Florida, Department of IEMS, Orlando, FL, 32816, United States of America, cmn891127@knights.ucf.edu, Qipeng Zheng

Facility location problem with appointment scheduling in healthcare is used to schedule elective surgeries for physician, as well as to provide multiple choices for patients. Facility location problem aims to improve the match between healthcare resources (physician, clinic location) and patient needs (preferences and types of diseases). By solving this problem, we can meet the minimum of loss for the hospital (the total travel time) and satisfied the each patient preference as much as possible.

3 - Exploiting Variability with Machine Learning Based Restart Strategies for MIP Solvers

Lars Beckmann, University of Paderborn, Warburger StraÙe 100, Paderborn, De, 33100, Germany, lars.beckmann@gmail.com

Performance variability, a.k.a. the heavy-tail phenomenon, can greatly affect the solution time of combinatorial problems, especially mixed-integer programming (MIP) models. We present a machine learning based restart strategy that exploits variability for quickly solving MIP problems. We show that this approach is effective on a large dataset of MIP models. Our approach can be integrated in any MIP solver and can potentially be generalized for solving other combinatorial problems as well.

4 - Faster Infeasibility Analysis for Mixed Integer Linear Programming

John Chinneck, Professor, Carleton University, Systems and Computer Engineering, 1125 Colonel By Drive, Ottawa, ON, K1S5B6, Canada, chinneck@sce.carleton.ca, Andrew Scherr

Finding an Irreducible Infeasible Subset of Constraints in an infeasible mixed integer linear program is extremely time consuming due to the need to solve many different MILPs. We present a number of new algorithms that greatly speed the process of analyzing infeasibility by reducing the number and size of MILP subproblems solved.

5 - Algorithms for Determining Internal Credit Ratings

Srinivas Bollapragada, Chief Engineer, General Electric, 1 Research Circle, Niskayuna, NY, 12309, United States of America, bollapragada@ge.com, Xing Wang

Financial Institutions assign credit ratings to customers for managing risks. Underwriters use these ratings to determine risk-based pricing. We developed an efficient algorithm to assign credit ratings to customers. Our algorithm partitions the probability of defaults associated with customers into a specified number of risk classes to achieve a target mean probability of default for each class. GE Capital Services uses our algorithm for its risk management needs.

■ TC13

13-Franklin 3, Marriott

Stochastic Combinatorial Optimization

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Sean Skwerer, Yale, 300 George Street, Suite 523, New Haven, CT, United States of America, sean.skwerer@yale.edu

1 - Finite Horizon Markov Decision Problems and a Central Limit Theorem for Total Reward

Alessandro Arlotto, Duke University, Durham, NC, United States of America, aa249@duke.edu, J. Michael Steele

We prove a CLT for a class of additive processes that arise naturally in the theory of finite horizon Markov decision problems (MDPs). The theorem generalizes a result of Dobrushin for temporally non-homogeneous Markov chains. The innovation is that here the summands are permitted to depend on the current state and a bounded number of future states of the chain. We show through examples that this flexibility gives a direct path to asymptotic normality of the total reward of finite horizon MDPs.

2 - Simplifying Ensembles of Trees

Sean Skwerer, Yale, 300 George Street, Suite 523, New Haven, CT, United States of America, sean.skwerer@yale.edu

Recursive partition functions (RPFs) are used in a wide variety of statistical methods including classification and regression trees, regression splines, random forests and boosting. The focus of this research is to find a framework for aggregating an ensemble into a single tree or a small number of trees which have comparable predictive strength to the entire ensemble. I will discuss advances made in aggregating ensembles of recursive partition functions.

3 - Large Submatrix Detection in Gaussian Random Matrices

Quan Li, Massachusetts Institute of Technology, 550 Memorial Drive Apt. 12B4, Cambridge, MA, 02139, United States of America, quanli@mit.edu, David Gamarnik

Iterative Search Algorithm is widely used to find large average submatrices of a real-valued matrix in the exploratory analysis. It alternately updates rows and columns until no further improvement is obtained. We present first theoretical analysis of its performance in Gaussian random matrices. We show that the algorithm terminates within finite iterations w.h.p.. This result implies that it converges to a local maximum submatrix w.h.p., leading to a constant factor gap from the global maximum.

4 - Locality in Optimization

Patrick Rbeschini, Yale University, New Haven, CT, United States of America, Patrick.rebeschini@yale.edu, Sekhar Tatikonda

How does the solution of a constrained network optimization problem behave under perturbations of the constraints with respect to the topology of the network? Typically, sensitivity results concern the objective function evaluated at the optimal point, not the optimal point itself. We develop a general theory for the local sensitivity of optimal points on networks. In the context of the network flow problem, this theory yields that local perturbations on the constraints have an impact on the components of the optimal point that decreases exponentially with the graph-theoretical distance. These results suggest a notion of decay of correlation for (non-random) optimization procedures. This notion can be used to develop local algorithms that can substantially reduce the computational complexity of canonical optimization procedures.

■ TC14

14-Franklin 4, Marriott

Stochastic Financial Optimization

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Miguel Lejeune, Associate Professor, The George Washington University, 2201 G Street, NW, Funger Hall, Suite 415, Washington, DC, 20052, United States of America, mlejeune@gwu.edu

1 - Scenario Decomposition for a Class of Risk-averse Stochastic Programs

Pavlo Krokhmal, University of Iowa, 2136 Seamans Center, Iowa City, IA, United States of America, krokhmal@engineering.uiowa.edu

We consider nonlinear convex stochastic optimization problems where objective or constraints involve downside coherent or convex risk measures of special form. A scenario decomposition algorithm that exploits the constraint structure induced by the corresponding risk measures is proposed. Numerical experiments on portfolio optimization problems illustrate the computational effectiveness of the developed procedure.

2 - Risk-budgeting Multi-portfolio Optimization with Portfolio and Marginal Risk Constraints

Ran Ji, PhD Candidate, The George Washington University, 2201 G St, NW, Funger 415H, Washington, DC, 20052, United States of America, jiran@gwmail.gwu.edu, Miguel Lejeune

We propose several stochastic risk budgeting multi-portfolio optimization models with portfolio and marginal risk constraints. The models permit the simultaneous optimization of multiple sub-portfolios with a downside risk measure assigned to each asset and sub-portfolio. Each model includes a joint chance constraint with random technology matrix. We expand a combinatorial modeling framework to represent the feasible set of the chance constraint as a set of mixed-integer linear inequalities.

3 - Factor-based Robust Indexing

Roy Kwon, Associate Professor, University of Toronto, 5 King's College Road, Toronto, Canada, rkwon@mie.utoronto.ca, Dexter Wu

We present an approach for tracking a benchmark index using robust factor models. Robust versions of the Fama-French 3 and 5 factor models are developed to construct uncertainty sets for a robust conic integer program. Constraints limit risk, tracking error, and number of tickets. A Lagrangian-based strategy is developed and computational results in tracking the SP 100 and SP 500 show that robust indexing can offer enhanced indexation in turbulent market conditions.

■ TC15

15-Franklin 5, Marriott

Optimization Models in Radiotherapy Treatment Planning

Sponsor: Optimization in Healthcare

Sponsored Session

Chair: Victor Wu, PhD Student, University of Michigan,
1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America,
vwu@umich.edu

- 1 - Tractable Approaches to Multiple-needle Radiofrequency Ablation**
Shefali Kulkarni-thaker, Graduate Student, University of Toronto,
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Dionne Aleman, Aaron Fenster

In radiofrequency ablation (RFA), needles are used to apply extreme heat to tumors, eradicating cancerous cells. To optimize multiple-needle RFA treatments, we first obtain needle trajectories and positions using minimum volume covering sphere and ellipse formulations. Then, we optimize the heat delivery duration for each needle using tractable approximations to several thermal damage models. We discuss resulting clinical treatment quality for four 3D patient models.

- 2 - Robotic Path Finding Techniques in Stereotactic Radiosurgery Treatment Optimization**

Marlee Vandewouw, University of Toronto, 5 King's College
Road, Toronto, Canada, marleev@mie.utoronto.ca,
Kimia Ghobadi, Dionne Aleman, David Jaffray

We investigate applying robotic path finding techniques to develop treatment plans for Gamma Knife Perfexion where the radiation is delivered continuously. We explore the use of simultaneous localization and mapping, combined with heuristic exploration techniques, to generate a path. A mixed integer model is then used to find the beam times for this selected path. We discuss the advantages and challenges of this method in comparison to the conventional forward and inverse step-and-shoot plans.

- 3 - Adaptive and Robust Radiation Therapy in the Presence of Drift**

Philip Allen Mar, Dept. of MIE, University of Toronto,
5 King's College Road, Toronto, ON, M5S 3G8, Canada,
philip.mar@mail.utoronto.ca, Timothy Chan

We present our computational study of an adaptive and robust optimization radiation therapy (ARRT) method. Previously, it was shown that this ARRT method provides asymptotically optimal treatment plans for convergent sequences of tumor motion distributions. In this work, we generate simulated sequences of tumor motion distributions that exhibit baseline, amplitude and breathing phase drift, and show the effectiveness of the ARRT method applied to these sequences.

- 4 - Vmat Radiation Therapy: Modeling Treatment Delivery Time Versus Plan Quality**

David Craft, Massachusetts General Hospital, 30 Fruit St, Boston,
MA, 02114, United States of America, dcraft@alum.mit.edu,
Marleen Balvert

Volumetric modulated arc therapy is a radiation method where the gantry delivers dose continuously as it rotates around the patient. Metal leaves sweep across the field to modulate the intensity fields. In commercial software, leaf trajectories are solved by heuristics without any guarantee of an optimality gap. VMAT is a large scale non-convex optimization problem with many local minima. We offer a solution approach and explore the tradeoff between treatment quality and delivery time.

■ TC16

16-Franklin 6, Marriott

Game Theory I

Contributed Session

Chair: Sam Ganzfried, Carnegie Mellon University, Computer Science
Department, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States
of America, sam.ganzfried@gmail.com

- 1 - A Stochastic Approach for Dynamic Urban Supply Chain Management**

Afroz Ansari-pour, Pennsylvania State University, 244 Leonhard
building, State College, PA, United States of America,
afroz.ansari-pour2000@gmail.com, Wenjing Song,
Terry Friesz, Yiou Wang, Zhaohu Fan

Lack of information sharing causes negative impacts such as traffic and pollution. City logistics aims to optimize urban freight systems. This paper is an extension of recent stochastic vehicle routing and scheduling frameworks. These frameworks do not necessarily account for real-time variability in traffic. This paper

incorporates uncertainty in demand and presents a real-time stochastic production plan and scheduling framework. SDVI will be used to obtain the equilibrium solution.

- 2 - A Mixed Cooperative Dual to the Nash Equilibrium**

Bill Corley, Professor, The University of Texas at Arlington,
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corley@uta.edu

A mixed dual to the Nash equilibrium is defined for n-person games in strategic form. This dual extends the Berge equilibrium from pure to mixed strategies so that mutual cooperation is achieved for the expected payoffs. Conditions are established for the existence of a dual equilibrium. However, it is shown that for each $n > 2$ there exists a game for which no dual equilibrium exists. This fact may be interpreted as there are mathematical as well as sociological obstacles to mutual cooperation.

- 3 - Nash's Continuous Transformation and a Smooth Homotopy Method for Computing Nash Equilibrium**

Yabin Sun, PhD, City University of Hong Kong, R5218, Academic
Building 2, Tat Chee Avenue, Kowloon, Hong Kong, Hong Kong -
PRC, yabinsun-c@my.cityu.edu.hk, Chuangyin Dang, Yin Chen

A different procedure often results in the different selection of Nash equilibrium. To prove the existence of Nash equilibrium, Nash defined a continuous transformation. This paper applies Nash's continuous transformation to develop a smooth homotopy method by introducing just one extra variable. Starting from any given totally mixed strategy profile, the method numerically follows a smooth path that ends at a Nash equilibrium. Extensive numerical results show that the method is very efficient.

- 4 - When to Release Feedback in a Dynamic Tournament**

Ruoyu Wang, PhD Candidate, Fuqua School of Business,
Duke University, 100 Fuqua Drive, Durham, NC, 27708,
United States of America, rw120@duke.edu, Brendan Daley

We study dynamic tournaments in which time is modeled explicitly, as opposed to with the abstract notion of periods. By doing so, we characterize the effects of the ex-ante-designated timing of an interim progress report. Whether a policy of reporting increases total expected effort does not depend on the release time. We find that total expected effort is single-peaked/single-troughed in the report's release time, with the peak/trough located at a time more than halfway through the tournament.

- 5 - Endgame Solving in Large Imperfect-information Games**

Sam Ganzfried, Carnegie Mellon University, Computer Science
Department, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United
States of America, sam.ganzfried@gmail.com, Tuomas Sandholm

Sequential games of perfect information can be solved in linear time by a straightforward backward induction procedure; however, this procedure does not work in games with imperfect information since different endgames can contain nodes that belong to the same information set and cannot be treated independently. We present an efficient algorithm for performing endgame solving in large imperfect-information games and demonstrate its success experimentally in two-player no-limit Texas hold 'em.

■ TC17

17-Franklin 7, Marriott

Network Analysis I

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Alexander Veremyev, University of Florida, 1350 N Poquito
Road, Shalimar, FL, United States of America, averemyev@ufl.edu

- 1 - Optimizing Network Recovery Time under Uncertainty**

Juan Borrero, University of Pittsburgh, 3700 O'Hara Street,
Pittsburgh, PA, 15213, United States of America, jsb81@pitt.edu,
Pavlo Krokhmal, Oleg Prokopyev

We consider a network under attack, where its nodes can recover either on their own, by receiving support from neighboring nodes, or by receiving support from outside the network. A decision maker has to determine how to invest his budget on these options in order to minimize recovery time. We propose a novel hierarchical and stochastic model to address the issue, derive closed form equations for the optimal resource allocation, and study its behavior as the number of nodes grows to infinity.

2 - s-plex and s-defective Numbers of a Graph

Vladimir Stozhkov, University of Florida, 2330 SW Williston Rd
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vstozhkov@ufl.edu, Eduardo Pasiliao, Vladimir Boginski

The presentation is dedicated to two clique relaxation models: s-plex and s-defective clique. Theoretical properties of the specified objects are investigated. Analytical and computational bounds for the related optimization problems are provided. The extensions of the Motzkin-Straus formulation for s-plex and s-defective clique are derived. The outline of the general procedure for solving the corresponding maximization problems is given.

3 - Minimum Edge Blocker Dominating Set Problem

Foad Mahdavi Pajouh, Assistant Professor, University of
Massachusetts Boston, 100 Morrissey Boulevard, Boston, MA,
02125, United States of America, Foad.Mahdavi@umb.edu,
Eduardo Pasiliao, Jose Walteros, Vladimir Boginski

Dominating sets are widely used in social and communication networks analysis. Given a weighted graph and $r > 0$, we consider the problem of removing a minimum number of edges so that the weight of any dominating set in the remaining graph is at least r . Complexity results, polyhedral results, a linear 0-1 programming formulation, and an exact algorithm for solving this problem will be presented.

4 - Minimum Risk Network Covering Location Problem

Konstantin Pavlikov, University of Florida, 1350 N. Poquito Road,
Shalimar, FL, 32579, United States of America,
kpavlikov@ufl.edu, Alexander Veremyev, Vladimir Boginski,
Eduardo Pasiliao

The network coverage problem under uncertainty is considered. In this problem, components of the covering set and links connecting them to remaining nodes of the network are subject to random failures. The emphasis is put on minimizing the risk of losing coverage in presence of such failures. We formalize the model and discuss its connection to the maximum expected covering location model.

TC19

19-Franklin 9, Marriott

Modeling and Optimization for Sustainable Cloud Computing

Sponsor: Computing Society

Sponsored Session

Chair: Yunpeng Pan, South Dakota State University, Mathematics & Statistics, Box 2220, Brookings, SD, 57007, United States of America, yunpeng.pan@gmail.com

1 - Remote Sensing Data Mining for Extracting Data Center Site Characteristics

Yunpeng Pan, South Dakota State University, Mathematics & Statistics, Box 2220, Brookings, SD, 57007, United States of America, yunpeng.pan@gmail.com, Adam Buskirk

Data centers are powerhouses of cloud. Companies rush to build out their cloud infrastructure to meet fast growing demand. The environmental impact such as carbon footprint falls into the category of public good, and therefore, calls for appropriate public policy decisions, which in turn require good information. Our current work intends to achieve this by mining the Landsat remote sensing data to extract characteristics of data centers in operation and under construction at a global scale.

2 - A Dynamic Workflow Framework for Server Provisioning

Wei Lin, Software Engineering Researcher, IBM,
8 Dongbeiwang Western Road, Haidian Dist, Beijing, China,
linweilw@cn.ibm.com, Brian Peterson, Qinhua Wang,
Zongying Zhang, Christopher Young, Sai Zeng

Cloud service providers support server provisioning to large number of enterprise customers, who have different functional, security and compliance requirements. We propose a framework which composes dynamic workflow at runtime to cater individualized provisioning procedures. In this framework, an onboarding module configures process steps and dependencies for each customer, and a composition module dynamically composes execution workflow based on dependency validation and sequence calculating.

3 - Minimizing Costs in Distributed Cloud Resource Provisioning

Julio Goez, Postdoctoral Fellow, Ecole Polytechnique Montreal and GERAD, 2900 Boulevard Edouard-Montpetit, Montréal, QC, H3T 1J4, Canada, jgoez1@gmail.com, Juan F. Pérez

We consider the problem of minimizing the cost of provisioning resources at different cloud locations, constrained to satisfying a required service-level objective. We present a mixed integer non-linear optimization model for this problem and show an equivalent mixed integer second order cone formulation. We also show that a simple round-up provides an initial feasible solution for the

problem. We use this property to design a heuristic procedure to improve the quality of the initial solution.

4 - Renewable Energy Prediction and Prescription in the Internet-of-things (IoT)

Hans Schlenker, IBM, Hollerithstr 1, Munich, 81829, Germany,
hans.schlenker@de.ibm.com, Yianni Gamvros

The IoT connects all sorts of devices — from sensors to embedded devices to smartphones to laptops to servers. IBM connected 1600 solar fields to its Renewable Energy IoT. Sensor data is collected, combined in the cloud, and further analyzed by analytics services to generate accurate local energy production forecast. These predictions are then used by (prescriptive) mathematical optimization in a network distribution model to balance under-runs and over-production in all connected areas.

TC20

20-Franklin 10, Marriott

Financial Engineering and Optimization

Contributed Session

Chair: Zhen Liu, Options Clearing Corp (OCC), One North Wacker Drive, Suite 500, Chicago, IL, 60606, United States of America, zhenliu@alum.northwestern.edu

1 - An Optimization Procedure for a Delta Neutral Constrained Theta with Maximum Gamma Portfolio

Arik Sadeh, Dean, HIT Holon Institute of Technology,
52 Golomb St. 5810201, Holon, Israel, sadeh@hit.ac.il

A large gamma portfolio is attractive for investors in order to get benefits from large increase or decrease in the value of the underlying asset. In large gamma portfolio the theta is negative. In this study, a delta neutral portfolio with maximum gamma and constrained theta, was developed. An optimization model was designed and solved for small time steps within a planning horizon. The model was run for many simulation scenarios as well as real world data, followed by statistical tests.

2 - Optimal Portfolio Liquidation and Dynamic Mean-variance Criterion

Jiawen Gu, Postdoc, University of Copenhagen, Department of Mathematical Science, University of Copenhagen, Copenhagen, 2100, Denmark, kaman.jwgu@gmail.com, Mogens Steffensen

We consider the portfolio liquidation problem under the dynamic mean-variance criterion and derive time-consistent solutions in three important models. We get explicit trading strategies in the basic model and when random pricing signals are incorporated. When consider stochastic liquidity and volatility, we construct an exact HJB equations under general assumptions for the parameters.

3 - Genetic Programming Optimization for a Sentiment Feedback Strength Based Trading Strategy

Steve Yang, Assistant Professor, Stevens Institute of Technology,
1 Castle Point on Hudson, Hoboken, NJ, 07030,
United States of America, steve.yang@stevens.edu

Based on the evidence that tweets are faster than news in revealing new market information, whereas news is regarded broadly a more reliable source of information than tweets, we develop a trading strategy based on the sentiment feedback strength between the news and tweets using generic programming optimization method. Result shows that this strategy generates over 14.7% Sterling ratio compared with 10.4% and 13.6% from the technical indicator-based and the buy-and-hold strategy respectively.

4 - Algorithmic Options Trading by Integer Programming

Vadim Timkovski, Keiser University, Port St. Lucie, FL,
United States of America, vtimkovski@keiseruniversity.edu

Algorithmic options trading has only begun its evolution. This work presents an integer programming system that simulates the activities of an experienced option trader on the construction and adjustment of option portfolios. The system adopts algorithms based on a recent discovery of an algebraic classification of option trading strategies, without which this kind of automation would not be possible and which has not been considered before as attainable.

5 - Linear Programming Approach to American Option Pricing

Zhen Liu, Options Clearing Corp (OCC), One North Wacker Drive, Suite 500, Chicago, IL, 60606, United States of America, zhenliu@alum.northwestern.edu

We solve the variational inequality (VI) from American option pricing problem by linear programming (LP) approach. We approximate its solution by a combination of Chebyshev basis functions. The objective is to minimize the absolute error of the solution and the max operator in VI is converted into linear constraints of LP. We discuss its convergence, and compare our results with Longstaff-Schwartz least-square approach and numerical partial differential equation (PDE) approach.

■ TC21

21-Franklin 11, Marriott

Innovations in Healthcare Operations

Sponsor: Health Applications

Sponsored Session

Chair: Mili Mehrotra, University of Minnesota, 321 19th ave south, Minneapolis, United States of America, milim@umn.edu

1 - Incentizing Less-Than-Fully-Qualified Providers for Early Diagnosis of Tuberculosis in India

Sarang Deo, Assistant Professor, Indian School of Business Hyderabad, ISB Hyderabad, Gachibowli, Hyderabad, TS, 500032, India, sarang_deo@isb.edu, Milind Sohoni, Neha Jha

A major driver of TB epidemic in India is delay in diagnosis by less-than-fully-qualified providers (LTFQs), who are typically the first point of contact for patients. This work is motivated by pilots funded by international donors to provide monetary incentives to LTFQs to induce earlier diagnosis. We develop a game-theoretic model to design an incentive contract that should be offered to LTFQs and calibrate it using realistic parameter estimates obtained from primary and secondary data.

2 - Optimizing Spatiotemporal Antiviral Release Schedules in a Pandemic Influenza

Bismark Singh, Assistant Professor, University of Texas at Austin, Austin, TX, United States of America, ned@austin.utexas.edu, Nedialko Dimitrov

To help the state of Texas plan influenza pandemic interventions, we build a stochastic MIP to compute time-based antiviral releases. We derive scenarios for the stochastic program from an epidemic simulator that accounts for the large amount of uncertainty in disease progression. We study the hardness of this problem, and present models and methods to solve it, even though a direct-solve is intractable because of the large number of scenarios.

3 - Online Scheduling of Operating Rooms

Chaitanya Bandi, Kellogg School of Management, Northwestern University, Evanston, IL, United States of America, c-bandi@kellogg.northwestern.edu, Diwakar Gupta

We consider the online operating room scheduling problem where we do not know the sequence of requests and associated surgery lengths beforehand. Given the uncertainty and the objective of feasible schedules, we model the uncertainty using a Robust Optimization (RO) approach, and utilize a RO framework to develop an interval-classification scheduling algorithm optimized under the RO framework. We obtain provable lower bounds on the performance and show promising results based on real data.

4 - Is Technology Eating Nurses? – Staffing Decisions in Nursing Homes

Feng Lu, Assistant Professor, Purdue University, 403 W State St, West Lafayette, IN, 47907, United States of America, lu428@purdue.edu, Huaxia Rui, Abraham Seidmann

We study the effect of IT-enabled automation on staffing decisions in healthcare facilities using a unique nursing home IT data from 2006 to 2012. We also develop a strategic staffing model that incorporates technology adoption.

■ TC22

22-Franklin 12, Marriott

Analysis and Control of Queues

Sponsor: Applied Probability

Sponsored Session

Chair: Hayriye Ayhan, Georgia Tech, Atlanta, GA, United States of America, hayriye.ayhan@isye.gatech.edu

1 - Control of Multiserver Energy-aware Queueing Systems

Vincent Maccio, McMaster University, 1280 Main Street West, Hamilton, Canada, macciov@mcmaster.ca, Douglas Down

We study the problem of controlling a multiple server system, where servers may be turned on or off. The cost function of interest is a combination of holding costs and energy costs (and potentially switching costs). We provide several structural results on the optimal policy - these structural results are enough to allow for the derivation of the optimal policy for a wide range of systems. Finally, we discuss how these policies compare with those extant in the literature.

2 - The Snowball Effect of Customer Slowdown in Critical Many-server Systems

Jori Selen, PhD Candidate, Eindhoven University of Technology, De Zaale, Eindhoven, Netherlands, j.selen@tue.nl, Johan Van Leeuwen, Vidyardhar Kulkarni, Ivo Adan

Customer slowdown describes the phenomenon that a customer's service requirement increases with experienced delay. In healthcare settings, there is

substantial empirical evidence for slowdown, particularly when a patient's delay exceeds a certain threshold. For such threshold slowdown situations, we design and analyze a many-server system that leads to a two-dimensional Markov process. Analysis of this system leads to insights into the potentially detrimental effects of slowdown.

3 - Maximizing throughput in Non-collaborative Networks of Queues

Tugce Isik, Georgia Institute of Technology, 755 Ferst Drive NW, Atlanta, GA, 30332-0205, United States of America, tugceisik@gatech.edu, Hayriye Ayhan, Sigrun Andradottir

We study queueing networks with flexible non-collaborative servers. We introduce a processor sharing (PS) scheme that yields maximal throughput when buffers are infinite. For systems where the servers cannot work together at a station, we develop non-collaborative round-robin policies that approximate PS as the rotation of the servers becomes more frequent. We evaluate the performance of these policies in queueing networks with tandem, merge, and split topologies for different buffer sizes.

4 - Optimal Assignment of Authentication Servers to Different Customer Classes

Daniel Silva, Georgia Tech, 755 Ferst Drive, Atlanta, GA, United States of America, dfs3@gatech.edu, Hayriye Ayhan, Bo Zhang

Consider a system where user requests for authentication arrive from several classes of customers, following independent Poisson processes. Each arrival has a class-dependent probability of being an impostor. The system has several authentication methods; each one has a known service time distribution, and a Type I and II error probability. A controller assigns a method to each user request. We model the system as a queueing network and find the structure of a cost-optimal routing policy.

■ TC23

23-Franklin 13, Marriott

Stochastic Modeling and Control of Production Systems

Cluster: Stochastic Models: Theory and Applications

Invited Session

Chair: Sanket Bhat, McGill University, 1001 Sherbrooke Street West, Room 520, Montreal, QC, H3A 1G5, Canada, sanket.bhat@mcgill.ca

1 - Using an Artificial Neural Network Model and Approximate Dynamic Programming for Stochastic Control

Han Wu, Student, University of Louisville, 2301 S 3rd St, Louisville, KY, 40218, United States of America, han.wu@louisville.edu, Gerald Evans, Kihwan Bae

Development of efficient control policies for dynamic production systems is difficult. The uncertain demands and large set up times on machines can cause significant problems. Consider an assembly line for dishwashers which require multiple types of wire racks that must be fabricated and coated at different machines. An Artificial Neural Network model is embedded within an approximate dynamic programming algorithm to search for a better production and inventory control policy.

2 - Resource Allocation Policies to Provide Differentiated Service Levels to Customers

Ananth Krishnamurthy, Associate Professor, University of Wisconsin-Madison, 1513 University Avenue., ME 3258, Madison, WI, 53706, United States of America, akrishn2@wisc.edu, Sanket Bhat

We analyze resource allocation decisions for component manufacturers who supply components to several original equipment manufacturers (OEMs). OEMs differ in their demand variability and service level expectations. We derive policies that provide differentiated service to OEMs depending on their demand variability. Under the dynamic programming framework, we investigate the value of these policies to component manufacturers.

3 - A Newsvendor Problem with Price-sensitive and Uncertain Supply

Z. Melis Teksan, University of Florida, ISE Dept. 303 Weil Hall, P.O. Box 116595, Gainesville, FL, 32611, United States of America, zmtksan@gmail.com, Meltem Tutar, Joseph Geunes

We study a newsvendor problem in which the supply quantity depends on the price offered by the newsvendor to suppliers. We analyze the optimal ordering policy, which depends on the economics of overage and underage costs, as well as the relationship between price and supply quantity. We characterize the optimal supply-pricing policies for cases in which suppliers are also unreliable, i.e., supply capacity is both price-dependent and random.

4 - Optimal Control of an Inventory System with Stochastic and Independent Leadtimes

Mohsen Elhafi, Professor, University of California, School of Business Administration, 900 University Avenue, Riverside, CA, 92521, United States of America, mohsen.elhafi@ucr.edu, Saif Benjaafar, Rui Chen

We study a continuous review inventory system with stochastic independent leadtimes. Because orders may not be delivered in the same sequence in which they have been placed, characterizing the optimal policy is difficult and much of the available literature assumes a fixed base-stock policy which we show is sub-optimal and can perform poorly. Instead, the optimal policy is state-dependent and specified in terms of an inventory-dependent threshold function characterized by at most m parameters.

■ TC24

24-Room 401, Marriott

Search Across Disciplines: Artificial Intelligence and Operations Research

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Nathan Sturtevant, University of Denver, 2280 S. Vine St., Denver, CO, 80210, United States of America, sturtevant@cs.du.edu

1 - The Cyclic Best-first Search Strategy for Branch-and-bound Algorithms

Jason Sauppe, University of Illinois at Urbana-Champaign, 201 North Goodwin Avenue, Urbana, IL, 61801, United States of America, sauppej@gmail.com, Edward Sewell, Sheldon Jacobson, David Morrison

The Cyclic Best-First Search (CBFS) strategy is a generalization of best-first search that splits unexplored subproblems over a collection of heaps, referred to as contours. During the search process, CBFS repeatedly cycles through a list of non-empty contours, selecting one subproblem to explore from each during every pass. Contours can be defined in various ways to influence the search process. This talk will present some properties of CBFS and computational results for a variety of problems.

2 - Adding Random Exploration to Search Algorithms

Rick Valenzano, Alberta Innovates Centre for Machine Learning, 2-21 Athabasca Hall, University of Alberta, Edmonton, AB, T5K1X4, Canada, valenzan@ualberta.ca

In this work, we will use a simple technique called epsilon-greedy node selection to demonstrate the value of enhancing search algorithms with random exploration. Through empirical evaluation, this technique is shown to substantially improve the performance of search-based automated planners. We also formally analyze this technique to demonstrate that algorithms that employ random exploration are more robust to heuristic error.

3 - Exploiting Large Admissible Heuristics in Search

Nathan Sturtevant, University of Denver, 2280 S. Vine St., Denver, CO, 80210, United States of America, sturtevant@cs.du.edu

Admissible heuristics, which do not overestimate the cost to the goal, are particularly useful in shortest-path search problems, as they can guide the search. They also can, if necessary, guarantee optimal solutions. This talk looks at recent heuristics that are larger than the memory, and suggests ways of exploiting the problem structure to reduce the memory overhead of storing the heuristic. Two methods, bloom filters and value range compression are discussed, along with their tradeoffs.

■ TC25

25-Room 402, Marriott

Online Crowds: Crowdfunding and Social Media

Sponsor: Information Systems

Sponsored Session

Chair: Qiang Gao, University of Arizona, 3700 N 1st Ave. #1020, Tucson, AZ, 85719, United States of America, qiangg@email.arizona.edu

1 - A Distant Supervision Approach for Social Media Pharmacovigilance

Xiao Liu, University of Arizona, 1130 E. Helen St., Room 430, Tucson, AZ, 85721, United States of America, xiaoliu@email.arizona.edu, Hsinchun Chen

Pharmacovigilance refers to the science relating to the detection, assessment, understanding, and prevention of adverse drug events. Prior studies showed

social media can be used to identify adverse drug events with supervised learning approaches. However, they require expert annotation and are not scalable for large datasets. In this study, we develop a framework for pharmacovigilance in social media using distant supervision. Our framework achieves competent performance without annotation.

2 - The Effect of Rating System Design on Negativity Bias

Ying Liu, Arizona State University, 1201 S McClintock Dr, Apt 221, Tempe, AZ, 85281, United States of America, yingliu_is@asu.edu, Pei-yu Chen, Kevin Hong

Does rating system design affect consumers' negativity bias in reporting product ratings? We examine the effect with both observational and experimental study. Results suggest that consumers tend to reflect their experiences in the least satisfied dimension in single-dimensional rating systems, whereas the overall ratings in multi-dimensional systems tend to reflect consumers' average experience. The study suggests that multidimensional rating systems could mitigate consumers' negativity bias.

3 - Predict Campaign Quality: An Empirical Analysis of the Value of Video in Crowdfunding Markets

Qiang Gao, University of Arizona, 3700 N 1st Ave. #1020, Tucson, AZ, 85719, United States of America, qiangg@email.arizona.edu, Mingfeng Lin

Videos are prevalent in crowdfunding campaigns where there is usually little verifiable information. Yet to date there is virtually no systematic study of its roles in this new context. We investigate how video features predict campaign quality using data from a leading rewards-based crowdfunding website by implementing both explanatory and predictive models.

4 - Content Monetization in Social Media: Estimation of Demand and Supply for User Generated Content

Ruibin Geng, Zhejiang University, 388 Yuhangtang Road, Hangzhou, ZJ, 310058, China, grace.bin1207@gmail.com, Bin Zhang, Paulo Goes

Social networking is reaching a maturity stage with fewer new registrations but more user churning. Our study investigates how a new market mechanism, content monetization, reduces turnover rate by using data from the largest Chinese social network Sina Weibo. It examines the factors that affect both the demand and supply for user-generated content (UGC) in social media. Our results confirm that this nascent mechanism effectively motivates the supply for UGC and also improves its quality.

■ TC26

26-Room 403, Marriott

Gray Market, Sustainability, Competition, and Diffusion

Cluster: Operations/Marketing Interface

Invited Session

Chair: Samar Mukhopadhyay, Professor, Sungkyunkwan University-GSB, 25-2 Sungkyunkwan-ro, Jongno gu, Seoul, 110 745, Korea, Republic of, samar@uwm.edu

1 - Countering Gray Market Threat using Marketing Effort

Samar Mukhopadhyay, Professor, Sungkyunkwan University-GSB, 25-2 Sungkyunkwan-ro, Jongno gu, Seoul, 110 745, Korea, Republic of, samar@uwm.edu, Xuemei Su

Gray markets are likely when there is a significant price difference of the same product in different markets. This paper studies the role of an important variable, marketing effort, in fighting gray market, in addition to price. We find that when both marketing effort and prices are controlled, the manufacturer's profit is improved. Sometimes, it may even be better not to sell through the authorized channel, but to manage the gray market by controlling the marketing effort levels and prices.

2 - Designing Sustainable Products under Co-Production Technology

Yen-Ting Lin, University of San Diego, School of Business Administration, 5998 Alcala Park, San Diego, CA, United States of America, linyt@sandiego.edu, Haoying Sun, Shouqiang Wang

We consider a manufacturer who takes a natural resource to make two products through co-production technology. Some consumers are green and additionally value conservation of the natural resource. We show that increasing the portion of green consumers may actually elevate resource consumption.

3 - Online Vs. Traditional Education: A Competitive Framework.

Vashkar Ghosh, University of Florida, Department of ISOM,
Gainesville, FL, 32611, United States of America,
vashkar.ghosh@warrington.ufl.edu, Gulver Karamemis,
Asoo Vakharia

Innovation and technological advancement are eliminating a lot of constraints (eg. physical presence) bringing sweeping changes to higher education. We examine how technology in higher education is likely to develop and what its impacts will be on existing institutions. We examine a university's incentive to offer online programs in addition to the traditional program in a competitive environment. We consider two different games: the simultaneous and the sequential leader/follower location game.

4 - The Diffusion of Product Generation of Auto Industry

Gary Chao, Kutztown University, P.O. Box 730, Kutztown, PA,
18031, United States of America, chao@kutztown.edu,
Maxwell Hsu

Instead of a whole new model, every a few years, automakers introduce a new generation of their existing model to continue their success of old models or to correct the mistakes in the old models. Based on the Bass diffusion theory, we would like to study whether the different sales behavior among models and generations in US market.

■ TC27

27-Room 404, Marriott

Evolutionary Bilevel Optimization

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Kalyanmoy Deb, Koenig Endowed Chair Professor, Michigan State University, 428 S. Shaw Lane, 2120 EB, East Lansing, MI, 48864, United States of America, kdeb@egr.msu.edu

1 - Bilevel Decision Making and Optimization

Pekka Malo, Assistant Professor, Aalto University School of Business, Runeberginkatu 22-24, Helsinki, Finland,
pekka.malo@aalto.fi, Ankur Sinha, Kalyanmoy Deb,
Jyrki Wallenius, Pekka Korhonen

Bilevel decision making and optimization problems are commonly framed as leader-follower problems, where the leader desires to optimize his own decision while taking the decisions of the follower into account. In such cases, the Pareto-optimal frontier of the leader is influenced by the decision structure of the follower facing multiple objectives. In this paper, we analyze this effect by modeling the lower level decision maker using value functions.

2 - Handling Uncertainties in Decision Variables for Bilevel Optimization Problems

Kalyanmoy Deb, Koenig Endowed Chair Professor, Michigan State University, 428 S. Shaw Lane, 2120 EB, East Lansing, MI,
48864, United States of America, kdeb@egr.msu.edu, Zhichao Lu

Bilevel problems involve two optimization problems in hierarchy and are challenging problems often found in practice. In this talk, we present evolutionary optimization algorithms and results on test and practical bilevel problems with uncertainties in decision variables for finding robust and reliable solutions. Uncertainties are considered for both lower and upper level variables and problems with and without constraints.

3 - Expected Frontiers: Incorporating Weather Uncertainty into an Integrated Bilevel Optimization

Moriah Bostian, Assistant Professor, Lewis & Clark College,
Department of Economics, 0615 SW Palatine Hill Rd, Portland,
OR, 97219, United States of America, mbbostian@lclark.edu,
Gerald Whittaker, Bradley Barnhart, Rolf Fare, Shawna Grosskopf

Weather is a main driver of agricultural nutrient fate and transport in the environment. We use bilevel optimization and a time-series bootstrap to evaluate a water pollution policy subject to a distribution of weather outcomes. Our results show that the deterministic Pareto frontier is sensitive to climate variation. Some policy configurations that appear equally effective in a deterministic model setup are strongly differentiated when weather uncertainty is included in the policy evaluation.

■ TC28

28-Room 405, Marriott

New Frontiers in Market Design

Cluster: Auctions

Invited Session

Chair: Tunay Tunca, ttunca@rsmith.umd.edu

1 - Integrating Market Makers, Limit Orders, and Continuous Trade in Prediction Markets

Sebastien Lahaie, Microsoft Research, New York, NY, United States of America, sebastien.lahaie@gmail.com, Hoda Heidari, David Pennock, Jenn Wortman Vaughan

We provide an algorithm that combines market makers and limit orders in a prediction market with continuous trade. We define the notion of an approximate trading path, a path in security space along which orders execute at their limit prices to within a fixed tolerance. We show that a trading path with efficient endpoint exists under supermodularity, but not in general. We develop an algorithm for the general case, and evaluate it using real combinatorial predictions over election outcomes.

2 - Multi-dimensional Virtual Values and Second-degree Price Discrimination

Nima Haghpahanah, MIT, Boston, MA, United States of America, nima.haghpahanah@gmail.com, Jason Hartline

We consider a problem of selling a product with multiple quality levels and derive conditions that imply only selling highest quality is optimal. With multi-dimensional preferences, virtual values from integration by parts on arbitrary paths may not be incentive compatible. To resolve this issue, we impose additional conditions that are satisfied only by a unique choice of paths, and identify distributions that ensure the resulting virtual surplus is indeed point-wise optimized by the mechanism.

3 - Optimal Pricing for Two-sided Platforms with Externalities

Levi Devalve, Duke University, Durham, NC,
United States of America, levi.devalve@duke.edu, Sasa Pekec

We consider pricing strategies of two-sided platforms serving consumers and marketers. We show that competing platforms can achieve optimal profit through "subscription-only" pricing. We identify settings in which competition increases both consumer prices and advertising volumes. We also derive the platform's optimal price menu under incomplete information about the consumer's disutility for advertising. We characterize when the optimal menu includes free use and no ad options.

4 - The Role of a Market Maker in Networked Cournot Competition

Desmond Cai, California Institute of Technology, 1200 E California Blvd, Pasadena, CA, 91125, wccai@caltech.edu, Subhmesh Bose, Adam Wierman

We study the role of a market maker (or market operator) in a transmission constrained electricity market. We model the market as a one-shot networked Cournot competition. We analyze the class of market maker objective functions given by linear combinations of social welfare, residual social welfare, and consumer surplus. We show that there exist cost functions for which the maximum possible social welfare at equilibrium is not attained when the market maker chooses to maximize social welfare.

■ TC29

29-Room 406, Marriott

Joint Session Analytics/HAS: Analytics Innovations in Healthcare and Medicine

Sponsor: Analytics

Sponsored Session

Chair: Issac Shams, Postdoctoral Research Fellow, University of Michigan, 1205 Beal Ave, Ann Arbor, United States of America, issacsh@umich.edu

1 - Improving Societal Outcomes in the Organ Donation Value Chain

Priyank Arora, Georgia Institute of Technology, 800 W Peachtree St. NW, Atlanta, GA, 30308, United States of America, priyank.arora@scheller.gatech.edu, Ravi Subramanian

We examine a unique principal-agent problem in the cadaver organ donation value chain (ODVC) where the principal in our case is a social planner that has an overall quality-adjusted-life-year improvement objective. The agents include a non-profit organ procurement organization with a volume-of-care objective and a for-profit hospital (trauma center).

2 - Appointment Scheduling and Overbooking to Improve Patient Access and Reduce Patient Backlog

Linda Laganga, Vp Of Quality Systems, Mental Health Center of Denver, 4141 East Dickenson Place, Denver, CO, 80302, United States of America, linda.laganga@mhcd.org, Stephen Lawrence

Patient no-shows continue to trouble outpatient clinical service delivery. We continue our piloting and implementation of scheduling models developed in our earlier research to develop new techniques to assist clinics in meeting their goals to improve patient flow and reduce backlog in scheduling. We utilize medical practice experience to develop realistic estimates of costs and their effect on the selection of high-performing scheduling alternatives.

3 - Improving HIV Early Infant Diagnosis Supply Chains in Sub-Saharan Africa: Models and Application to Mozambique

Jonas Jonasson, Student, London Business School, Regent's Park, London NW1 4SA, United Kingdom, jjonasson@london.edu, Sarang Deo, Jérémie Gallien

Most countries in sub-Saharan Africa experience delays in HIV early infant diagnosis (EID). We develop a two-part modeling framework to generate operational improvements in EID networks and evaluate their impact on public health. For the case of Mozambique, we estimate that the interventions of optimally re-assigning clinics to labs and optimally re-allocating diagnostic capacity would result in 11% and 22% shorter turnaround times and 4% and 7% more infants starting treatment, respectively.

TC30

30-Room 407, Marriott

Decision Support Systems I

Contributed Session

Chair: Mohamad Hasan, Associate Professor, Kuwait University, Department of Quantitative Methods & IS, CBA, Kuwait University, Kuwait City, 13055, Kuwait, mkamal@cba.edu.kw

1 - Review of Consistency Among Pairwise Comparisons: Relationship Between Indices and Human Perception

Yuji Sato, Graduate School of Management, Chukyo University, 101 Yagotohonmachi, Showa, Nagoya, 466-8666, Japan, ysatoh@1988.jukuin.keio.ac.jp

This paper reviews the Consistency Index (CI) of AHP. Since AHP requires redundant pairwise comparisons, transitivity in judgment is often violated. The review focuses on the detection capability of CI, and the relationship between the size of CI and the goodness-of-fit of weight to decision maker's perception. The results imply that CI may not distinguish the consistency of judgment nor the size may have no relation with the degree of goodness-of-fit of weight to decision maker's perception.

2 - Transformations and Materializations of Uncertainty Sets in Robust Optimization

Abhilasha Aswal, International Institute of Information Technology, Bangalore, 26/C Electronics City, Bangalore, KA, 560100, India, abhilasha.aswal@iiitb.ac.in, Prasanna Gns

We present a polyhedral representation of uncertainty for robust optimization and a volume based uncertainty measure for it. Our decision support framework enables easy transformations and materializations of a given uncertainty set and also easy set-theoretic operations on alternative uncertainty sets. These operations are quite useful in practice and are more difficult with probabilistic representations of uncertainty and non-polyhedral robust uncertainty sets.

3 - Open Source or Proprietary? A Study on Software Diffusion in a Competitive Market

Chao Ding, Assistant Professor, University of Hong Kong, KKL 807, Hong Kong, Hong Kong - PRC, chao.ding@hku.hk

When choosing between open source software and proprietary software, consumers will consider software quality, cost, consumer reviews, promotions, compatibility, technical support, ease of use, etc. In this paper, we consider three important decision making factors as identified in literature: external influence, internal influence and ownership cost and study their impact on consumers' adoption decision.

4 - A Decision Support System for Predicting International Freight Flows for Trade

Mohamad Hasan, Associate Professor, Kuwait University, Department of Quantitative Methods & IS, CBA, Kuwait City, 13055, Kuwait, mkamal@cba.edu.kw

A decision support system is developed that can help decision makers to take right decisions about the country international trade system. It helps them to evaluate deferent scenarios to improve the multimodal Transport system and import, export, re-export, and transit operations. These improvements will enhance the competitiveness and integration of this system. The overall results will help in increasing the international trade share for the country.

TC31

31-Room 408, Marriott

Joint Session DM/QSR: Quality and Statistical Decision Making in Health Care Applications

Sponsor: Data Mining

Sponsored Session

Chair: Shuai Huang, University of Washington, Dept. of Industrial and Systems Eng., Seattle, WA, United States of America, shuai.huang.ie@gmail.com

1 - Social Media Analytics for the Promotion of Mental Health

Qingpeng Zhang, Assistant Professor, City University of Hong Kong, Kowloon, Hong Kong - PRC, qingpeng.zhang@cityu.edu.hk

The digital footprints of Web users left on social media present important mental health proxies. In this work, we aim to characterize the dynamics of the online social groups for the mutual help of people suffering from depression. We identified unique features in both language and social interaction patterns, and interesting relationship between the two, which could have important implications of the causes and factors of depression.

2 - Adaptive Cluster-based Oversampling Method: Application to Gynecological Surgery Failure Prediction

Iman Nekooimehr, PhD Candidate, University of South Florida, 14304 Wedgewood Ct., Apt. 201, Tampa, FL, 33613, United States of America, nekooimehr@mail.usf.edu, Stuart Hart, Allison Wyman, Susana Lai-yuen

A new oversampling method called Adaptive Semi-Unsupervised Weighted Oversampling is presented for imbalanced dataset classification. It is adaptive, and avoids overgeneralization and overfitting. The method was used with Support Vector Machines to predict surgical failure after gynecological repair operations. Results show 76% weighted accuracy and improvement over other oversampling methods.

3 - Real-time Detection of System Change Points via Graph Theoretic Sensor Fusion

Prahalad Rao, SUNY Binghamton, 4400 Vestal Pkwy. E, Binghamton, NY, United States of America, prao@binghamton.edu, Chou-An Chou, Samie Tootooni

We propose a novel graph theoretic approach for detection of system change points from multidimensional sensor data. The approach is based on transform time series data into an un-weighted and undirected planar graph, and subsequently extracting topological invariants. This approach outperforms conventional statistics-based monitoring techniques. We demonstrate the effectiveness of the approach based on experimentally acquired sensor data from advanced manufacturing processes and healthcare.

4 - High-throughput Screening for Rule Discovery from High-dimensional Datasets

Mona Haghighi, University of South Florida, 3202 E Fowler Avenue, Tampa, FL, 33620, United States of America, monahaghighi@mail.usf.edu, Shuai Huang, Xiaoning Qian, Bo Zeng

We propose a rule-based methodology to Identify risk-predictive baseline patterns of Alzheimer's disease through a network-based mathematical model. We apply data-mining techniques to reduce dimensionality while taking care of synergistic interaction of variables. Selecting a set of rules to monitor the progression of the disease is the second part of this study.

TC32

32-Room 409, Marriott

Decision Support Systems for Data Mining

Contributed Session

Chair: Zhiguo Zhu, Associate Prof., Dongbei University of Finance and Economics, No. 217 JianShan St., Shahekou District, Dalian, 110625, China, zhuzg0628@126.com

1 - A Mixture Method of Multivariate Time Series Clustering

Cheng-Bang Chen, Penn State University, 233 Leonhard Building, University Park, PA, 16802, United States of America, czc184@psu.edu, Soundar Kumara

Time series clustering is widely used in different domains. Although much literature is available on time series clustering, only a few articles relate to multivariate time series clustering. This research developed a clustering methodology and applies different similarity/dissimilarity measures to multivariate time series datasets. It can reduce the data size and has good clustering performance.

2 - Mining Association between Promotions and Transactions to Find Optimum Time for Targeted Promotions

Hari Koduvely, Dr. Samsung, # 2870, Orion Building, Outer Ring Road, Bangalore, K, 560037, India, hari.koduvely@gmail.com, Roshni Mohandas

In the usual Targeted Promotion scenario one optimizes the promotion content tailored towards a consumer's purchase interests to maximize response. However time of targeting a promotion also equally important. In this paper we present a new method, based on the temporal association patterns between promotion and transaction events, to find the optimum time for targeted promotions. We validate our method against existing approaches on a real retail data set and show significantly better results.

3 - The Effect of Non-local Diversity in Dynamic Class Prediction

Senay Yasar Saglam, PhD Student, University of Iowa, 108 Pappajohn Business Building, S210, Iowa City, IA, 52242, United States of America, senayyasarsaglam@gmail.com, Nick Street

Classifiers' agreement in the region where a new data instance resides in has been considered a major factor in dynamic ensembles. We hypothesize that in this region the agreement among classifiers that are different is more important than among the similar ones. In other words, high local accuracy and confidence, and high diversity in other regions, is desirable. In this study, we check the validity of this hypothesis and verify that diversity still plays a role in the dynamic class prediction.

4 - Measuring Influence in Online Social Network Based on the User-content Bipartite Graph

Zhiguo Zhu, Associate Prof., Dongbei University of Finance and Economics, No. 217 JianShan St., Shahekou District, Dalian, 110625, China, zhuzg0628@126.com

How to precisely identify and measure influence has been a hot research direction. Differentiating from existing researches, we are devoted to combining the status of users in the network and the contents generated from these users to synthetically measure the influence diffusion. In this paper, we firstly proposed a directed user-content bipartite graph model. Finally, the experiment results verify our proposed model can discover most influential users and popular broads effectively.

■ TC33

33-Room 410, Marriott

Appointment Scheduling in Healthcare

Sponsor: Health Applications

Sponsored Session

Chair: Armagan Bayram, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60201, United States of America, abayram@northwestern.edu

1 - Ensuring Timely Access and Adequate Capacity for an Endocrinology Clinic

Moses Chan, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, United States of America, mosesyh@umich.edu, Amy Cohn, Amy Rothberg

The weight management program was designed to promote weight loss for morbidly obese patients. Program participation is associated with reductions in BMI and improvements in cardiovascular risk factors and quality of life. Providers are booked weeks out, posing a challenge to schedule consecutive weekly visits. Non-adherence to schedule undermines the effectiveness of the program. The purpose of this study is to improve patient compliance with the program and to increase program access.

2 - An Online Appointment Scheduling Model

Ali Kemal Dogru, Om PhD Student, University of Alabama, 315 Bidgood Hall, 361 Stadium Drive, Tuscaloosa, AL, 35487, United States of America, akdogru@crimson.ua.edu, Sharif Melouk

Incorporating patient centered medical home (PCMH) principles, we develop an online appointment scheduling system (OASS) for a primary care setting. We propose a simulation optimization solution approach that uses two models working in concert to provide high quality solutions (i.e., schedules) in short time. We aim to minimize: 1) weighted cost of expected patient waiting time and 2) doctor idle time and overtime. Key Words: Online Appointment Scheduling, Simulation Optimization, PCMH

3 - Managing Series Patients in a Healthcare Facility

Siyun Yu, STOR Department, UNC-Chapel Hill, B26 Hanes Hall, Chapel Hill, NC, 27514, United States of America, yusiyun@live.unc.edu, Vidyadhar Kulkarni, Vinayak Deshpande

Series patients are scheduled for a series of appointments, such as patients in physical therapy clinic, dialysis center, etc. To balance the demands from different

types of new as well as returning patients and the available appointment slots, we develop stochastic models to determine the number of slots and the scheduling policy that optimize performance. Heuristic policies are proposed which share the same structural properties of the optimal policy and are more computationally efficient.

4 - Managing Virtual Appointments in Chronic Care

Armagan Bayram, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60201, United States of America, abayram@northwestern.edu, Seyed Iravani, Sarang Deo, Karen Smilowitz

Virtual visits can assist in managing chronic conditions by providing low cost monitoring, treatment and education. Motivated by these benefits, we develop capacity allocation models that decide which patients to schedule given limited availability of both office and virtual visit slots. We model this problem using a dynamic programming framework over a finite horizon, and perform analytical and numerical analyses to identify policies for scheduling patients for different medical interventions.

■ TC34

34-Room 411, Marriott

Optimal Cancer Therapy

Sponsor: Health Applications

Sponsored Session

Chair: Kevin Leder, Assistant Professor, University of Minnesota, 111 Church St, Minneapolis, MN, 55455, United States of America, lede0024@umn.edu

1 - Nonstationary Spatiotemporally Integrated Fractionation

Ali Ajdari, University of Washington, Industrial and Systems Engineering, Seattle, WA, 98195, ali.adr86@gmail.com, Archis Ghate

We consider the optimal fractionation problem where the fluence-maps are allowed to change over treatment sessions. This results in a high-dimensional nonconvex dynamic optimization problem. We present an approximate solution method rooted in convex and dynamic programming.

2 - Treatment of Chronic Myeloid Leukemia with Multiple Targeted Therapies

Qie He, University of Minnesota, 111 Church Street SE, Minneapolis, MN, United States of America, qhe@umn.edu, Junfeng Zhu, Kevin Leder, Jasmine Foo

Recently several targeted therapies have been developed to treat Chronic Myeloid Leukemia (CML). A significant problem is the development of resistance to therapy in patients. Therapy combination can slow this development, but the number of combinations is huge. We develop a model to find combinations that are promising for clinical trials. The model captures cell evolution and toxicity constraints. Our optimal combinations are predicted to significantly outperform common clinical practice.

3 - Combined Therapy in Acute Lymphoblastic Leukemia

Kevin Leder, Assistant Professor, University of Minnesota, 111 Church St, Minneapolis, MN, 55455, United States of America, lede0024@umn.edu

Acute lymphoblastic leukemia is a cancer of the blood system. While successful treatment of the disease in juvenile patients is possible, it is difficult to treat in adult patients. One treatment modality is the use of the targeted therapy nilotinib. However, drug resistance is a serious issue. To avoid this drug resistance we consider the combination of nilotinib and radiation. We develop a mathematical model for this combined therapy and compare with experimental observations.

■ TC35

35-Room 412, Marriott

Disaster and Emergency Management I

Contributed Session

Chair: Rafael Diaz, Research Associate Professor, Old Dominion University, 1040 University Blvd, Suffolk, VA, 23435, United States of America, rdiaz@odu.edu

1 - An Optimization Model for Seismic Hazard Loss Analysis for Spatially Distributed Infrastructure

Hasan Manzour, Industrial & Systems Engineering, University of Washington, Box 352650, Seattle, WA, 98195-2650, United States of America, hmanzour@uw.edu, Rachel Davidson

The new Optimization-based Probabilistic Scenario method produces a small set of probabilistic ground motion maps to represent the seismic hazard for analysis of spatial distributed infrastructure. A set of just 124 ground motion maps were able to match the hazard curves based on a million-year Monte Carlo simulation. This enormous computational savings has substantial implications for regional-scale since it can allow many more downstream analyses.

2 - A Model of the Effect of Pandemic Influenza on the U.S. Blood Supply

Hussein Ezzeldin, FDA, CBER, 10903 New Hampshire Ave, Bldg 71 Rm 1009C, Silver Spring, MD, 20993, United States of America, hussein.ezzeldin@fda.hhs.gov, Arianna Simonetti, Richard Forshee

We present the spatial and temporal impact of Pandemic Influenza (PI) on the US blood supply through an inter-regional blood transfer system. We utilize a hybrid optimization heuristic to enhance the global performance of the network. Using Neural Networks trained by Particle Swarm Optimization, we model a function of regional factors to optimize the daily blood transfers among US regions. We simulate the effect of PI on regional blood transfers and compare to those during normal operations.

3 - Agent-Based Modeling to Simulate Resilience of Water Systems for Healthy and Secure Communities

Emily Berglund, Associate Professor, North Carolina State University, CB 7908, Raleigh, NC, 27695, United States of America, emily_berglund@ncsu.edu, Jacob Monroe, Hayden Strickling, Michael Knepper, Elizabeth Ramsey, M. Ehsan Shafiee

Civic water systems are vulnerable to attacks and disasters that threaten the health and security of communities. When water service is lost due to a water quality failure or an attack on critical infrastructure, the decision-making of perpetrators, security personnel, utility managers, and the public can influence event outcomes. An agent-based modeling approach is developed to simulate the impact of sensing, communication, security, and infrastructure management on community resilience.

4 - Decision Support to Air Rescue Unit Allocation in Disaster Management Operations

Sergio Reboucas, ITA, Rua H9C, Apt. 302, São Jose Dos Campos, SP, 12228612, Brazil, reb@ita.br

After a disaster break up, rescue helicopters have a valuable role in response phase. The allocation of these air rescue units requires knowledge about certain conditions that are most of times uncertain and its analysis and trade-offs must be thoroughly done. This paper aims to suggest a methodology to support the air rescue unit allocation decision in a natural disaster response phase context.

5 - Modeling Housing Stock Recovery after a Catastrophic Storm Event

Rafael Diaz, Research Associate Professor, Old Dominion University, 1040 University Blvd, Suffolk, VA, 23435, United States of America, rdiaz@odu.edu, David Earnest, ManWo Ng, Joshua G. Behr

Severe catastrophic storm events adversely affect housing stock and regional capacity to build and repair houses. Rebuilding this capacity takes time while the region faces an unexpected surge in the demand. We present a simulation model that considers a supply chain perspective. The model provides significant insights for policy makers into how the production of permanent housing depends upon the uncertainties and feedback effects of material, labor, funds, and regulatory environments.

■ TC36

36-Room 413, Marriott

Humanitarian Applications III

Sponsor: Public Sector OR

Sponsored Session

Chair: Melih Celik, Middle East Technical University, ODTÜ Kampüsü Endüstri Mühendisliği, Oda 219 Cankaya, Ankara, 06800, Turkey, cmelih@metu.edu.tr

1 - Pre-disaster Unmanned Air Vehicle Base Location and Routing for Road Damage Assessment and Repair

Seyyed Kian Farajkhah, Middle East Technical University, METU-Cankaya, Metu Campus Endüstri Mühendisliği, Ankara, 06800, Turkey, kian.farajkhah@metu.edu.tr, Melih Celik

Following large-scale disasters, unmanned air vehicles (UAVs) can help efficiently gather data on the status of the roads in the network. Given a set of potential disaster scenarios, we address the problem of establishing connectivity between relief supply and demand by means of road repair. A two-stage stochastic model is developed to determine a UAV base location and time-limited routes so that the expected shortest path length between the supply and demand nodes is minimized.

2 - Disaster Operations Management: Recovery Classification and Research Framework

Niratcha Grace Tungtisanont, PhD Candidate, Clemson University, 100 Regency Dr, #22, Central, SC, 29630, United States of America, ntungti@g.clemson.edu, Aleda Roth, Yann Ferrand

We propose a research framework for improving post-disaster phase recovery. We address what types of investments should be made and their relative allocations in the "pre" and "during" emergency phases to improve the effectiveness of the recovery process? We use the proposed framework to draw managerial and policy implications.

■ TC37

37-Room 414, Marriott

Kidney Allocation and Exchange

Contributed Session

Chair: Naoru Koizumi, Assoc Professor, GMU, 3351 N Fairfax Dr, Arlington, VA, 22203, United States of America, nkoizumi@gmu.edu

1 - The Dynamics of Kidney Exchange

John Dickerson, CMU, 9219 Gates-Hillman Center, Pittsburgh, PA, 15213, United States of America, dickerson@cs.cmu.edu, Tuomas Sandholm

We discuss analytic, optimization, and game-theoretic approaches to matching in dynamic kidney exchange. We consider dynamism (i) at the post-match pre-transplant stage (ii) as patients and donors arrive and depart over time, and (iii) as multiple exchanges compete for overlapping sets of participants. We empirically validate our models and theoretical results on over 150 match runs of the UNOS national kidney exchange.

2 - A New Model to Decide Kidney-Offer Admissibility Dependent on Patients' Lifetime Failure Rate

Michael Bendersky, Ben Gurion University of the Negev, Beersheba, Israel, michael.bendersky@gmail.com, Israel David

We propose a new model to decide kidney-offer admissibility depending on patient's age, estimated lifetime probabilistic profile and prospects on the waiting list. We allow for a broad family of lifetime distributions - Gamma - thus enabling flexible modeling of one's survival under dialysis. It yields the optimal critical times for acceptance of offers of different qualities and may serve the organizer of a donation program, the surgeon and the individual recipient practicing patient-choice.

3 - Preemptive Approach to Kidney Allocation in USA

Philip Appiah-Kubi, Ohio University, 14 Pine St, Apt. #1B, The Plains, OH, 45780, United States of America, pa809911@ohio.edu

The new kidney allocation policy improves kidney utilization. However, the policy has no consideration for allocation of cadaveric kidneys under emergency situations; a problem observed by the National Kidney Foundation. This research evaluates a point scoring model with considerations for emergency allocation. Simulated results indicate that the model minimizes number of waitlist deaths by 2% while prioritizing sensitive candidates and waiting time.

4 - Optimal Integration of Kidney Exchange Programs with Antibody Reduction Therapy

Naoru Koizumi, Assoc Professor, GMU, 3351 N Fairfax Dr,
Arlington, VA, 22203, United States of America,
nkoizumi@gmu.edu, Monica Gentili, Keith Melancon

Kidney paired donation (KPD) allows incompatible pairs to exchange kidneys with other incompatible pairs. However, evidence suggests there stills exist barriers to KPD utilization, especially among difficult-to-match transplant candidates and positive actual or virtual crossmatches. Using mathematical models, we investigate how to optimally integrate antibody reduction therapy in KPD to increase successful living-donor kidney transplants among difficult to match candidates.

■ TC38

38-Room 415, Marriott

Queueing Models II

Contributed Session

Chair: Benjamin Legros, Ecole Centrale Paris,
Grande Voie des Vignes, Chateauf-Malabry, 92290, France

1 - A New Look at Markov Processes of G/M/1-type

Jason Joyner, PhD Student, Clemson University, Clemson
University O-110 Martin Hall, Box 340975, Clemson, SC, 29634,
United States of America, jjoyner@g.clemson.edu

We present a new method for deriving the stationary distribution of an ergodic Markov process of G/M/1-type in continuous-time. Our method derives and makes use of a new representation for each element of the rate matrices contained in the stationary distribution. This method can also be modified to derive the Laplace transform of each transition function associated with Markov processes of G/M/1-type.

2 - Exact Simulation of Non-Stationary Reflected Brownian Motion

Mohammad Mousavi, Assistant Professor, University of
Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA, 15212,
United States of America, mousavi@pitt.edu

We discuss the challenges that arise in the planning simulations of systems with time dependent arrival and service rates. Estimating how far back in time a simulation must be initialized is an essential problem in planning simulations. We propound using reflected Brownian motion (RBM) with time-dependent drift and volatility as a guide for estimating this initialization time. We develop the first exact simulation method for RBM with time-dependent drift and volatility.

3 - Traffic Volume and Travel Time Variability under Random Interruptions

Marcelo Figueroa, PhD Student, Rutgers University, 93 Marvin
Lane, Piscataway, NJ, 08854, United States of America,
marcelo.figueroa@rutgers.edu, Melike Baykal-görsoy

We show the advantages of modeling the number of vehicles on a freeway corridor as an M/M/Infinity queueing system subject to random service degradation in order to obtain variability estimates for congestion and travel time delay. We make use of the analytical stationary distribution of the number of customers thus avoiding the use of traffic simulation. We validate our approach by using traffic count data, and relevant weather events and traffic incidents as causes of service degradation.

4 - Admission Control Policies for Multi-Channel Call Centers: Should We Delay the Call Rejection?

Benjamin Legros, Ecole Centrale Paris, Grande Voie des Vignes,
Chateauf Malabry, France, belegros@laposte.net

We study strategies of rejection in call centers with inbound and outbound calls. The firm is looking for the best possible trade-off between the inbound and outbound calls performance. Rejection at arrivals, so-called rejection "a priori" and rejection after experimenting some wait, so-called rejection "a posteriori" are considered. Our main finding is that rejection a posteriori provides a better performance in terms of waiting time for served customers than a rejection a priori.

■ TC39

39-Room 100, CC

Distribution Channel Management

Cluster: Operations/Marketing Interface

Invited Session

Chair: Xiaowei Xu, Associate Professor, Rutgers Business School-New Brunswick, 100 Rockefeller Rd., Piscataway, NJ, 08854,
United States of America, xiaoweix@andromeda.rutgers.edu

1 - Co-Advertising and Channel Power in Distribution Channels

Xiaowei Xu, Associate Professor, Rutgers Business School-New Brunswick, 100 Rockefeller Rd., Piscataway, NJ, 08854,
United States of America, xiaoweix@andromeda.rutgers.edu

We study a manufacturer-retailer channel, in which the manufacturer decides wholesale price as the channel leader and the retailer decides the retail price as the channel follower. Besides the retail price, customer demand is influenced by non-price marketing instruments, such as advertising. We identify business scenarios, under which the manufacturer should not participate any co-advertising campaign even if it's free, since doing so will increase the channel power of the retailer.

2 - Effects of Channel Intermediaries on Quality-price Competition

S. Chan Choi, Rutgers Business School-New Brunswick,
100 Rockefeller Road, Piscataway, NJ, 08854,
United States of America, chancoi@rci.rutgers.edu

We show that when products are vertically differentiated, the optimal channel structure depends on whether a company is a high- or low-quality producer. Either manufacturer benefits by channel integration while the competitor uses an intermediary, but this effect is stronger for the low-quality manufacturer. If an intermediary is to be used, the low-quality manufacturer has more incentive to use an exclusive dealer. But the total channel profit is higher with a common retailer.

3 - Fairness in Supply Chain Contracts with Sales Efforts

Ju Myung Song, Rutgers Business School, Room 430, 1
Washington Park, Newark, NJ, 07102, United States of America,
jumyung.song@rutgers.edu

Fairness is an important incentive for supply chain contract design. I consider a setting where a retailer chooses both retail price and sale effort to maximize profit, and analyze how fairness in a supply chain affects supplier and retailer's behaviors and their expected profits.

4 - A Longitudinal Analysis of Supplier Working Relations in Component Markets

Sengun Yeniyurt, Associate Professor, Rutgers Business School,
100 Rockefeller Rd, Piscataway, NJ, 08854, United States of
America, yeniyurt@business.rutgers.edu, Steven Carnovale,
John W. Henke

This study utilizes a longitudinal dataset that includes information regarding supplier working relations and sourcing transactions in the North American Automotive industry. Econometric models are developed and estimated utilizing information provided by first tier component suppliers to major automotive manufacturers. The estimates reveal the interplay between past interactions, future expectations, and working relations and their effect on transactional decisions in component markets.

■ TC40

40- Room 101, CC

Marketing I

Contributed Session

Chair: Robert Bordley, Expert Systems Engr Professional,
Booz-Allen-Hamilton, 525 Choice Court, Troy, MI, 48085,
United States of America, Bordley_Robert@bah.com

1 - How Cultural Difference Influences Consumer Behavior in Hypermarket Industry

Mei-Wen Chao, Assistant Professor, Kao Yuan University, 1821
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t80149@cc.kyu.edu.tw

No empirical research exists to discuss the issues of culture and consumer behavior in the hypermarket industry using the territory of Taiwan and the U.S. as the units of comparison. This paper attempted to explore grocery consumers' inner world and how their shopping perceptions vary between Taiwanese and American cultures. The contexts of interviews are given and additional findings are also put forward. Salient results and practical issues are discussed in detail in this paper.

2 - The Effect of Price Ending on Consumer Behavior

Yoshiyuki Okuse, Professor, Senshu University, 2-1-1,
Higashi-Mita, Tama-Ku, Kawasaki, 2148580, Japan,
okuse@isc.senshu-u.ac.jp

In the area of pricing research, a lot of researches on price endings have been developed. The purpose of this research is to specify the effect of price endings on consumer behavior in Japan.

3 - I Like using My Mobile Apps But...**A Study of Post Consumption Appraisal**

Anubha Mishra, Assistant Professor Of Marketing,
University of Idaho, 875 Perimeter Dr, Moscow, ID, 83844,
United States of America, amishra@uidaho.edu

The study of mobile app consumption suggested three distinct dimensions. Users' evaluation of control, freedom, newness, assimilation, and fulfillment of need from apps was captured by Perceived Benefits; Perceived Apprehension, covered chaos, enslavement, obsolescence, isolation, and creation of needs and Perceived Obscurity, examined ambiguity. Perceived usefulness positively influenced all dimensions indicating that while apps may be perceived as helpful, it can also create isolation.

4 - Increasing User Engagement with Mobile Analytics

Chaitanya Sagar, Chief Executive Officer, Perceptive Analytics,
353 West 48th Street, New York, NY, 10036,
United States of America, cs@perceptive-analytics.com

Mobile represents a tectonic platform shift with great opportunities and challenges. 80% of users do not return to an app after the first day of downloading it. 80% of total app revenue is 'in-app' purchases - so unless an app can engage users, it cannot generate significant revenue. Add to that, top 20% apps generate 97% of the revenue making fierce competition among 1.2 million apps. I focus on the heart of this problem increasing engagement with users specifically using push-notifications.

5 - Maximum Entropy Models of Individual Choice

Robert Bordley, Expert Systems Engr Professional, Booz-Allen-Hamilton, 525 Choice Court, Troy, MI, 48085, United States of America, Robert_Bordley@bah.com, Ehsan Soofi

Many forecasts are based on economic models of individual choice. But these models assume actual individual choice is rational, an assumption which some viewed as having been refuted. To avoid making this assumption, this paper shows that maximum entropy models can approximate general discrete choice models. This paper also shows how to parameterize such models in order to use them for forecasting.

TC41

41-Room 102A, CC

Joint Session MSOM-Health/HAS: Healthcare Operations

Sponsor: Manufacturing & Service Oper
Mgmt/Healthcare Operations

Sponsored Session

Chair: Alireza Sabouri, Assistant Professor, Haskayne School of Business, University of Calgary, Calgary, AB, Canada,
alireza.sabouri@haskayne.ucalgary.ca

1 - A Queueing Model for Liver Transplant Waiting List Process

Zinan Yi, Operations Research, North Carolina State University,
Raleigh, NC, United States of America, zyi@ncsu.edu, Maria Mayorga, Stephanie Wheeler, Sidney Barritt, Eric Orman

Liver transplant is the only therapy for patients with end stage liver disease. The composition and dynamics of the waiting list are the interest of both patients and doctors. In this paper, we used the United Network for Organ Sharing and Organ Procurement and Transplantation Network database to develop a queueing model for the waiting list population. Using the model, we will predict future waiting list and other characteristics.

2 - Investigating Steroid Withdrawal Strategies for Kidney Transplant Recipients

Yann Ferrand, Assistant Professor, Clemson University,
100 Sirmine Hall, Clemson, SC, 29634, United States of America,
yferran@clemson.edu, Vibha Desai, Christina Kelton,
Teresa Cavanaugh, Jaime Caro, Jens Goeble, Pamela Heaton

We evaluate various steroid withdrawal strategies for kidney transplant recipients. The goal is to minimize major complications resulting from these complex drug regimens over the long term. We develop a model calibrated with an econometric study of patient data from a national registry to simulate the long-term course of these patients. We report on the frequency and timing of adverse events and identify trade-offs in the steroid withdrawal strategies.

3 - Dynamic New Patient Consult Scheduling for Medical Oncology

Antoine Sauré, University of British Columbia, 2053 Main Mall,
Vancouver, BC, V6T 1Z2, Canada, antoine.sauere@sauder.ubc.ca,
Claire Ma, Jonathan Patrick, Martin Puterman

Motivated by an increasing demand for cancer care and long waits for new patient consults, we undertook a study of medical oncology scheduling practices at a regional cancer center. As a result, we formulated and approximately solved a discounted infinite-horizon MDP model that seeks to identify policies for allocating oncologist consultation time to incoming new patients, while reducing waits in a cost-effective manner. The benefits from the proposed method are evaluated using simulation.

4 - Optimal Issuing Policies for Hospital Blood Inventory

Alireza Sabouri, Assistant Professor, Haskayne School of Business,
University of Calgary, Calgary, AB, Canada,
alireza.sabouri@haskayne.ucalgary.ca, Steven Shechter, Tim Huh

We propose a model for allocating red blood cells for transfusion to patients, which is motivated by recent evidence suggesting that transfusing older blood is associated with increased mortality rate. We study the properties of blood issuance policies that balance the trade-off between "quality" measured in average age of blood transfused and "efficiency" measured in the amount of shortage. Based on our analysis, we design efficient issuance policies and evaluate their performance.

TC42

42-Room 102B, CC

Joint Session MSOM-Health/HAS: Workarounds, Errors and Interruptions in Healthcare

Sponsor: Manufacturing & Service Oper
Mgmt/Healthcare Operations

Sponsored Session

Chair: Anita Tucker, Associate Professor, Brandeis University,
415 South Street, Waltham, MA, 02453, United States of America,
atucker@brandeis.edu

1 - Hospital Operations and Patient Satisfaction

Sarah Zheng, Doctoral Candidate, Boston University, 16 Gold Star Rd., Cambridge, MA, 02140, United States of America,
xinzheng@bu.edu, Amy McLaughlin, Aubrey Podell,
Anita Tucker, Z. Justin Ren

We look at the impact of operations performance on service quality. Our study site is a nationally-ranked major hospital in the Boston area. Service quality is measured by both medical errors and patient satisfaction. Daily operations are measured by performance in about a dozen of its supporting services. We attempt to answer questions such as: What are the operational drivers of medical errors? To what extent does higher operations performance lead to higher patient satisfaction?

2 - Medical Errors in the Healthcare Delivery: An Econometric Analysis of the Operational Sources

Sriram Thirumalai, Associate Professor, Texas Christian University, Neeley School of Business, TCU Box 298530,
Fort Worth, TX, 76116, United States of America,
s.thirumalai@tcu.edu

Medical errors in the delivery of care is a significant cause of concern in healthcare supply chains. Based on an econometric analysis of a panel dataset on medical errors, this study serves to examine the sources of medical errors and error mitigation in the delivery of care in hospitals.

3 - The Impact of Workarounds on Patient Falls and Pressure Ulcers

Anita Tucker, Associate Professor, Brandeis University, 415 South Street, Waltham, MA, 02453, United States of America,
atucker@brandeis.edu

We present results from a survey of 100 medical/surgical nursing units that tests the impact of workarounds and operational failures on nursing sensitive patient outcomes, such as pressure ulcers, falls, patient satisfaction and infections.

4 - Batching of CSP Medication in In-Hospital Pharmacy

Vera Tilson, Simon School of Business, University of Rochester,
Rochester, NY, 14627, United States of America,
vera.tilson@simon.rochester.edu, Gregory Dobson, David Tilson

Hospital pharmacy departments batch production of Compounded Sterile Products (CSP). A change in a patient's condition can lead to change or cancellation of physician's orders. A very large proportion of orders are cancelled, which leads to waste custom compounded medication. We create an integer programming model to help pharmacies plan batch production trading off the cost of waste and the cost of employee labor.

■ TC43

43-Room 103A, CC

Joint Session RMP/MSOM: Choice Models: Estimation and Optimization

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Sumit Kunnumkal, Indian School of Business, Gachibowli, Hyderabad, India, Sumit_Kunnumkal@isb.edu

1 - Formulation, Motivation, and Estimation for the D-Level Nested Logit Model

Guang Li, University of Southern California, Bridge Hall 401, None, Los Angeles, CA, 90089-0809, United States of America, guangli@usc.edu, Huseyin Topaloglu, Paat Rusmevichientong

Using a tree of depth d , we provide a novel formulation for the d -level nested logit model. Our model is consistent with the random utility maximization principle and equivalent to the elimination by aspects model. Using new concavity results on the log-likelihood function, we develop an effective parameter estimation algorithm. Numerical results show that the prediction accuracy of the d -level nested logit model can be substantially improved by increasing the number of levels d in the tree.

2 - Assortment Optimization Over Time

James Davis, Cornell University, 290 Rhodes Hall, Ithaca, NY, United States of America, jamesmariodavis@gmail.com, Huseyin Topaloglu, David Williamson

Inspired by online retail we introduce a new type of assortment optimization problem: assortment optimization over time. In this problem the retailer must choose which products to display but must also choose an ordering for the products. This is a relevant problem when items are displayed as a list; this is common when returning results from a search query, for example. We provide a framework to analyze this problem, provide an approximation algorithm, and some hardness results.

3 - Tractable Bounds for Assortment Planning with Product Costs

Sumit Kunnumkal, Indian School of Business, Gachibowli, Hyderabad, India, Sumit_Kunnumkal@isb.edu, Victor Martínez-de-Albéniz

Assortment planning under a logit demand model is a difficult problem when there are product specific costs associated with including products into the assortment. In this paper, we describe a tractable method to obtain an upper bound on the optimal expected profit. We provide performance guarantees on the upper bound obtained. We describe how the method can be extended to incorporate additional constraints on the assortment or multiple customer segments.

4 - Clustering Consumers Based on Their Preferences

Ashwin Venkataraman, New York University, 715 Broadway, New York, NY, United States of America, ashwin.venkataraman@gmail.com, Srikanth Jagabathula, Lakshminarayana Subramanian

Preference-based clustering is an important and challenging problem. We propose a non-parametric method to cluster consumers based on their preferences for a set of items. Our method combines the versatility of model-free clustering (such as k -means) with the flexibility and rigor of model-based clustering (based on EM algorithm). Our approach is fast, can handle missing data, identify general correlation patterns in consumer preferences, and has provable guarantees under reasonable assumptions.

■ TC44

44-Room 103B, CC

Pricing in Online Markets

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Kostas Bimpikis, Stanford GSB, 655 Knight Way, Stanford, CA, 94305, United States of America, kostasb@stanford.edu

1 - Modeling Growth for Services: Evidence from the App Economy

Ken Moon, PhD Candidate, Stanford GSB, 655 Knight Way, Stanford, CA, 94305, United States of America, kenmoon@stanford.edu, Haim Mendelson

We present a model of service operations to grow and sustain customers by the operational design and performance of services, rather than marketing alone. Applying our framework to data from services in the app economy, we show (i) that customers' engagement contributes as powerfully to growth as virality; and (ii) evidence of an experience curve (from customer interactions) for service operations. We present a model of incentive-compatible pricing for this setting.

2 - Mobile Technology in Retail: The Value of Location-based Information

Marcel Goic, Assistant Professor Of Marketing, University of Chile, Republica #701, Santiago, 8370438, Chile, mgoic@dii.uchile.cl, Jose Guajardo

We analyze the value of location-based information in mobile retailing and the conditions under which incorporating geolocation information increase effectiveness metrics for retailers.

3 - Dynamic Pricing in Ride-Sharing Platforms

Siddhartha Banerjee, Postdoc, Stanford University, 475 Via Ortega, Stanford, CA, 94305, United States of America, sidb@stanford.edu, Carlos Riquelme, Ramesh Johari

We develop a model for ride-share platforms, which combines a queueing model for the platform dynamics with strategic models for passenger and driver behavior. Using this, we study various aspects of this system - the value of dynamic pricing versus static pricing; the robustness of these policies; the effect of heterogeneous ride-request rates and traffic between different locations. Joint work with Ramesh Johari, Carlos Riquelme and the Data Science team at Lyft.

4 - Pricing with Limited Knowledge of Demand

Maxime Cohen, MIT, 70 Pacific Street, Apt. 737B, Cambridge, MA, 02139, United States of America, maxcohen@mit.edu, Georgia Perakis, Robert Pindyck

How should a firm price a new product with limited information on demand? We propose a simple pricing rule that can be used if the firm's marginal cost is constant: the firm estimates the maximum price it can charge and then sets price as if demand were linear. We develop bounds that show that if the true demand is one of many commonly used demand functions, the firm will do "very well" - its profit will be close to what it would earn if it knew the true demand.

■ TC45

45-Room 103C, CC

Behavioral Issues in RM

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Anton Ovchinnikov, Queen's University, 143 Union Str West, Kingston, Canada, anton.ovchinnikov@queensu.ca

1 - Should Consumers be Strategic?

Arian Aflaki, Doctoral Student, Duke University, 100 Fuqua Drive, Box 90120, Durham, NC, 27708, United States of America, arian.aflaki@duke.edu, Robert Swinney, Prina Feldman

We consider whether strategic consumer behavior benefits consumers when they purchase from a rational, revenue-maximizing firm that sets prices over multiple periods. We show that strategic behavior does not benefit all consumers. Then, by studying a wide range of pricing and inventory strategies in a unified setting, we find that different strategies may induce different levels of interest in strategic behavior.

2 - Intertemporal Pricing under Minimax Regret

Ying Liu, Stern School of Business, New York University, 44 West 4th Street, KMC 8-154, New York, NY, 10012, United States of America, yliu2@stern.nyu.edu, Rene Caldentey, Ilan Lobel

We consider a monopolist selling a product to a population of consumers who are heterogeneous in valuations and arrival times. We study the policies that attain minimum regret when selling to either myopic or strategic customers. We characterize the set of optimal policies and demonstrate their structural properties.

3 - Behavioral Anomalies in Consumer Wait-or-Buy Decisions and the Implications for Markdown Management

Nikolay Osadchiy, Emory University, 1300 Clifton Rd NE, Atlanta, GA, 30322, United States of America, nikolay.osadchiy@emory.edu, Anton Ovchinnikov, Manel Baucells

A decision to buy at a tag price or wait for a possible markdown involves a trade-off between the value, delay, risk and markdown magnitude. We build an axiomatic framework that accounts for three well-known behavioral anomalies along these dimensions and produces a parsimonious generalization of discounted expected utility. We consider a pricing/purchasing game and show that accounting for the behavioral anomalies results in substantially larger markdowns and leads to noticeable revenue gains.

4 - Selling a Dream: Pricing under Savoring and Anticipation

Javad Nasiry, Assistant Professor, Hong Kong University of Science and Technology, ISOM, LSK Building, HKUST, Hong Kong, Hong Kong - PRC, nasiry@ust.hk, Ioana Popescu

We study a market where customers derive emotional utility from anticipating pleasurable purchase outcomes, but experience disappointment if outcomes fall short of what they anticipated. In this context, we show that firms can profit by adopting randomized pricing policies.

■ TC46

46-Room 104A, CC

Issues Related to Supply Chain Management

Sponsor: Manufacturing & Service Oper Mgmt/Service Operations

Sponsored Session

Chair: Achal Bassamboo, Professor, Kellogg School of Management, 2001 Sheridan Road, Evanston, IL, 60208, United States of America, abassamboo@kellogg.northwestern.edu

1 - Worker Poaching in a Supply Chain: Enemy from Within?

Evan Barlow, Northwestern University, Evanston, IL, United States of America, e-barlow@kellogg.northwestern.edu, Gad Allon, Achal Bassamboo

Poaching workers has become a universal practice. We explore worker poaching between firms linked in a supply chain. We show that the classical intuition from labor economics is insufficient in explaining poaching between supply chain partners. We also show how and under what conditions worker poaching can actually improve supply chain performance. Finally, we show how the equilibrium identity of the supply chain bottleneck depends on the interaction between hiring, poaching, and productivity.

2 - Dynamic Clustering and Assortment Personalization: The Value of Information Pooling

Sajad Modaresi, Duke University, 100 Fuqua Drive, Durham, NC, United States of America, sajad.modaresi@duke.edu, Denis Saure, Fernando Bernstein

A retailer faces heterogeneous customers with initially unknown preferences. The retailer can personalize assortment offerings based on available profile information; however, users with different profiles may have similar preferences, suggesting that the retailer can benefit from pooling information among customers with similar preferences. We propose a dynamic clustering approach that adaptively adjusts customer segments and personalizes the assortment offerings to maximize cumulative profit.

3 - Policing a Self-policing Firm: Incentives for Detection and Disclosure of Compliance Violations

Sang Kim, Yale School of Management, New Haven, CT, United States of America, sang.kim@yale.edu

One of the challenges in enforcement of environmental regulations is designing an effective incentive mechanism that elicits firms' voluntary detection and disclosure of compliance violations. With a right incentive, a firm self-polices its internal operations to detect random violations before a regulator does, and subsequently puts a remedial action in place. We study this incentive dynamic using a game-theoretic framework.

4 - Reshoring Manufacturing: Supply Availability, Demand Updating, and Inventory Pooling

Bin Hu, Assistant Professor, UNC Kenan-Flagler Business School, CB#3490 McColl Bldg, University of North Carolina, Chapel Hill, NC, 27519, United States of America, Bin_Hu@kenan-flagler.unc.edu, Li Chen

Reshoring shortens the distance from factory to market, however limited onshore supply availability may force reshoring manufacturers to remain dependent on offshore suppliers, leading to increased distance from supplier to factory. In this case, we show that manufacturers' preferences toward reshoring boil down to trade-offs between operational flexibilities. We characterize when manufacturers prefer reshoring, and further identify operational strategies that can swing such preferences.

■ TC47

47-Room 104B, CC

Topics in Remanufacturing and Recycling

Sponsor: Manufacturing & Service Oper Mgmt/Sustainable Operations

Sponsored Session

Chair: Gal Raz, Associate Professor, Ivey Business School, Western University, 1255 Western Road, London, ON, Canada, RazG@darden.virginia.edu

Co-Chair: James Abbey, Texas A&M University, 4217 TAMU 320P, College Station, TX, 77843, United States of America, jabbey@mays.tamu.edu

1 - Recycling as a Strategic Supply Source

Gal Raz, Associate Professor, Ivey Business School, Western University, 1255 Western Road, London, ON, Canada, RazG@darden.virginia.edu, Gilvan (Gil) Souza

In this paper we investigate how recycling can be used as a strategic source of supply in the presence of competition and a powerful material supplier. We examine the economic and environmental impact of a manufacturer's decision to recycle its products and the implications on the customers, supplier and society as a whole.

2 - The Effect of Environmental Regulation on DFE Innovation: Social Cost in Primary/ Secondary Markets

Cheryl Druehl, George Mason University, 4400 University Dr MS 5F4, Fairfax, VA, 22030, United States of America, cdruehl@gmu.edu, Vered Blass, Gal Raz

We examine DFE innovations in the use stage and for refurbishing of a firm selling new primary market products and refurbished products in a separate secondary market. The firm determines innovations, prices, and fraction collected. Using LCA data from cell phones, we compare EPR and Use stage regulations on profits and environmental impact.

3 - New Versus Refurbished: Key Factors that Influence Consumers' Decisions

Erin Mckie, University of South Carolina, 1014 Greene Street, Columbia, SC, 29208, United States of America, erinmckie@gmail.com, Mark Ferguson, Michael Galbreth, Sriram Venkataraman

Remanufacturing is increasingly providing new profit opportunities for firms, and more product condition options – such as new, refurbished, and used – for consumers to choose between. Using secondary data and choice model analysis techniques, this study estimates the influence of various factors on consumers' purchasing decisions.

4 - The Value of Competition in Remanufacturing

Narendra Singh, Georgia Institute of Technology, Atlanta, GA, United States of America, Narendra.Singh@scheller.gatech.edu, Karthik Ramachandran, Ravi Subramanian

We study an OEM's product strategy when the OEM offers a new product that depreciates over time and consumers are strategic. The OEM competes with a third-party remanufacturer for acquisition and remanufacturing of the depreciated products. We study how competition from the third-party remanufacturer affects the OEM.

■ TC48

48-Room 105A, CC

Managing Finances and Risk in Supply Chains

Sponsor: Manufacturing & Service Oper Mgmt/iFORM

Sponsored Session

Chair: Danko Turcic, Associate Professor Of Operations, Olin Business School, Washington University in St. Louis, St Louis, MO, United States of America, turcic@wustl.edu

Co-Chair: Panos Kouvelis, Professor, Olin Business School, Washington University in St. Louis, St Louis, MO, United States of America, kouvelis@wustl.edu

1 - Quality at the Source or Quality at the End? Managing Supplier's Quality under Information Asymmetry

Mohammad Nikoofal, Católica Lisbon School of Business & Economics, UCP, Palma de Cima, Lisbon, 1649-023, Portugal, mohammad.nikoofal@ucp.pt

In this paper, we first develop and then compare two different mechanisms for the buyer in order to control quality improvement efforts exerted by the supplier when the supplier has private information about his inborn reliability.

2 - Optimal Monitoring Decisions for Asset Based Lending

Nikolaos Trichakis, Harvard Business School, Boston, MA, United States of America, HBS, ntrichakis@hbs.edu, Dan Iancu, Do Young Yoon

We consider a firm financing its operations by collateralizing its working assets, e.g., inventory. To mitigate the risk due to the assets' uncertain valuation, the lender has a monitoring option entitling him to early repayment by liquidation. We derive the optimal liquidation policy, showing that it can have a nonthreshold structure. We derive bounds on the optimal monitoring time, and leverage them to devise simple heuristics, which perform well in numerical studies.

3 - Capital Structure with Flexible Future Investments

Qi Wu, Case Western University, Cleveland, OH, United States of America, Weatherhead School of Management, CWRU, qxw132@case.edu, Peter Ritchken

We analyze the interaction between investment and financing decisions in a dynamic contingent claims model where the firm has the ability to dynamically control production decisions of assets in place and has growth options to invest in that can be financed with debt and equity. The fundamental question to be addressed is how investment timing and financing decisions are affected by the existing capital structure and the nature of the operating flexibility inherent in the growth options.

4 - Make-to-Order vs. Make-to-Stock when Firms Compete, Input Costs, and Demand are Stochastic

Danko Turcic, Associate Professor of Operations, Olin Business School, Washington University in St. Louis, St. Louis, MO, United States of America, turcic@wustl.edu, Guang Xiao, Panos Kouvelis

This paper provides a new rationale for why firms choose long and short production lead times that is based, in part, on non-competitive behavior in product markets. We identify a set of conditions, which imply that some, otherwise identical, production firms want to choose long production lead times, while others choose short production lead times. The conditions are: (i) stochastic production costs, (ii) price-dependent demand, and (iii) strategic inventory withholding.

TC49

49-Room 105B, CC

Multi-Echelon Inventory Modeling

Sponsor: Manufacturing & Service Oper Mgmt/Supply Chain
Sponsored Session

Chair: Sean Willems, University of Tennessee, 453 Haslam Business Building, Knoxville, TN, 37996, United States of America, willems@bu.edu

1 - Velocity-based Storage in a Semi-automated Order Fulfillment System

Stephen Graves, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, sgraves@mit.edu, Rong Yuan

Online retailers continue to invest in technology to improve the efficiency of order fulfillment. This technology creates new operating challenges and opportunities. We examine a semi-automated fulfillment system in which pickers and stowers are stationary, and the inventory storage units are brought to them. We evaluate the effectiveness of velocity-based storage and consider how to deploy a velocity-based storage policy in light of picking, stowing and storage decisions.

2 - Incorporating an Operational Layer into the Guaranteed-service Inventory Optimization Approach

Steffen Klosterhalfen, University of Richmond, 1 Gateway Road, Richmond, VA, 23173, United States of America, steffenklosterhalfen@googlemail.com, Daniel Dittmar

The existing guaranteed-service contributions assume bounded demand and do not explicitly model how excess demand is handled by some type of flexibility measure. The lack of a clear operational description leaves the material flow representation somewhat incomplete and renders the approach controversial. We incorporate operating flexibility in the form expediting. By doing so we can work directly with the external (unbounded) demand and the entire material flow is easy to trace and understand.

3 - Multi-item Spare Parts Inventory Planning with Selective use of Advance Demand Information

Geert-Jan Van Houtum, Full Professor, Eindhoven University of Technology, P.O. Box 513, Eindhoven, 5600MB, Netherlands, g.j.v.houtum@tue.nl, Tarkan Tan, Engin Topan

We propose a multi-item, spare parts inventory system model with a general representation of imperfect demand information. We determine which parts should be monitored and how much stock should be kept for each component so that a given aggregate system availability is maintained. Our model allows excess inventory on stock and on order to be returned to the central depot or external supplier at a certain return cost. We also characterize the optimal ordering and return policy.

TC50

50-Room 106A, CC

Operations Economics

Sponsor: Manufacturing & Service Operations Management
Sponsored Session

Chair: Terry Taylor, U.C. Berkeley, Haas School of Business, 2220 Piedmont Avenue, Berkeley, CA, United States of America, taylor@haas.berkeley.edu

Co-Chair: Wenqiang Xiao, Associate Professor, New York University, Stern School of Business, 44 West Fourth Street, 8-72, New York, NY, 10012, United States of America, wxiao@stern.nyu.edu

1 - Strategic Outsourcing under Competition and Asymmetric Information

Lusheng Shao, University of Melbourne, Melbourne, Australia, lusheng.shao@unimelb.edu.au, Xiaole Wu, Fuqiang Zhang

This paper studies two firms' outsourcing strategies under competition and asymmetric cost information. We find that without asymmetric information, the firms will choose the supplier with smaller cost uncertainty. However, with information asymmetry, the supplier with greater cost uncertainty may be preferred.

2 - Information Preferences in the Supply Chain under Strategic Inventory

Abhishek Roy, PhD Student, McCombs School of Business, University of Texas at Austin, 2110 Speedway Stop B6500, Austin, TX, 78712, United States of America, abhishek.roy@utexas.edu, Steve Gilbert, Guoming Lai

We investigate how the possibility of strategic inventory influences the preferences for information sharing between supply chain partners. Among other results, we show that the presence of strategic inventory may alter traditional information preferences of the supply chain partners regarding the creation of a mechanism for sharing information about the retailer's operation with the supplier.

3 - Product Quality in a Distribution Channel with Inventory Risk

Kinshuk Jerath, Columbia University, 521 Uris Hall, 3022 Broadway, New York, NY, 10027, United States of America, jerath@columbia.edu, Sang Kim, Robert Swinney

We analyze a situation in which a product has to be designed and sold under demand uncertainty. We consider the jointly optimal quality and inventory decision in both a centralized channel (a single firm determines both) and a decentralized channel (a manufacturer determines quality while a retailer determines inventory), and discuss how demand uncertainty impacts the optimal quality-inventory pair and how coordination of the decentralized channel may be achieved.

4 - Congested Platforms

Terry Taylor, U.C. Berkeley, Haas School of Business, 2220 Piedmont Avenue, Berkeley, CA, United States of America, taylor@haas.berkeley.edu

In a platform business model, the platform firm provides a per-service wage payment to independent agents (e.g., drivers in riding-sharing services (e.g., Uber), shoppers in delivery services (e.g., Instacart)) to motivate them to provide service to customers. This paper uses a queueing model to examine the impact of congestion on the platform's optimal price and wage.

■ TC51

51-Room 106B, CC

Online Retailing

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Dorothee Honhon, Associate Professor, University of Texas at Dallas, 800 W. Campbell Road, Richardson, TX, 75080, United States of America, Dorothee.Honhon@utdallas.edu

Co-Chair: Amy Pan, Assistant Professor, University of Florida, Dept. of ISOM, Warrington College of Business Administration, Gainesville, FL, 32608, United States of America, amy.pan@warrington.ufl.edu

1 - Counteracting Strategic Purchase Deferrals: The Impact of Online Retailers' Return Policy Decisions

Tolga Aydinliyim, Baruch College, One Bernard Baruch Way, Dept of Management Box B9-240, New York, United States of America, Tolga.Aydinliyim@baruch.cuny.edu, Mehmet Sekip Altug

We study the impact of (i) forward-looking (i.e., discount-seeking) consumer behavior and (ii) consumers' sensitivity to clearance period stock availability on retailers' returns management decisions and the ensuing demand segmentation and profit effects in both monopolistic and competitive settings.

2 - Replenishment under Uncertainty in Online Retailing

Jason Acimovic, Penn State University, 462 Business Building, University Park, PA, 16802, United States of America, jaa26@smeal.psu.edu, Stephen Graves

Online retailers often may serve most customers from any warehouse location. Simple order-up-to policies are easy to implement; however, they may perform suboptimally leading to high shipping costs. We propose a replenishment heuristic based on bringing inventory up to a target level on the day inventory arrives. We calculate robust target levels, taking into account demand uncertainty, shipping costs, and estimated stockout costs. We show how this policy performs on realistic data.

3 - Optimal Spending for a Search Funnel

Shengqi Ye, The University of Texas at Dallas, 800 West Campbell Road, Richardson, TX, 75080, United States of America, sxy143530@utdallas.edu, Goker Aydin, Shanshan Hu

Sponsored search marketing has been a major advertising channel for online retailers. Recent observation indicates that not all customers finalize their purchase decision after their first search query. Instead, customers might take a path of keywords and clicks - a search funnel - to complete a conversion. Noting this behavior, we investigate a retailer's optimal advertising budget allocation across keywords in the search funnel.

4 - Omnichannel Inventory Management with Buy-Online-and-Pickup-in-Store

Fei Gao, The Wharton School, University of Pennsylvania, 3730 Walnut Street, 500 Jon M. Huntsman Hall, Philadelphia, PA, United States of America, feigao@wharton.upenn.edu, Xuanming Su

Many retailers offer customers the option to buy online and pick up orders in store. We study the impact of this omnichannel strategy on store operations and offer recommendations to retailers.

■ TC52

52-Room 107A, CC

Machine Learning Applications in Marketing

Sponsor: Marketing Science

Sponsored Session

Chair: Daria Dzyabura, Assistant Professor of Marketing, NYU Stern School of Business, 40 West 4th Street, Tisch 805, New York, NY, 10012, United States of America, ddzyabur@stern.nyu.edu

1 - Big Data Pricing

Eric Schwartz, University of Michigan, Ann Arbor, Michigan, United States of America, ericmsch@umich.edu, Kanishka Misra

We study how a firm should maximize revenue by dynamically setting its price over time for a new product. We solve this optimal experimentation problem as a multi-armed bandit problem combined with economic theory. The approach adds to dynamic pricing in marketing and econometrics using non-parametric identification of demand by using reinforcement learning. In particular, we derive a pricing algorithm based on upper confidence bound and illustrate its theoretical and empirical properties.

2 - Nonparametric Demand Predictions for New Products

Srikanth Jagabathula, NYU, 44 West Fourth Street, New York, NY, United States of America, sjagabat@stern.nyu.edu, Lakshminarayanan Subramanian, Ashwin Venkataraman

Predicting demand for new products is important and challenging. Existing parametric approaches require selection of relevant features of products and specification of the parametric structures, both of which are challenging. We propose a non-parametric approach combining ideas from "Learning to Rank" in machine learning and "Choice Estimation" in operations and marketing. The resulting methods can be used out-of-the-box and allow us to predict the impact of changes in product features.

3 - A Structured Analysis of Unstructured Big Data Leveraging Cloud Computing

Xiao Liu, Assistant Professor Of Marketing, New York University, 44 West 4th Street, New York, NY, 10012, United States of America, xiaoliu@andrew.cmu.edu, Kannan Srinivasan, Param Vir Singh

In this study, we combine methods from cloud computing, machine learning and text mining to illustrate how content from social media can be effectively used for forecasting purposes. We conduct our analysis on a staggering volume of nearly two billion Tweets. Our main findings highlight that, in contrast to basic surface-level measures such as volume or sentiment, the information content improve forecasting accuracy significantly.

4 - Modeling Multi-taste Consumers

Liu Liu, NYU Stern School of Business, 40 West 4th Street, Tisch Hall, Room 825, New York, NY, 10012, United States of America, lliu@stern.nyu.edu, Daria Dzyabura

In many product categories where recommendation systems are used, a single consumer may have multiple different tastes. We propose a framework for modeling choice behavior of such a multi-taste consumer and an iterative algorithm for estimation. We test it in numerical studies and an empirical application (Allrecipes.com). Our results show that it has superior out-of-sample predictive performance than single-taste models and is able to accurately recover parameters in simulation studies.

■ TC53

53-Room 107B, CC

Grab Bag of Behavioral Papers

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Kenneth Schultz, Associate Professor, AFIT, 2950 Hobson Way, WPAFB, OH, 45433, United States of America, Kenneth.Schultz@afit.edu

1 - The Influence of Education and Experience Upon Contextual and Task Performance in Warehouse Operations

Allen Miller, Student, Air Force Institute of Technology, 2950 Hobson Way, WPAFB, OH, 45433, United States of America, Allen.miller@afit.edu

We believe worker-performance may be affected by the individual's knowledge of why and where they fit into a larger system, defined as mission clarity. We conduct a controlled experiment to discern how education, experiences and subject characteristics impact mission clarity and subsequently contextual and task performance in a pick-and-pack operation.

2 - Personal Bias and Contract Setting

Julie Niederhoff, Syracuse University, Syracuse, NY, United States of America, jniederh@syr.edu

The efficacy and necessity of coordinating contracts has a strong analytical support, but experimental work shows that decision makers do not set the contracts as theory prescribes. Alternative objective functions of risk and fairness are explored at the individual level to understand when and for whom the contracts are most and least effective and necessary.

3 - The Influence of Emergency Medical Services Load on Paramedics On-scene Clinical Decisions

Mohammad Delasay, Post-doctoral Fellow, Tepper School of Business, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, United States of America, delasays@andrew.cmu.edu, Kenneth Schultz, Armann Ingolfsson

We investigate the effect of emergency medical system load on paramedics' medical decisions. We hypothesize that paramedics' decisions about on-scene time and transporting a patient to hospital are influenced by the emergency system load. We test our hypotheses by analyzing a data set of emergency responses in Calgary, Canada.

4 - The Bright Side of Managerial Overconfidence

Juan Li, Assistant Professor, Nanjing University, No. 5 Ping Cang Xiang, Nanjing, China, juanli@nju.edu.cn, Baojun Jiang, Fuqiang Zhang

Managers are often overconfident about the accuracy of their demand forecast. This paper shows that the firm may actually benefit from such overconfidence bias whether or not its competitor has such bias. Further, such bias can lead to a win-win situation for both competing firms.

TC54

54-Room 108A, CC

Discrete Optimization Models for Homeland Security and Disaster Management

Cluster: Tutorials

Invited Session

Chair: Laura Mclay, Associate Professor, University of Wisconsin, 1513 University Ave, ISYE Department, Madison, WI, 53706, United States of America, lmclay@wisc.edu

1 - Discrete Optimization Models for Homeland Security and Disaster Management

Laura Mclay, Associate Professor, University of Wisconsin, 1513 University Ave, ISYE Department, Madison, WI, 53706, United States of America, lmclay@wisc.edu

Preparing for and responding to disasters, including acts of terrorism, is an important issue of national and international concern. Recent disasters underscore the need to manage disasters to minimize their impact on critical infrastructure and human suffering. In this tutorial, we survey the operations research literature that develops, analyzes and applies discrete optimization models to effectively mitigate, prepare for, respond to and recover from a wide variety of disasters.

TC55

55-Room 108B, CC

Outsourcing I

Contributed Session

Chair: Ting Luo, University of Texas at Dallas, 800 W Campbell Rd, Richardson, TX, 75080, United States of America, ting.luo@utdallas.edu

1 - Outsourcing Supplier Selection: Quality-driven Demand and Taguchi Loss Function

Yanni Ping, Drexel University, 3220 Market Street, Gerri C. LeBow Hall 730, Philadelphia, PA, 19104, United States of America, yp86@drexel.edu, Seung-lae Kim, Min Wang

Facing limited capacity, a manufacturer would often rely on external suppliers. How to select suppliers to work with becomes a strategic decision particularly when demand for the final product is quality driven. In this talk, we adopt a Taguchi loss function as a supplier's quality measurement and present a dynamic programming model to explore how supplier quality affects manufacturer's outsourcing strategy. We propose simple and efficient algorithms for supplier selection in a dynamic setting.

2 - Fixed Entry Cost Effect on Contract Length and Renewals in a Maintenance Service Contract Systems

Rodrigo Ulloa, Pontificia Universidad Católica de Chile, Av. Vicuña Mackenna 4860, Santiago, Chile, rsulloa@uc.cl, Alejandro Mac Cawley, Rodrigo Pascual, Gabriel Santelices

We analyze how the inclusion of a fixed entry cost will affect the decision making of a maintenance contract, using a model that evaluates the contract value for the vendor according to the contract duration and its renewals. The analysis considers different scenarios that show the existence of a relationship between the length of the contract and the amount of renovations from which the contract is valuable for the vendor.

3 - Long-term Outsourcing under Stochastic Learning and Information Asymmetry

Ting Luo, University of Texas at Dallas, 800 W Campbell Rd, Richardson, TX, 75080, United States of America, ting.luo@utdallas.edu

Suppliers can reduce their cost through learning by doing, however their learning abilities and outcomes are kept as private information. When buyers design the procurement contract, they must consider the above effects. We study the interplay of stochastic learning and information asymmetry. We show that the stochastic learning has a profound impact on the optimal contract.

4 - Opportunism in Manufacturing Outsourcing

Keith Skowronski, The Ohio State University, Fisher 251A, 2100 Neil Avenue, Columbus, OH, 43210, United States of America, skowronski.2@osu.edu, W. C. Benton

Using dyadic buyer-supplier data, we empirically examine two types of supplier opportunism, poaching and shirking, in manufacturing outsourcing relationships. In this multi-country study, the legal environment of the supplier's location is hypothesized to moderate the relationships between exchange hazards, relational governance mechanisms and the different forms of opportunism.

5 - Suppliers as Liquidity Providers

Panos Markou, IE Business School, Calle Maria de Moina 12 Bajo, Madrid, 28006, Spain, pmarkou.phd2016@student.ie.edu, Daniel Corsten

Using a novel dataset comprising the top 10 suppliers of more than 80,000 public and private companies, we examine the value of having a supplier that is not financially constrained. For financially constrained customers, holding cash is costly. However, we show that having even one financially unconstrained supplier allows these customers to "outsource" some of their cash holdings. Financial standing is an important consideration when choosing suppliers.

TC56

56-Room 109A, CC

Commercialization of New Technologies

Cluster: New Product Development

Invited Session

Chair: Karthik Ramachandran, Georgia Institute of Technology, 800 West Peachtree NW, Atlanta, GA, 30308, United States of America, Karthik.Ramachandran@scheller.gatech.edu

Co-Chair: Sreekumar Bhaskaran, SMU, Dallas, TX, United States of America, sbhaskar@cox.smu.edu

1 - Product Line Design for Strategic Customers

Saurabh Bansal, Assistant Professor, Penn State Univrsity, 405 Business Building, University Park, PA, 16802, United States of America, sub32@psu.edu, Karthik Ramachandran

We report results for optimal product line design when customers are strategic about uncertain quality of products. Our analysis explains evolution of product lines observed in practice.

2 - Licensing Contracts: Control Rights and Options

Niyazi Taneri, SUTD, 8 Somapah Rd, Singapore, Singapore, niyazitaneri@sutd.edu.sg, Pascale Crama, Bert De Reyck

Research and development (R&D) collaborations, though common in high-tech industries, are challenging to manage due to technical and market risks as well as incentive problems. We investigate the impact of control rights, options, payment terms and timing decisions on R&D collaborations between an innovator and a marketer. We provide recommendations on the optimal contract structure and timing based on the R&D project characteristics.

3 - Does Equity Crowdfunding Improve Entrepreneurial Firm Performance?

Susanna Khavul, UTA/London School of Economics, London, United Kingdom, s.khavul@lse.ac.uk, Saul Estrin

As a fast moving financial innovation, equity crowdfunding may relax resource constraints for new ventures. Using four years of proprietary data, we model how information provision, generation, and exchange affects the supply of funds and likelihood of pitch funding. We evaluate this against the survival and performance of the firms that sought funding.

■ TC57

57-Room 109B, CC

Long-Term Electric Power System Planning Models

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Ramteen Sioshansi, Associate Professor, The Ohio State University, Integrated Systems Engineering, 1971 Neil Avenue, Columbus, OH, 43210, United States of America, sioshansi.1@osu.edu

1 - Optimizing Storage Operations in Longer-term Power System Models

Sonja Wogrin, Comillas Pontifical University, Calle Alberto Aguilera 23, Madrid, Spain, sonja.wogrin@comillas.edu,
David Galbally, Javier Reneses

In a rapidly changing power system the proper characterization of storage behavior becomes an increasingly important issue. We propose a new formulation to capture storage behavior in medium- and long-term power system models that use a load duration curve. In such models the chronology among individual hours is lost; our approach addresses related shortcomings and is able to accurately replicate hourly evolution of storage levels while keeping computational time tractable.

2 - Multi-stage Investment in Renewable Energies via Linear Decision Rules

Maria Ruth Dominguez Martin, Universidad de Castilla - La Mancha, Av. Carlos III, s/n, Toledo, Spain,
Ruth.Dominguez@uclm.es, Miguel Carrion, Antonio Conejo

Investment in generating capacity involves high uncertainty. In the real world, these decisions are usually made in several stages. We propose a multi-stage investment model to transform a thermal-based power system into a renewable-dominated one. We consider the uncertainty of the demand growth and the investment costs, as well as the variability of the renewable power production throughout the year.

3 - Impact of Unit Commitment Constraints on Generation Expansion Decisions under Wind Uncertainty

Jalal Kazempour, Technical University of Denmark, Department of Electrical Engineering, Kgs. Lyngby, 2800, Denmark,
seykaz@elektro.dtu.dk, Amin Nasri, Antonio Conejo

Most of available generation expansion decision-making tools in the literature neglect a number of unit commitment (UC) constraints, e.g., on/off commitment status, ramping limits and minimum production level of thermal units. This study analyzes the impact of those constraints on generation expansion decisions in power systems with significant wind power integration. To this end, a two-stage stochastic programming problem is proposed and solved using a decomposition technique.

4 - Stochastic Generation and Transmission Investment Planning Model

Yixian Liu, The Ohio State University, 210 Baker Systems Bldg., 1971 Neil Ave., Columbus, OH, 43210, United States of America,
liu.2441@osu.edu, Ramteen Sioshansi

Increasing electricity demand makes it necessary to expand the capacity of the current electrical grid. We propose a multi-stage stochastic linear programming model to seek an optimal investment plan in generators, storage devices and transmission lines in a long time horizon. Multiple uncertainties are considered involving both investment and dispatch decisions. The model is large in scale and may take excessive computational time to be solved. Decomposition methods will be applied to solve it.

■ TC58

58-Room 110A, CC

Electricity and System Resilience

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Valerie Thomas, Professor, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, United States of America, valerie.thomas@isye.gatech.edu

1 - Stochastic Model for Assessment of Thermoelectric Power Generation Drought Risk under Climate Change

Royce Francis, George Washington University, 800 22nd St. NW B1850, Washington, DC, 21212, United States of America,
seed@gwu.edu, Behailu Bekera

The objective of this article is to propose a stochastic method for analyzing drought risk to the thermoelectric power generation infrastructure sector due to its heavy reliance on freshwater availability. In particular, this article proposes a thermoelectric drought characterization framework from which a stochastic

drought risk assessment model is constructed from the thermoelectric power sector's operational perspective.

2 - Portfolio Approach for Optimal Rooftop Solar Arrays Selection for Distributed Generation

Olufemi Omitaomu, Senior Research Scientist, Oak Ridge National Laboratory, 1 Bethel Valley Road, MS-6017, Oak Ridge, TN, 37831, United States of America, omitaomuoa@ornl.gov,
Xueping Li

We present a portfolio selection approach that consider thousands of buildings with different solar energy potential and that are being considered for utility-scale distributed power generation. Our approach uses Markowitz mean-variance portfolio selection model to select suitable rooftops by identifying a combination of buildings that will maximize solar energy outputs and minimize system variability. Our approach is implemented using some real data-sets.

■ TC59

59-Room 110B, CC

Impacts of Climate Change

Sponsor: ENRE – Environment II – Forestry

Sponsored Session

Chair: Chris Lauer, Oregon State, Portland, OR, United States of America, cjlaue@gmail.com

1 - Planning Forest Harvesting under Climate Change: A Stochastic Optimization Model

Jordi Garcia, Researcher, Instituto Superior de Agronomia, Universidade de Lisboa, Portugal, Tapada da Ajuda., Lisbon, Portugal, jordigarcia@isa.ulisboa.pt, Andres Weintraub,
Cristobal Pais, Joanna Bachmatiuk

In this paper we consider a medium term forest planning problem in the presence of uncertainty due to climate change. For each time period the forest planner must decide which areas to cut in order to maximize expected net profit. A multistage stochastic model using 32 climate scenarios was developed and solved to determine optimal harvesting decisions under uncertainty. The stochastic solutions were compared to the solution of a deterministic model where an average climate scenario was used.

2 - Will Climate Change Induced Effects Cause Harm to Value Chains of the Bio-based Industry?

Peter Rauch, Pd, BOKU, Feistmantelstrasse 4, Wien, 1180, Austria, peter.rauch@boku.ac.at

Uncertainty increasingly affects ecosystems and storms and bark beetle infestations are the main causes of forest damage. Risks and their impacts on value chains of the bio-based industry are evaluated by a System Dynamics model of the Austrian wood supply including a stochastic simulation of risk agents. Results provide insights on probabilistic future wood supply security for sawlogs, pulpwood resp. energy wood and reveal a contra-intuitive system effect for the climate change scenario.

3 - Multiobjective Optimization to Study the Impact of Climate Change on the Joint Provision of Ecosystem Services

Nick Kullman, Masters Student, University of Washington, 360 Bloedel Hall, Seattle, WA, United States of America, nick.kullman@gmail.com, Sventlana Kushch, Sandor Toth

Climate change has been shown to alter the provision of forest ecosystem services such as carbon sequestration and wildfire mitigation. Less understood is how climate change will alter the tradeoffs among ecosystem services acquired simultaneously. We present a scenario-based multi-objective mathematical programming method to study these changes on the joint provision of ecosystem services in the Deschutes National Forest.

4 - Incorporating Acclimation and Feedback into Reserve Selection During Climate Change

Austin Phillips, University of Washington, Seattle, WA, United States of America, austinjphillips90@gmail.com, Sandor Toth, Robert Haigh

Climate change threatens many species, and conservation in such a dynamic setting is challenging. We developed a mixed integer reserve selection model that pairs population dynamics and sequential selection in a nonlinear feedback loop. The model accounts for species' ability to acclimate, as well as disperse, to track suitable conditions. We explore optimal management strategies to facilitate species' survival as they disperse and acclimate in response to warming.

■ TC60

60-Room 111A, CC

Disruption Management

Contributed Session

Chair: Min Ouyang, Associate Professor, Huazhong University of Science and Technology, Room W308 in S1 Building, 1037 Luoyu Road, Wuan, 430074, China, mouyang618@gmail.com

1 - Transportation Network Protection: A Model with Variable Flow Demand

Stefano Starita, PhD Researcher, Kent Business School, University of Kent, University of Kent, Canterbury, CT2 7PE, United Kingdom, s.starita@kent.ac.uk, Dr. Maria Paola Scaparra

Protecting transportation infrastructure is critical to avoid life and economic losses. We model a fortification problem on an all-pairs, flow-based network. To model system users' behavior, the traffic demand is assumed to be dependent on the length of the shortest path available. We present an efficient heuristic solution approach and a case study on the London tube.

2 - Comparison of Supply Chain Recovery Policies After a Major Disruption

Joanna Marszewska, Assistant Professor, Jagiellonian University, Department of Japanology and Sinology, Krakow, 31120, Poland, rokimi@op.pl, Tadeusz Sawik

Different recovery policies of a supply chain after major disruption caused by natural disasters are presented. The Japan's competitiveness-robustness dilemma is discussed against a resilient supply chain design strategy. Single, dual or multiple sourcing, improved suppliers visibility, protection of suppliers against natural disasters and prepositioning of emergency inventory of product-specific parts along a supply chain are considered and their impact on the recovery process is analyzed.

3 - Cargo Prioritization and Terminal Allocation in Case of Inland Waterway Disruption

Liliana Delgado Hidalgo, Graduate Student, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, AR, 72701, United States of America, ld002@uark.edu, Heather Nachtmann

We propose a solution approach to reroute barges in case of an Inland waterway disruption. The first part of the solution uses an Analytic Hierarchical Process (AHP) to assign priority index to the barges. We formulate a Integer Linear Problem to assign the barges to the terminals where the cargo is offloaded to be transported by a different transportation mode. The AHP results are used to schedule the barges assigned to a terminal. A case example is presented to illustrate our results.

4 - Resilient Design in Agribusiness Supply Chain under Supply Disruptions

Golnar Behzadi, PhD Student, University of Auckland, Level 2, Room 439-215, 70 Symonds St, Auckland, 1010, New Zealand, gbeh681@aucklanduni.ac.nz, Abraham Zhang, Tava Olsen, Michael O'sullivan

Agribusiness supply chains have limited lifecycle of products, seasonality of supply and demand, long lead time for production and delivery, and supply that is affected by climatic variability, which makes them especially vulnerable to supply disruptions. A special approach to risk management is required and here we consider resilience. Resilience incorporates concepts from vulnerability and risk management to address the recovery of a system from disruptions (rare high-impact risks).

5 - Decision Support for Critical Infrastructure Resilience Enhancement

Min Ouyang, Associate Professor, Huazhong University of Science and Technology, Room W308 in S1 Building, 1037 Luoyu Road, Wuan, 430074, China, mouyang618@gmail.com

It develops a framework of resilience decision support system RDSS for critical infrastructures. This RDSS includes seven modules: Data Input, Property Statistics, Scenario Generation, Vulnerability Analysis, Restoration Simulation, Resilience Assessment and Strategy Exploration, which together allow for statistically and visually exploration of critical infrastructure system resilience under point and period disruption scenarios and facilitates effectiveness analysis of resilience strategies.

■ TC61

61-Room 111B, CC

Sustainable and Responsible Supply Chain Management

Sponsor: ENRE – Environment I – Environment and Sustainability
Sponsored Session

Chair: Jose Cruz, Associate Professor, University of Connecticut, 2100 Hillside Road, Storrs, CT, 06269, United States of America, Jose.Cruz@business.uconn.edu

1 - Corporate Social Responsibility and Supply Chain Profitability

Zugang Liu, Associate Professor, Penn State Hazleton, 76 University Dr, Hazleton, PA, United States of America, zxl23@psu.edu, Trisha Anderson, Jose Cruz

We find that environmental and social responsible activities have different impacts on different stages of supply chains. For manufacturers, positive social activities and negative environmental activities increase the return on assets; for wholesalers, neither social nor environmental activities has significant impact; for retailers, negative environmental activities negatively affect the return on assets.

2 - The Amazon Tax and E-tailer Supply Chains

Trisha Anderson, Associate Professor, Texas Wesleyan University, 1201 Wesleyan Street, Fort Worth, TX, United States of America, trdanderson@txwes.edu, Kevin McGarry

We study two hypothesis to address a key legal question that e-tailers consider when opening up distribution centers: whether they should operate under the assumption that collecting state sales tax for all online transactions is inevitable or continue to strategically position themselves to minimize the tax burden where possible, even if it compromises supply chain strategic positioning. We also study the environmental implications of these e-tailer supply chain decisions.

3 - Social Responsibility Investments: Financial Networks, Transaction Cost, and Risk Effects

Jose Cruz, Associate Professor, University of Connecticut, 2100 Hillside Road, Storrs, CT, 06269, United States of America, Jose.Cruz@business.uconn.edu

This paper develops a network equilibrium model in conjunction with capital asset pricing model (CAPM) and the net present value (NPV) to determine the optimal portfolio, prices, profits, and equity values of financial network firms under financial risks and economic uncertainty. We investigate how social responsible financial investment decisions affect the values of interconnected financial firms from a network perspective.

4 - Green Building Decision-making using an Exploration and Exploitation Approach

John Dickson, Symphony Teleca Analytics, 5360, Legacy Drive, Plano, TX, United States of America, john.dickson@mavs.uta.edu, Jay Rosenberger, Victoria Chen

The experiments or simulations conducted by computers can be a tedious task, which require substantial computational time. This research focuses on developing a surrogate based optimization, in which we iteratively build a surrogate model, using few points and then optimize the model by adding more points until the best solution is found. A single story residential green building based in California is used as a case study.

■ TC62

62-Room 112A, CC

Optimization in Bio-energy

Cluster: Energy Systems: Design, Operation, Reliability and Maintenance
Invited Session

Chair: Mohammad Marufuzzaman, Mississippi State University, Industrial & Systems Engineering, Starkville, MS, 39762, United States of America, mm2006@msstate.edu

1 - Designing a Dynamic Multimodal Transportation Network under Biomass Supply Uncertainty

Sushil Poudel, Mississippi State University, Starkville, MS, United States of America, srp224@msstate.edu, Mohammad Marufuzzaman, Linkan Bian, Hugh Medal

This study presents a two-stage stochastic programming model that assigns multimodal facilities dynamically to design a biomass supply chain network under feedstock supply uncertainty. We develop algorithms combining sample average algorithm, progressive hedging algorithm, and rolling horizon algorithm to solve this challenging NP-hard problem.

2 - Designing a Reliable Bio-fuel Supply Chain Network Considering Link Failure Probabilities

Linkan Bian, Assistant Professor, Mississippi State University, 260 McCain Building, Starkville, MS, 39762, United States of America, bian@ise.msstate.edu, Sushil Poudel, Mohammad Marufuzzaman

This study presents a pre-disaster planning model that seeks to strengthen the multi-modal facilities links for a bio-fuel supply chain system under limited budget availability. The failure probability of the links are estimated using a spatial-statistical model. We developed a combinatorial Benders decomposition algorithm to solve this challenging NP-hard problem.

3 - Managing Congestion in a Multi-modal Facility Location Problem under Uncertainty

Mohammad Marufuzzaman, Mississippi State University, Industrial & Systems Engineering, Starkville, MS, 39762, United States of America, mm2006@msstate.edu

This paper presents a mathematical model that studies the impacts of the congestion effect in a multi-modal facility location design problem under feedstock supply uncertainty. The model is solved using a hybrid algorithm that integrates constraint generation, sample average approximation, progressive hedging and rolling horizon algorithm.

■ TC63

63-Room 112B, CC

Operations Management I

Contributed Session

Chair: Mohammed Darwish, Associate Professor, Kuwait University, Industrial and Management Systems Eng., P.O. Box 5969, Safat, 13060, Kuwait, m.darwish@ku.edu.kw

1 - Probabilistic Estimation of the Inventory Shortage Cost

Feng Xu, Georgia Southwestern State University, 800 GSW State University Drive, School of Business Administration, Americus, GA, 31709, United States of America, feng.xu@gsu.edu

Due to the difficulty in calculating the loss of goodwill, in estimating the shortage cost practitioners and researchers often assume a fixed penalty cost or switch to assigning a specific customer service level. This paper proposes probabilistic measurements of the shortage cost, based on mathematical relationship between the cost and the shortage amount. The derived closed-form estimates of the expected shortage cost can then be applied to determining the optimal inventory control policy.

2 - Optimal Staffing with Endogenous Goals

Buket Avci, Singapore Management University, 50 Stamford Road, Singapore, 248196, Singapore, buketavci@smu.edu.sg

We investigate the optimal staffing level decision of a firm, when employee performance is indirectly affected by staffing levels through workload. In the spirit of Prospect Theory, we posit that goals act as reference points, and there is an asymmetry between under and over-performance relative to a goal. We solve the corresponding principal-agent model in a queueing context and characterize conditions when endogenous goals are relevant for staffing decisions.

3 - Quality Management Theory Development via Meta-analysis

Xianghui Peng, University of North Texas, 1307 West Highland Street, College of Business, Denton, TX, 76201, United States of America, xianghui.peng@unt.edu, Victor Prybutok, Robert Pavur

A meta-analysis is conducted on the empirical studies in quality management (QM). The results allow evaluation of the relationship strength among QM practices, performance, and content factors. The longitudinal evaluation in this study investigates how relationships and content factors in the post-2005 period compare with the pre-2005 period.

4 - Determination of the Maximum Worth of Auctioned Lots using Acceptance Sampling Method

Mohammed Darwish, Associate Professor, Kuwait University, Industrial and Management Systems Eng., P.O. Box 5969, Safat, 13060, Kuwait, m.darwish@ku.edu.kw, Fawaz Abdulmalek

In recent years, auction becomes an important method of buying and selling different items around the world. The most common type of auctions that is found in practice is the English Auction where a bidder inspects the auctioned lot by taking a sample and based on the number of defective items found in the sample, he or she takes a critical decision regarding the maximum worth of the auctioned lot. We show how the maximum worth of an auctioned lot can be determined using acceptance sampling.

5 - Progressive Modeling: Towards a New Complex Systems Optimization Paradigm

Mohamed Ismail, Assistant Professor, University of Regina, 3737 Wascana Parkway, Regina, SK, S4S0A2, Canada, mohamed.ismail@uregina.ca

Progressive Modeling (PM) is a multidisciplinary forward-looking modeling approach that finds pragmatic solutions for many complex and large-scale industrial problems. Many related applications will be presented to demonstrate the principles and the techniques adopted in this paradigm. The new modeling paradigm is expected to have many engineering applications and influence many disciplines such as systems optimization, Operations management, and system of systems engineering.

■ TC64

64-Room 113A, CC

Panel Discussion: Analytics and Decision Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Jeffrey Keisler, University of Massachusetts Boston, 100 Morrissey Boulevard, Boston, MA, 02125, United States of America, Jeff.Keisler@umb.edu

1 - Analytics and Decision Analysis

Moderator: Jeffrey Keisler, University of Massachusetts Boston, 100 Morrissey Boulevard, Boston, MA, 02125, United States of America, Jeff.Keisler@umb.edu, Panelists: Jeff Vales, Casey Lichtendahl, John Turner, Don Kleinmuntz, Max Henrion

Huge increases in data availability and computing power have transformed quantitative fields and led to a proliferation of tools for analytics. Panelists will discuss how can DA strengthen analytics broadly defined, and how can analytics strengthen DA.

■ TC65

65-Room 113B, CC

Joint Session DAS/MAS: Game Theory, Decision Analysis, and Homeland Security, Part B

Sponsor: Decision Analysis

Sponsored Session

Chair: Jun Zhuang, University at Buffalo, SUNY, 317 Bell Hall, Buffalo, NY, 14221, United States of America, jzhuang@buffalo.edu

1 - Modeling A Multi-target Attacker-defender Resource Allocation Game Considering Risk Preferences

Jing Zhang, University at Buffalo, SUNY, 338 Bell Hall, Buffalo, NY, 14221, United States of America, jzhang42@buffalo.edu, Jun Zhuang, Victor Richmond Jose

Although evidence has been found that people often demonstrate risk preference when faced with risky decisions, the literature mostly assumed that adversaries are risk-neutral. This paper models a sequential attacker-defender game where the defender allocates defensive resources to multiple targets while considering the risk preferences of both the defender and attacker. We study the cases when the attacker could be either non-strategic, or strategic.

2 - Game Theoretic Analysis of Secret and Reliable Communication

Melike Baykal-görsoy, Rutgers, The State University of New Jersey, 96 Frelinghuysen Road, CoRE Building, Room 201, Piscataway, NJ, 08854, United States of America, gursoy@rci.rutgers.edu

Secret and reliable communication presents a challenge involving a double dilemma for a user and an adversary. To get insight into this problem, we present two simple stochastic games. Explicit solutions are found. In addition, we show that under some conditions, incorporating in the transmission protocol a time slot dealing just with the detection of malicious threats can improve the secrecy and reliability of the communication without extra transmission delay.

3 - Optimal Cost-sharing in General Resource Selection Games

Konstantinos Kollias, Stanford University, 474 Gates Building, 353 Serra Mall, Stanford, CA, 94305, United States of America, kkollias@stanford.edu, Tim Roughgarden, Vasilis Gkatzelis

Resource selection games provide a model for a diverse collection of applications where a set of resources is matched to a set of demands. In reality, demands are often selfish and congestion on the resources results in negative externalities for their users. We consider a policy maker that can set a priori rules to minimize the inefficiencies induced by selfish behavior and we characterize the control methods that minimize the worst-case inefficiency of equilibria.

4 - Strategic Security Screening Queue with Abandonments

Ali Pala, PhD Student, University at Buffalo, 441 Delta Rd, Apt. 2,
Amherst, NY, 14226, United States of America,
alipala@buffalo.edu, Jun Zhuang

Risk of threats and congestion are the major problems in security screening procedures. Strict security screening policies help detect or deter the adversary applicants, but also lead to congestion which may discourage good applicants from applying or cause unnecessary abandonment from the screening queue. This research focuses on a novel strategic queueing system and proposes a data supported game-theoretical model to study this problem.

5 - When Security Games Go Green: Designing Defender Strategies to Prevent Poaching and Illegal Fishing

Fei Fang, University of Southern California, 941 Bloom Walk,
SAL 300, Los Angeles, CA, United States of America,
feifang@usc.edu, Milind Tambe, Peter Stone

Building on the successful applications of Stackelberg Security Games (SSGs) to protect infrastructure, researchers have begun focusing on applying game theory to green security domains such as protection of endangered animals and fish stocks. We introduce Green Security Games (GSGs), a novel game model for green security domains and provide algorithms to plan effective sequential defender strategies and to learn adversary models that further improves defender performance.

TC66

66-Room 113C, CC

Managing Airport Arrival Flows

Sponsor: Aviation Applications
Sponsored Session

Chair: John-Paul Clarke, Georgia Tech, 270 Ferst Drive, N.W.,
Atlanta, GA, United States of America, johnpaul@gatech.edu

1 - Combining Control by CTA and Enroute Speed Adjustment to Improve Ground Delay Program Performance

James Jones, University of Maryland, 3117 A.V Williams, College
Park, MD, 20742, United States of America, jonesjc1@umd.edu,
Michael Ball, David Lovell

Over the past several years there have been proposals and discussions regarding a move from the use of controlled times of departure (CTDs) to controlled times of arrival (CTAs) for ground delay programs (GDPs) in the U.S. In this talk we show that, by combining control by CTA with the judicious use of en route speed control, significant improvements to GDP performance can be achieved.

2 - Robust Airport Gate Planning – First Order Stability Concept

Bruno Santos, Assistant Professor, TU Delft, Faculty of Aerospace
Engineering, Delft, Netherlands, B.F.Santos@tudelft.nl,
Dennis Buitendijk, Joris De Kaey, John-Paul Clarke

We present a novel approach to the airport gate assignment problem entitled "First Order Stability" (FOS). The FOS has the goal of increasing gate plans robustness and uses two key concepts to achieve this: it postpones the gate scheduling to a moment when uncertainty is reduced significantly; and it stabilizes the order of flights, minimizing the risk on disturbances. A real case study application showed that FOS provides more stable solutions that can make equal or higher usage of the capacity.

3 - Heuristic Gate Assignment Model for Airports with Multiple Parallel Concourses

Parth Shah, Graduate Research Assistant, Georgia Tech, 401 17th
Street, Apt. 5205, Atlanta, GA, 30363, United States of America,
parth.shah1053@gmail.com, John-Paul Clarke

Ramp operation model of Atlanta International airport is simulated to understand the characteristic of aircraft movement on ramp. A new heuristic approach is adopted in which aircraft are assigned gates based on their direction of ramp entry and exit points. The model is calibrated using ASPM traffic data. The results show that the proposed new method achieves 23% reduction in total ground delay by significantly reducing the gate wait, taxi blocking and pushback blocking time.

TC67

67-Room 201A, CC

Consolidation in Transport

Sponsor: TSL/Freight Transportation & Logistics
Sponsored Session

Chair: Wentao Zhang, University of Southern California,
Los Angeles, CA, United States of America, United States of America,
wentao@usc.edu

1 - Frequency-Location Clustering for Efficient Inbound Routes to Consolidation Centers

Zhijie Dong, Cornell University, United States of America,
zd57@cornell.edu, Mark A. Turnquist

An optimization model addresses joint decisions of frequency of pickup from individual suppliers and grouping suppliers into collection routes by clustering in both time and space. The objective is to minimize total logistics (transportation plus inventory) cost. The optimization problem is equivalent to a single-source fixed charge facility location problem, and near-optimal solutions are found using a very efficient heuristic algorithm. Results of numerical experiments show the effectiveness of both the model formulation and the heuristic solution method. A case study demonstrates that substantial total cost savings can be achieved in realistic applications using the combined frequency-location clustering method.

2 - A Lagrangian-based Strategy to Consolidate Freight of Perishable Products

Christine Nguyen, Northern Illinois University, DeKalb, IL, United
States of America, United States of America, cnguyen@niu.edu,
Alejandro Toriello, Maged Dessouky

Our research focuses on a supply chain of suppliers with low demand for perishable products, where consolidating their product would take advantage of better shipping FTL rates versus LTL or courier rates. We consider a Lagrangian Relaxation formulation that includes a capacity constraint for a shared consolidation center. We develop an LR-based heuristic that aims to balance the consolidated economical shipping cost and the inventory cost at the consolidation center.

3 - Cost Sharing Mechanism Design for Supply Chain Consolidation and Cooperation in Agriculture Industry

Wentao Zhang, University of Southern California, Los Angeles,
CA, United States of America, United States of America,
wentao@usc.edu, Nelson Uhan, Alejandro Toriello,
Maged Dessouky

We design cost sharing mechanisms for a consolidation center where suppliers who need to ship products to a common destination can consolidate their shipments and save transportation costs. Using the Moulin mechanism framework, we propose cost sharing mechanisms that are group strategyproof and budget-balanced. By studying the efficiency of these mechanisms empirically and analytically, we show that the outcome of these mechanisms often closely resembles an optimal solution of a central planner.

4 - Temporal Shipment Consolidation under Stochastic Dynamic Demand

Sila Cetinkaya, SMU, EMIS and ITOM Departments, Dallas, TX,
United States of America, sila@smu.edu, Liqing Zhang

We consider stochastic dynamic shipment consolidation problems with general demands and characterize the structural properties of optimal shipment release policies under general cost structures with scale economies and quantity discounts.

TC68

68-Room 201B, CC

TSL Prize Session

Sponsor: Transportation, Science and Logistics
Sponsored Session

Chair: Barrett Thomas, Associate Professor, The University of Iowa,
W272 Pappajohn Business Building, Iowa City, IA, 52242,
United States of America, barrett-thomas@uiowa.edu

1 - TSL Prize Winners

Barrett Thomas, Associate Professor, The University of Iowa,
W272 Pappajohn Business Building, Iowa City, IA, 52242,
United States of America, barrett-thomas@uiowa.edu

The TSL 2015 Prize Session finalists will present their award-winning work in this session. Prize committee chairs will say a few words about the winning selections.

■ TC69

69-Room 201C, CC

Multimodal Traffic Signal Control in a Connected Vehicle Environment

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: K. Larry Head, University of Arizona, Tucson, AZ, United States of America, larry@sie.arizona.edu

1 - The Multi Modal Intelligent Traffic Signal Control System (MMITSS)

K. Larry Head, University of Arizona, Tucson, AZ, United States of America, larry@sie.arizona.edu, Yiheng Feng, Mehdi Zamanipour, Shayan Khoshmagham, Byunho Beak, Sara Khosravi

The Multi Modal Intelligent Traffic Signal Control System (MMITSS) is a Dynamic Mobility Application for connected vehicles in signalized networks. MMITSS provides intelligent signal control, priority control for emergency vehicles, transit, trucks, and pedestrians, and performance observation. MMITSS has been implemented in the Arizona Connected Vehicle Testbed in Anthem, AZ.

2 - Personalized Signaling for Connected Travelers in a Multi Modal Traffic Signal System

Sara Khosravi, University of Arizona, Tucson, AZ, United States of America, sarakhosravi@email.arizona.edu, Sriharsha Mucheli, K. Larry Head

Smartphones have become standard equipment for almost all travelers. The smartphone can be used to provide personalized signaling information for multi modal travelers including pedestrians and bicycles at signalized intersections, transit riders, and automobile drivers using navigation applications. This talk will explore how smartphone applications can impact the transportation system.

3 - Multi-Modal Intelligent Traffic Signal System, Optimal Priority Control

Mehdi Zamanipour, University of Arizona, Yiheng Feng, K. Larry Head, Shayan Khoshmagham

A priority control algorithm is presented that simultaneously considers the needs of different modal users in a Connected Vehicle environment. A mathematical programming framework that allows multiple priority requests to be considered simultaneously based on a hierarchical control policy at the intersection level will be presented.

4 - Real-Time Performance Observation under Connected Vehicle Technology

Shayan Khoshmagham, University of Arizona, K. Larry Head, Yiheng Feng, Mehdi Zamanipour

This paper introduces an approach to observe the performance measures of a multi-modal transportation system in a connected vehicle environment. Different types of metrics including traffic-based, CV-based and signal-based measures are observed and estimated by mode by movement. Challenges regarding low market penetration rate and privacy of the road users are addressed respectively

■ TC70

70-Room 202A, CC

Predictive Analytics in Railway – Practice

Sponsor: Railway Applications

Sponsored Session

Chair: Dharma Acharya, President, KOSU Services LLC, 241 Auburndale Dr., Ponte Vedra, FL, 32081, United States of America, acharya.dharma@gmail.com

1 - State of Railway Analytics

Dharma Acharya, President, KOSU Services LLC, 241 Auburndale Dr., Ponte Vedra, FL, 32081, United States of America, acharya.dharma@gmail.com

A brief overview of how the new emerging technology “Analytics” has been leveraged by railroads will be presented. Potential new areas where railways might be able to further utilize this new techniques to bring bottom line value to the company will also be discussed.

2 - Big Data Analytics for Optimized Track Maintenance and Renewal Management

Luca Ebreo, MERMEC Inc., 110 Queen Parkway, Columbia, NY, United States of America, Luca.ebreo@mermecgroup.com, Pietro Pace

Nowadays, track inspection technology allows railways to collect more and more data on track's condition. These data are comparable to “big data” and require proper analysis in order to extract information for properly managing Track

Maintenance and Renewals. Since railways need to make use as much as possible of the available data for optimizing their maintenance programs, the required analytics to support key decisions in an efficient and effective manner will be illustrated and discussed.

3 - Using Data Visualization to Assess Performance Risk

Eric Pachman, Director, Network Modeling & Analytics, CSX, 500 Water Street, Jacksonville, FL, 32202, United States of America, Eric_Pachman@csx.com

At CSX, the way we think about “capacity” is changing. By adding data visualization to traditional industry modeling tools, discussions on capacity are shifting to discussions on risk and reliability. Our evolution in capacity analysis is helping CSX better prioritize infrastructure projects to improve network fluidity. In addition, through data visualization, we can start to “see” how various operating and commercial requirements and initiatives impact line of road capacity and risk.

4 - Deploying Predictive Analytics Solutions in the Rail Industry and Seeing a Return on the Investment

Robert Morris, Chief Science Officer, Predikto, Inc., 1320 Ellsworth Industrial Blvd, Suite A1600, Atlanta, GA, 30318, United States of America, Robert@predikto.com, Mario Montag

In this panel, Predikto will provide an overview of automated dynamic predictive analytics solutions specific to the rail industry. Use cases currently in deployment across the globe specific to predicting and reducing downtime in freight and commuter locomotives are discussed alongside the challenges that organizations face during the process of deploying such technology. Also considered are strategies to assist in expediting monetary return on investments in predictive maintenance.

■ TC71

71-Room 202B, CC

Transportation Planning I

Contributed Session

Chair: Antonio Antunes, Professor, University of Coimbra, Dept. of Civil Engineering, Coimbra, Portugal, antunes@dec.uc.pt

1 - Plug-in Electric Vehicle Charging Infrastructure Planning using Cellular Network Data

Jing Dong, Assistant Professor, Iowa State University, 350 Town Engineering Building, Ames, IA, 50011, United States of America, jingdong@iastate.edu, Luning Zhang

This paper presents a method to identify activity-travel patterns, in terms of timing and duration at home, work, and other major destinations, using multiday cell phone records. A Hidden Markov Model (HMM) is built to link traveler's activity transitions to the observed cell tower locations. The probabilistic parameters of HMM are estimated using the Baum-Welch algorithm. The derived travel distances and dwell times are key inputs for plug-in electric vehicle charging infrastructure planning.

2 - The Barriers of Electric Vehicles Spread Adoption in China

Faping Wang, Ph.d Candidate, Tsinghua University, Shenzhen Graduate School of Tsinghua, Shenzhen, GD, 518100, China, wfp13@mails.tsinghua.edu.cn

This paper present a survey research about barriers of electric vehicle spread adoption in China, 1000 questionnaire was designed and send to participants which come from Beijing, Shanghai, Guangzhou and Shenzhen, all of which are large city in China. Majority of participants have EVs driving experience or owner of EV or PHEV. The demographic data was analyzed by statistic methods which reveal that more different choice behavior exist between western consumer and Chinese in EVs consumption.

3 - Strategic Infrastructure Development for Alternative Fuel Vehicles with Routing Considerations

Seong Wook Hwang, PhD Student, The Pennsylvania State University, 232 Leonhard Building, The Pennsylvania State University, University Park, PA, 16802, United States of America, soh5223@psu.edu, Sang Jin Kweon, Jose A. Ventura

This research considers decisions on the siting of alternative fuel (AF) refueling stations and on the routing of AF vehicles when drivers take a detour to refuel. Supposing that a driver takes any path whose distance is less than or equals to a detour distance, we provide an algorithm that finds feasible paths between origins and destinations. Then, a mathematical model is proposed to determine the locations of AF refueling stations with the objective of maximizing the covered flows.

4 - Optimization Model for Floating Carsharing System Planning

Antonio Antunes, Professor, University of Coimbra, Dept. of Civil Engineering, Coimbra, Portugal, antunes@dec.uc.pt

The focus of this presentation is an optimization model aimed to assist a floating carsharing company in the making of its key planning decisions – the area to be operated by the company (called home area), the price rate or rates to be charged to customers, the relocation operations to perform across zones of the home area, and, indirectly, the size of the fleet to be used by the company. The results that can be obtained through the model are exemplified for a real-world setting.

TC72

72-Room 203A, CC

DDDAS for Industrial and System Engineering Applications III

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Shiyu Zhou, Professor, University of Wisconsin-Madison, Department of Industrial and Systems Eng, 1513 University Avenue, Madison, WI, 53706, United States of America, shiyuzhou@wisc.edu

Co-Chair: Yu Ding, Professor, Texas A&M University, ETB 4016, MS 3131, College Station, TX, United States of America, yuding@iemail.tamu.edu

1 - The Predict Project: Enhancing DDDAS/Infosymbiotics with Privacy and Security

Vaidy Sunderam, Emory University, 400 Dowman Dr #W-401, Math & CS, Atlanta, GA, 30322, United States of America, vss@emory.edu, Li Xiong

The ubiquitousness of mobile devices will greatly expand the applicability of DDDAS, provided privacy and security issues are addressed. The PREDICT project is developing: (1) approaches to assign data-targets to participants with privacy protection; (2) methods for aggregating and fusing data that quantify veracity of the data sources and maintain high fidelity; and (3) secure distributed computation for field- and region-level deployment of the DDDAS paradigm with adaptation and feedback.

2 - Securing Industrial Control Systems with Software-defined Networking

Dong Jin, Assistant Professor, Illinois Institute of Technology, 10 W 31st Street, Stuart Building 226E, Chicago, IL, 60614, United States of America, dong.jin@iit.edu

Modern industrial control systems (ICSes) are increasingly adopting Internet technology to boost control efficiency, which unfortunately opens up a new frontier for cyber-security. With the goal of safely incorporating existing networking technologies in ICSes, we design a novel software-defined networking (SDN) architecture for ICSes, with innovative security applications (e.g., network verification and intrusion detection) and rigorous evaluation using IIT's campus microgrid.

3 - A DDDAS Approach to Distributed Control in Computationally Constrained Environments (UAV Swarms)

Vijay Gupta, Univ. of Notre Dame, 275 Fitzpatrick Hl Engrng, Notre Dame, IN, 46556, United States of America, vgupta2@nd.edu, Greg Madey, Daniel Quevedo, Wann-jiun Ma

In modern applications of distributed control, the traditional assumption of ample processing power at every time step at each agent can be challenged by use of processor intensive sensors such as cameras. Inspired by the Dynamic Data Driven Application System approach, we present an algorithm that shifts computational loads among the agents to guarantee performance in spite of reduced average processor availability. Analytical results and numerical simulations illustrate the approach.

TC73

73-Room 203B, CC

Quality Monitoring and Analysis in Complex Manufacturing Processes

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Li Zeng, Assistant Professor, Texas A&M University, Industrial and Systems Engineering, College Station, TX, 77843, United States of America, lizeng@tamu.edu

Co-Chair: Qiang Zhou, Assistant Professor, City Univ of Hong Kong, Kowloon, Hong Kong, China, q.zhou@cityu.edu.hk

1 - Monitoring Uniformity of Particle Distributions in Manufacturing Processes using the K Function

Xiaohu Huang, Graduate Student, City University of Hong Kong, 106B, Hall 8, Student Residence, CityU, Hong Kong, China, xhhuang6-c@my.cityu.edu.hk, Qiang Zhou

Data in the form of spatial point patterns are frequently encountered in manufacturing processes. The distributional characteristics of a spatial point pattern can be summarized by functional profiles like K function. In this study, a Gaussian process is designed to characterize its behaviour under complete spatial randomness. A T2 control chart is proposed to monitor the uniformity of point patterns.

2 - Bayesian Hierarchical Linear Modeling of Profile Data with Apps to Quality Control of Nanomanufacturing

Jianguo Wu, Assistant Professor, University of Texas-El Paso, El Paso, TX, United States of America, jwu2@utep.edu, Yuhang Liu, Shiyu Zhou

To achieve a highly automatic quality control, simultaneous profile monitoring and diagnosis is often required. This paper presents a general framework by using a hierarchical linear model to connect profiles with both explanatory variables and intrinsic processing or product parameters for simultaneous monitoring and diagnosis. The effectiveness is illustrated through numerical studies and applications to NDE profiles for quality control of nanocomposites manufacturing.

3 - Modeling of Optical Profiles in Low-E Glass Manufacturing

Qian Wu, Graduate Student, Texas A&M University, Industrial and Systems Engineering, College Station, TX, 77843, United States of America, hi.wuqian@gmail.com, Li Zeng

Quality of low-E glass is measured by optical profiles. This study considers modeling of the optical profile data in Phase I analysis.

4 - Wafer Yield Prediction Based on Virtual Metrology-generated Parameters

Wan Sik Nam, Seoung Bum Kim/Korea University, Korea University, 145 Anam-ro, Seongbuk-, Seoul, Korea, Republic of, wansiknam@korea.ac.kr

Yield prediction is one of the most important issues in semiconductor manufacturing. Especially, for a fast-changing environment of the semiconductor industry, accurate and reliable prediction techniques are required. In this study, we propose a procedure to predict wafer yield using process parameters generated from the virtual metrology of the semiconductor fabrication, which is based on a variety of regression and classification algorithms.

TC74

74-Room 204A, CC

Innovative Methods for System Informatics

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Peihua Qiu, Professor, University of Florida, 2004 Mowry Road, Gainesville, FL, 32610, United States of America, pqiu@phhp.ufl.edu

1 - When Importance Sampling Meets Stochastic Simulation Models

Eunshin Byon, Assistant Professor, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, ebyon@umich.edu, Youngjun Choe, Nan Chen

Importance sampling has been used to improve the efficiency of simulations where the simulation output is uniquely determined, given a fixed input. We extend the theory of importance sampling to estimate a system's reliability with stochastic simulations where a simulator generates stochastic outputs. Given a budget constraint on total simulation replications, we derive the optimal importance sampling density that minimize the variance of an estimator.

2 - QQ Models: Joint Modeling for Quantitative and Qualitative Quality Responses in Manufacturing System

Ran Jin, Virginia Tech., Grado Department of Industrial and Systems Engineering, Blacksburg, VA, 24061, United States of America, jran5@vt.edu, Xinwei Deng

A manufacturing system with both quantitative and qualitative (QQ) responses is widely encountered. The QQ responses are closely associated with each other, but current methodologies often model them separately. This paper presents a novel modeling approach, called "QQ models", to jointly model the QQ responses through a constrained likelihood estimation. Both simulation studies and a case study are used to evaluate the performance of the proposed method.

3 - Discussant's Presentation

Yu Ding, Professor, Texas A&M University, ETB 4016, MS 3131,
College Station, TX, United States of America,
yuding@iemail.tamu.edu

As a discussant in this Technometrics special issue session on system informatics, I will present my understanding of strengths and weaknesses of the two papers selected by Technometrics editor for this session. I will also discuss other related research problems on the similar topics.

■ TC75

75-Room 204B, CC

IBM Research Best Student Paper Award III

Sponsor: Service Science

Sponsored Session

Chair: Ming-Hui Huang, National Taiwan University, Taiwan - ROC,
huangmh@ntu.edu.tw

1 - Best Student Paper Competitive Presentation

Ming-Hui Huang, National Taiwan University, Taiwan - ROC,
huangmh@ntu.edu.tw

Finalists of the IBM Research Best Student Paper Award present their research findings in front of a panel of judges. The judging panel will decide the order of winners, which will be announced during the business meeting of the Service Science Section at the Annual Conference.

2 - Efficient Information Heterogeneity in a Queue

Yang Li, Rotman School of Management, University of Toronto,
105 St. George Street, Toronto ON M5S3E6, Canada,
Yang.Li10@Rotman.Utoronto.Ca, Ming Hu

How would the growing prevalence of real-time delay information affect a service system? We consider an M/M/1 queueing system in which only a fraction of customers are informed about real-time delay. Surprisingly, we find that system throughput and social welfare can be unimodal in the fraction of informed customers.

3 - Scheduling and Pricing Services for Online Electric Vehicle Charging

Mark Nejad, Assistant Professor, University of Oklahoma,
Industrial and Systems Engineering, Norman OK, United States of
America, mark.nejad@ou.edu, Ratna Babu Chinnam, Daniel
Grosu, Lena Mashayekhy

We design mechanisms for EV charging services in online settings. We prove that our proposed mechanisms are incentive compatible, that is, truthful reporting of price and the amount of charging is a dominant strategy for self-interested EV drivers. Our preemption-aware charging mechanisms allow providers to manage fluctuations in renewable energy production.

4 - Scheduling with Testing

Thomas Magnanti, Institute Professor, MIT, 77 Massachusetts
Avenue, 32-D784, Cambridge MA 02139, United States of
America, magnanti@mit.edu, Retsef Levi, Yaron Shaposhnik

We study a new class of scheduling problems that captures a common tradeoff between using resources for processing jobs, and investing resources to 'test' jobs and learn more about their uncertain attributes. This can inform future decisions, but also delay service. We derive intuitive structural properties of the optimal policies, and use a new cost-accounting scheme to devise a surprisingly low dimensional dynamic programming formulation, which ultimately leads to an FPTAS.

5 - Trading Time in a Congested Environment

Luyi Yang, Doctoral Student, University of Chicago Booth School
of Business, Chicago, IL, United States of America,
luyi.yang@chicagobooth.edu, Laurens Debo, Varun Gupta

We propose a time-trading mechanism, mediated by a revenue maximizing broker, in which customers privately informed about their waiting costs mutually agree on the ordering in a queue via trading positions. To that end, we show that the broker can implement an auction with a trade-participation fee and two trade restriction prices on customer bids. Under the optimal auction, there is partial pooling in the bidding strategies and therefore customers are not strictly prioritized.

■ TC76

76-Room 204C, CC

Advances in Stochastic Simulation

Sponsor: Simulation

Sponsored Session

Chair: Henry Lam, University of Michigan, 1205 Beal Ave., Ann Arbor,
MI, United States of America

1 - Risk Assessment for Input Uncertainty

Helin Zhu, School of Industrial and Systems Engineering, Georgia
Institute of Technology, 755 Ferst Drive NW, Atlanta, GA, 30332,
United States of America, hzhu67@gatech.edu, Enlu Zhou

When simulating a complex stochastic system, the behavior of the output response depends on the input parameter estimated from finite real-world data, and the finiteness of data brings input uncertainty to the output response. Risk assessment for input certainty, which quantifies the extreme behavior of the mean output response, is extremely important. In the present paper, we introduce the risk measures for input uncertainty and study the corresponding estimators.

2 - Projected Directional Derivatives for High Dimensional Gradient Estimation

Raghu Pasupathy, Associate Professor, Department of Statistics,
Purdue University, 250 N University Street, West Lafayette, IN,
47907, United States of America, pasupath@purdue.edu,
Boqian Zhang

We present a method to estimate gradients in high dimensions by projecting randomly generated directional derivatives onto the various axes. We discuss theoretical properties and sampling measures that minimize the resulting estimator's error norm. The method appears particularly relevant in high dimensions since only two observations are needed for a complete gradient estimator.

3 - Perfect Sampling of GI/GI/C Queues

Yanan Pei, Columbia University, 500 W. 120th St, Mudd 313,
New York, NY, 10027, United States of America,
yp2342@columbia.edu, Jose Blanchet, Jing Dong

We introduce the first class of perfect sampling algorithms for the steady-state distribution of multi-server queues with general inter-arrival time and service time distributions. Our algorithm is built on the classical dominated coupling from the past protocol using a coupled multi-server vacation system as the upper bound process. The algorithm has finite expected termination time with mild moment assumptions on the inter-arrival time and service time distributions.

4 - Rare Event Simulation in the Neighborhood of a Rest Point

Konstantinos Spiliopoulos, Assistant Professor, Boston University,
Department of Mathematics and Statistics, 111 Cummington
Mall, Boston, MA, 02215, United States of America,
kspiliop@math.bu.edu

We construct efficient importance sampling Monte Carlo schemes for finite time exit probabilities in the presence of rest points. The main novelty of the work is the inclusion of rest points in the domain of interest. We motivate the construction of schemes that perform well both asymptotically and non-asymptotically. We concentrate on the regime where the noise is small and the time horizon is large. Examples and simulation results are provided. Joint work with Paul Dupuis and Xiang Zhou.

■ TC77

77-Room 300, CC

Logistics II

Contributed Session

Chair: Fateme Fotuhiardakani, Data Scientist, TMW Systems, 6085
Parkland Blvd, Mayfield Heights, OH, 44124, United States of America,
fateme.fotuhi@gmail.com

1 - Using Heuristics to Solve the Container Loading Problem Focusing on Priority Levels and Utilization

Crystal Wilson, Clemson University, 6 Natalie Ct., Greer, SC,
29651, United States of America, crysta3@clemson.edu,
Mary Beth Kurz

Just-in-time manufacturers need the parts to arrive to the facility by a scheduled time to keep the assembly line moving smoothly. How small containers, such as parts, are loaded onto a larger container is a special type of packing problem. This research will focus on creating a heuristic that creates loading patterns that balances priority levels, while also maximizing the utilization of the container with respect to the weight and cube.

2 - Bundling and Pricing Truckload and Less-than-truckload Services with Stochastic Demand

Rodrigo Mesa Arango, Assistant Professor, Florida Institute of Technology, 150 W. University Blvd, Melbourne, FL, 32901, United States of America, rmesaara@purdue.edu, Satish V. Ukkusuri

Algorithms to bundle and price Truckload (TL) and Less-than-truckload (LTL) services are proposed considering stochastic demand, value-based pricing, and demand segmentation. A two-stage min-cost flow problem accounts for uncertain demand. Its deterministic equivalent is formulated as a regular min-cost flow problem and efficiently solved. Deterministic models overestimate benefits. Numerical experiments reveal the cost of uncertainty and demonstrate improvements in bundle quality.

3 - Stochastic Models for Optimal Reusable Pallets Management and Sustainable Supply Chain Configuration

Xiangxiang Fan, Huazhong University of Science and Technology, Wuhan, China, goodman432700@163.com, Yeming Gong, Xianhao Xu

This paper compares the impact of supply chain configuration and operating rules on the management of reusable pallets in closed-loop supply chains. We evaluate how pallet management strategy could affect the whole performance of a supply chain in terms of minimizing the number of pallets and the cycle time and propose semi-open queuing network models to analysis four different alternatives which could provide an effective tool for optimal pallet management.

4 - Iterative Mechanisms for Shippers' Collaboration in Production-Shipping Schedule Planning

Minghui Lai, Assistant Professor, Southeast University, Economics and Management Building, Jiulonghu Campus, Nanjing City, China, laimh@seu.edu.cn

We study the collaborative distribution problem of the shippers with sensitive private information. We propose iterative mechanisms that are convergent, strategy-proof, individually rational, and budget balanced in most cases. The mechanisms are implemented by efficiently computable distributive algorithms. Extensive simulations show that the mechanisms converges fast and have high efficiency.

5 - Dynamic Capacitated Intermodal Terminal Location Problem

Fateme Fotuhiardakani, Data Scientist, TMW Systems, 6085 Parkland Blvd, Mayfield Heights, OH, 44124, United States of America, fateme.fotuhi@gmail.com, Nathan Huynh

In this paper we introduce a dynamic intermodal terminal location problem which intends to locate new intermodal terminals to dynamically meet fluctuations in customers' demands. The planning horizon is partitioned into multiple consecutive time periods with a given budget for network configuration in each time period. A lagrangian relaxation approach embedded with a heuristic algorithm for upper bound computation is developed to solve this NP-hard problem.

TC78

78-Room 301, CC

Optimization of Energy Systems

Contributed Session

Chair: Florian Perrotton, IFP Energies Nouvelles & GDF Suez, 228-232 avenue Napoléon Bonaparte, Rueil-Malmaison, France, florianperrotton@gmail.com

1 - Distributed Algorithms for the DC-OPF Problem

Hesam Ahmadi, Student, Pennsylvania State University, 107 Holerman Hall, University Park, PA, 16802, United States of America, ahmadi.hesam@gmail.com, Uday Shanbhag

In this talk, an ADMM-based distributed algorithm is presented for the solution of the Direct Current Optimal Power Flow (DC-OPF) problem. We consider a dual formulation that respects privacy concerns and leverage the structure to develop a distributed scheme. We show that the resulting sequence of primal and dual iterates is provably convergent. Preliminary numerics are provided.

2 - What Short-term Market Design for Efficient Flexibility Management in Gas Systems?

Florian Perrotton, IFP Energies Nouvelles / GDF SUEZ / Université Paris Ouest Nanterre, 7 Rue de Rochechouart, Paris, 75009, France, florian.perrotton@gmail.com

With the increase of electric intermittent renewables, often backed-up by CCGTs, variability has been transferred to the gas network. Balancing the network has become a technical and economic issue. Applied to gas systems, market designs similar to locational marginal pricing might improve the situation. However, in such markets, flexibility can be handled in different ways. Using a linearized transient model of the gas network (LP), we analyze the efficiency of two different auction designs.

3 - Optimal Decision Support System for Large Scale Energy Management in Smart Grid

Sunil Vuppala, IIITB, Electronics City, Bangalore, India, sunil.vuppala@iiitb.ac.in, Prasanna Gns

We propose a decision support system with modeling methodologies to handle large scale energy management problems in smart grid. The convexified model is solved in rolling horizon approach using solvers (Cplex) both at consumer and utility levels. The systems comes with heuristic for quick run times. We analyze the stability and accuracy of the system for millions of users with sensitivity analysis. The results indicate that our system is beneficial to both consumers and utility companies.

4 - Asset Management Strategies for Wind Turbines

Suna Cinar, Wichita State University, 1845 Fairmount Street, Wichita, KS, 67260, United States of America, sxcinar@wichita.edu, Bayram Yildirim

The decision to retrofit or keep an aged Wind Turbine (WT) can be a difficult decision. Based on existing operation and maintenance cost or budget allocated, one can either retrofit a WT or maintained the existing WT with a preventive maintenance. The difficult question is which of these options is superior. In this study, a mixed integer linear programming (MILP) modelling approach is proposed to determine the trade-off between these two options.

TC79

79-Room 302, CC

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - Syncopation Software - DPL Portfolio and DPMX™ : A Decision Analysis based System for Better Portfolio Decisions

Chris Dalton, Syncopation Software, 6 State Street, Suite 308, Bangor, ME, 04401, United States of America, cdalton@syncopation.com

This demonstration will show how the DPMX System can serve as the analytical backbone for an effective portfolio analysis process. We'll start with an overview of DPL Professional, a proven modelling environment for decision analysis, risk analysis and Monte Carlo simulation. Next, we'll cover DPL Portfolio, the modelling environment for portfolio analysis, visualization and prioritization. Finally we'll show DPMX, a web-based based system for managing project data and presenting portfolio results in attractive, management-friendly charts. The motivating examples will be drawn from the prioritization of an R&D portfolio in the pharmaceutical industry.

2 - Frontline Systems, Inc. – Analytic Solver® Platform: Integrated Data Mining, Simulation and Optimization in Microsoft Excel

Frontline Systems

Analytic Solver Platform in Microsoft Excel has everything you need for forecasting and data mining, Monte Carlo simulation and risk analysis, conventional and stochastic optimization – with data from Apache Spark and visualization of results in Excel, Tableau and Power BI. See how you can use it to build your own analytic expertise and teach others, leveraging what you already know, build and solve industrial-scale models with the world's best Solvers, and effectively communicate business results.

Tuesday, 4:30pm - 6:00pm

■ TD01

01-Room 301, Marriott

Optimizing Decisions in Conflict, Deterrence, and Peace

Sponsor: Military Applications

Sponsored Session

Chair: Brian Lunday, Assistant Professor Of Operations Research, Department of Operational Sciences, Grad. Sch. of Engr. & Mgmt., Air Force Institute of Technology, Wright Patterson AFB, OH, 45433, United States of America, Brian.Lunday@afit.edu

1 - Active Target Defense Cooperative Differential Game

David Casbeer, Dr., Air Force Research Laboratory, 2210 8th Street, B20146 R300, Wright Patterson AFB, OH, 45433, United States of America, david.casbeer@us.af.mil, Meir Pachter, Eloy Garcia

This work addresses an active target defense differential game where an Attacker pursues a Target. The Target cooperatively teams with a Defender, to maximize the distance between the Target and the point where the Attacker is intercepted by the Defender, while the Attacker tries to minimize said distance. The solution to this differential game provides the min-max optimal heading angles for the Target and the Defender team, as well as the Attacker.

2 - Approximate Dynamic Programming for the Military Inventory Routing Problem with Direct Delivery

Matthew Robbins, Assistant Professor Of Operations Research, Department of Operational Sciences, Grad. Sch. of Engr. & Mgmt., Air Force Institute of Technology, Wright Patterson AFB, OH, 45433, United States of America, matthew.robbins@afit.edu, Brian Lunday, Ian McCormack, Rebeka Mckenna

The military inventory routing problem (IRP) with direct delivery is formulated to model resupply decisions concerning a set of geographically dispersed brigade combat team elements operating in an austere combat situation. We construct a Markov decision process model of the military IRP and obtain solutions via approximate dynamic programming. Designed computer experiments are conducted to determine how problem features and algorithmic features affect the solution quality of our policies.

3 - Improving Chemotherapy Delivery through the Simulation of Scheduling Heuristics

Ryan Slocum, Instructor, Department of Mathematical Sciences, Building 601, United States Military Academy, West Point, NY, 10996, United States of America, ryan.slocum@usma.edu, Javad Taheri, Thom Hodgson

In the last decade, chemotherapy delivery has largely become an outpatient service. This has challenged clinics to administer complex treatments to as many patients as possible within a fixed period of time. We apply selected scheduling heuristics to reduce patient waiting times and minimize nurse overtime hours. We present the results of a case study for which our heuristics found two solutions that respectively reduce the average patient's waiting time by 20% and annual overtime by 60%.

4 - A Game Theoretic Model for the Optimal Disposition of Integrated Air Defense Missile Batteries

Brian Lunday, Assistant Professor Of Operations Research, Department of Operational Sciences, Grad. Sch. of Engr. & Mgmt., Air Force Institute of Technology, Wright Patterson AFB, OH, 45433, United States of America, Brian.Lunday@afit.edu, Chan Han, Matthew Robbins

We examine the allocation of air defense batteries to protect a country's population as a three-stage sequential, perfect information, zero-sum game between two opponents. We formulate a trilevel nonlinear integer program, but instead apply both an enumeration algorithm and a customized heuristic to search the game tree. We test both on small instances to assess the efficacy of the heuristic, and we demonstrate the computational efficiency of the heuristic on realistic-sized instances.

■ TD02

02-Room 302, Marriott

Military Applications

Contributed Session

Chair: Irene Gerlovin, PhD Candidate/ Part Time Lecturer, Rutgers Business School, 1 Washington Pl, Newark, NJ, 07102, United States of America, irene.gerlovin@gmail.com

1 - Modeling Disease Mortality in The National Operational Environment Model (NOEM)

Venkat Venkateswaran, Rensselaer Polytechnic Institute, 275 Windsor St., Hartford, CT, 06033, United States of America, venkav3@rpi.edu, John Salerno

The National Operational Environment Model (NOEM) is a large scale stochastic model that can be used to simulate the operational environment of a nation-state. Effects of various action alternatives can then be studied through simulations. In this work we describe the methodology developed to estimate disease mortality. Extensive V&V tests show that estimated disease death rates compare well with published values, year by year, for several countries tested.

2 - Optimization of The Canadian Armed Forces Domestic Transportation Network

Raman Pall, Defence Scientist, Department of National Defence, 1600 Star Top Road, Ottawa, ON, K1B 3W6, Canada, raman.pall@forces.gc.ca, Abdeslem Boukhouta

The Canadian Armed Forces domestic transportation network transports goods between military bases and depots throughout Canada using a combination of military transport assets and commercial carriers. In this presentation, we provide an overview of the network, describing it as a directed graph and analyzing its efficiency. Recommendations are made on how utilization of the military resources can be maximized through improvements to the route scheduling.

3 - Supply Chain Program Management (SCPM) to the Rescue! F-35 Program

Irene Gerlovin, PhD Candidate/ Part Time Lecturer, Rutgers Business School, 1 Washington Pl, Newark, NJ, 07102, United States of America, irene.gerlovin@gmail.com, Yao Zhao

F-35 program had a number of technical challenges. Since its inception in 2001, the program is seven years behind the schedule and 70% over initial budget. We review its key SCPM practices to identify root causes for the delays and to enhance the chance of success for future DOD acquisitions.

■ TD03

03-Room 303, Marriott

Inventory Management II

Contributed Session

Chair: Ruiqi Hou, University of Science and Technology of China, East Campus USTC, No. 96 Jinzhai Road, Room 367-414, Hefei, 230026, China, qiqimath@gmail.com

1 - A Continuous Formulation for a Location-Inventory Problem Considering Demand Uncertainty

Matias Schuster Puga, Université Catholique de Louvain, Chaussée de binche, 151, Mons, 7000, Belgium, matias.schuster@uclouvain.be, Jean-sébastien Tancrez

We propose a location-inventory model that can be applied to design large supply chain networks. We address a continuous non-linear formulation that minimizes transportation, inventory, order, safety stock and facility opening costs. We solve the non-linear model with an heuristic algorithm that relies on the fact that the model simplifies to a continuous linear program when two auxiliary variables are fixed. We show the efficiency of the algorithm with the computation of numerical experiments.

2 - SQRTN and Portfolio Effect Inventory Models: Notes on Practical Use and Accuracy for Practitioners

Tan Miller, Director Global Supply Chain Management Program, Rider University, 12 Winding Way, Morris Plains, NJ, 07950, United States of America, tanjean@verizon.net, Renato De Matta, Minghong Xu

We conduct simulations of alternative logistics network inventory stocking strategies. We then evaluate the accuracy and practical utility to network planners of using multiple portfolio effect models and the SQRTN model to predict changes in inventory investment requirements under alternative inventory network strategies and configurations.

3 - A Critique of Empirical Tests on the Inventory-performance Relationship in U.S. Manufacturing

Daesung Ha, Professor, Marshall University, 415 Corbly Hall,
1 John Marshall Drive, Huntington, WV, 25755,
United States of America, ha@marshall.edu

In this study, we discuss the estimation errors and the model specification problem of the existing studies which investigated the relationship between inventory productivity and firm performance in U.S. manufacturing industry. Using the panel data of U.S. manufacturing firms over the period of 1980–2014 collected from the Compustat database, we provide the corrected estimation results.

4 - The Effect on Inventories Assets Turnover Change Ratio by Firm Characteristics

Jihye Lee, Kyungpook National University, Sangyeok
3-Don Buk-Gu, Daegu, Korea, Daegu, Korea, Republic of,
jj2083@gmail.com, Pansoo Kim

This study analyzed the effect on ratio of change of inventories turnover by firm characteristics using panel data targeting manufacturing companies listed on the Korea Stock Exchange securities market since January 1, 1999 to December 31, 2012. Firm size, sales growth rate, ROA(return on assets), leverage ratio, credit rating, age of firm were used as a 6 important firm characteristic variables.

5 - Service Management in Dynamic Online Markets with Positive and Negative Word of Mouth

Ruiqi Hou, University of Science and Technology of China,
East Campus USTC, No. 96 Jinzhai Road, Room 367-414, Hefei,
230026, China, qiqimath@gmail.com

We consider that comments online may lead to customers' leaving the market. We use the effect that value for money level may have on market size to measure the economic effect. The model considers both single and two-firm model and the decision is setting investment cost. Customers are distinguished by their types which induce heterogeneous rates of adoption information. The information of value for money level diffuses and affects the transitions of consumers. We establish conditions for a Nash equilibrium policy.

■ TD04

04-Room 304, Marriott

Economics I

Contributed Session

Chair: Patrick O'Reilly, PhD Candidate, Mineral And Energy Economics, Colorado School of Mines, P.O. Box 11, Golden, CO, 80402, United States of America, poreilly@mines.edu

1 - Foreign Direct Investment and Organized Crime in Mexico: A Spatial Approach

Lorena Berumen, Head Of Academic Area In Operations
Management, Universidad Panamericana, Augusto Rodin 498,
Ciudad de México, Mexico, laberumen@up.edu.mx, Roldán
Andrés-rosales, Margarita Hurtado

Foreign Direct Investment (FDI) has played an important role in the growth and development of the Mexican economy. In this paper our main contribution is the analysis of FDI by sector and its spillover effect in the different regions in which FDI has been concentrated. Using spatial panel data and a spatial Durbin Model to assess the direct and indirect effects of FDI on the sectors affected by organized crime.

2 - The Role of Social Planner in Closed-loop Supply Chain

Lan Wang, Assistant Professor, California State University at East
Bay, 25800 Carlos Bee Blvd., Hayward, CA, 94401, United States
of America, lan.wang@csueastbay.edu, Tharanga Rajapakshe,
Asoo Vakharia

Our paper studies the problem of legislation practices on who should be responsible for recycling, and compares the existing mechanisms on the efficiency of environmental protection. Given different social objectives – prioritized consumer welfare, prioritized environmental benefit, or jointly social objective, we aim to provide roadmap to the social planner on legislation and incentives for remanufacturing and the end-of-life/use product recycling activities.

3 - Modelling Heterogeneous Economies – Two Competing Paradigms

Grzegorz Koloch, Warsaw School of Economics, Al.
Niepodległości 162, Warsaw, 02-554, Poland,
gkoloch@gmail.com, Mateusz Zbikowski, Bogumil Kaminski

Two modelling paradigms gained most popularity in the field of heterogeneous agent macroeconomic modelling: the heterogeneous agent DSGE models and Agent Based Macroeconomic simulation models. The first approach, is based on neoclassical foundations and uses dynamic programming paradigm. It is considered to be a mainstream. The second one still is not used to a comparable extent both by researchers and policy makers. In this paper we propose an explanation of the reasons for such a situation.

4 - An Optimization Model for Allocation and Routing of Municipal Solid Waste in Flanders

Jens Van Engeland, KU Leuven Campus Brussels, Warmoesberg
26, Brussels, 1000, Belgium, jens.vanengeland@kuleuven.be

Historical evolutions and inter-municipal cooperations decide on the current allocation of municipal solid waste (MSW) to treatment facilities in Flanders. However, in the near future the region will be confronted with a number of important waste dilemmas. Therefore it is important to know what gains could be achieved by redesigning the current allocation in the first place. The proposed model optimizes the allocation and routing of MSW from municipalities to treatment plants.

5 - A Network Formulation of Competing Demands for Water: Transaction Costs, Property Rights, and Rents

Patrick O'Reilly, PhD Candidate, Mineral And Energy Economics,
Colorado School of Mines, P.O. Box 11, Golden, CO, 80402,
United States of America, poreilly@mines.edu

Markets and centrally-planned regimes may be seen as having network structure, exhibiting not only spatial dependence, but transaction costs and the dual notion of economic property rights. Water allocation problems pose a range of institutional questions that network models may be uniquely suited to answer. This paper investigates transaction cost and economic rent consequences of choosing between market and command-oriented institutions in light of their respective network structure.

■ TD05

05-Room 305, Marriott

Social Media Engagement

Cluster: Social Media Analytics

Invited Session

Chair: Les Servi, The MITRE Corporation, 202 Burlington Road,
Bedford, MA, United States of America, lservi@mitre.org

1 - Development and Evaluation of Tagalog LIWC Dictionaries for Negative and Positive Emotion

Amanda Andrei, Graduate Student, Georgetown University,
Washington, DC, United States of America
aal436@georgetown.edu

Developing non-English sentiment analysis tools can ensure that data is not lost due to language. A proof-of-concept Tagalog Linguistic Inquiry and Word Count (LIWC) dictionary for positive and negative emotion was developed for use in analyzing mixed language Twitter data from the Philippines and evaluated against human-annotated sentiment for Twitter, referred to as groundtruth.

2 - Consumer Engagement with Green Brands on Facebook as Revealed in Refined Sentiment Analysis

Tiffany Ting-Yu Wang, Associate Professor, College of
Informatics, KNU, 70-7 Xianyan Rd. Lane 16, Taipei, No. 11688,
Taiwan - ROC, tiffanyt.wang122@gmail.com

The fast-growing number of social media users together with inundating user generated content has posed significant challenges to firms trying to detect consumers' attitudes. This research aims to uncover consumer experiences with two green brands in the cosmetics industry through collecting and analyzing public Facebook posts. We refine sentiment analysis by applying the Tetraclasse model to identify social media context and/or green product attributes as satisfaction determinants.

3 - Tailored Incentives and Least Cost Influence Maximization on Social Networks

Rui Zhang, University of Maryland, College Park, MD, United
States of America, ruizhang@rhsmith.umd.edu, S. Raghavan

We wish to promote a product over a social network and attain 100% adoption. We study a cost minimization problem where incentives can be tailored to each individual. A totally unimodular formulation is proposed for trees. Observing that the influence propagation network is acyclic, we apply this formulation (along with an exponential set of anti-cycle inequalities) to general networks. Next, a branch-and-cut approach is developed and used to solve problems on real-world graphs with 5000 nodes.

4 - Large-scale Bid Optimization in Online Advertising Auctions

Mustafa Sahin, University of Maryland, Van Munching Hall 3330,
College Park, MD, 20742, United States of America,
mustafa.sahin@rhsmith.umd.edu, Abhishek Pani, S. Raghavan

In sponsored search ads, the search operator collects bids for a given keyword and determines whose ads will be displayed in what position. The advertisers have to decide on keywords and positions to bid on given a budget, which can be modeled as a Multiple Choice Knapsack Problem. The number of keywords and positions considered can be in the order of hundreds of millions for this application. We offer an algorithm that is both time and memory efficient and present results on hard instances.

■ TD06

06-Room 306, Marriott

Quantitative Finance and Risk Management

Sponsor: Financial Services

Sponsored Session

Chair: Ning Cai, Associate Professor, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, China, ningcai@ust.hk

1 - Pricing Asian Options under Markov Processes

Ning Cai, Associate Professor, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, China, ningcai@ust.hk

We derive analytical approximations to both continuous and discrete Asian option prices under general Markov processes. Numerical results illustrate that our pricing methods are accurate and fast under diffusion models, jump diffusion models, and pure jump models.

2 - Transform Methods for Default Timing Problems

Alex Shkolnik, University of California, Berkeley, CA, United States of America, ads2@berkeley.edu, Kay Giesecke

Reduced-form models of name-by-name default timing are widely used to measure portfolio credit risk. Combinatorial aspects of many default timing problems render them NP-complete. Nevertheless, well designed transform methods do yield efficient algorithms. We illustrate such an algorithm on an application of CDO pricing. The proposed method reduces computational complexity by orders of magnitude over those encountered in the literature. A complete error analysis is provided.

3 - Closed-Form Valuation of Barrier Options

Haohong Lin, Department of Industrial Engineering and Logistics Management, HKUST, Hong Kong, Hong Kong - PRC, hlinaa@ust.hk, Ning Cai

We study the pricing problem of barrier options that are among the most popular exotic options in the financial market and derive closed-form pricing formulas under some option pricing models. Numerical results suggest that our pricing method is accurate and efficient.

4 - Does the Prohibition of Trade-throughs Hurt Liquidity Demanders?

Ningyuan Chen, Columbia University, S. W. Mudd 321, 500 W 120th Street, New York, NY, 10027, United States of America, nc2462@columbia.edu, Steven Kou

We study the impact of prohibiting trade-throughs on liquidity demanders. We find that after trade-throughs are prohibited, the transactions of a liquidity demander might have higher execution cost and effective spread. However, the additional cost is insignificant for small trades and stocks with abundant liquidity provision. Our results favor the enforcement of the Order Protection Rule, as the cost it incurs on liquidity demanders may be outweighed by its benefit.

■ TD07

07-Room 307, Marriott

Topics in Optimal Investment

Cluster: Risk Management

Invited Session

Chair: Mykhaylo Shkolnikov, Princeton University, ORFE, Princeton, NJ, 08540, United States of America, mshkolni@gmail.com

1 - Arbitrage-free Valuation and Hedging of XVA

Maxim Bichuch, Johns Hopkins University, Baltimore, MD, United States of America, mbichuch@jhu.edu, Agostino Capponi, Stephan Sturm

We introduce a framework for computing the Total Valuation Adjustment (XVA) of an European claim accounting for funding costs, counterparty risk, and collateral mitigation. We derive the nonlinear BSDEs associated with the replicating portfolios of long and short positions, and define the buyer and seller's XVAs. When borrowing and lending rates coincide we provide a fully explicit expression for the XVA. When they differ, we derive the semi-linear PDEs, and conduct a numerical analysis.

2 - Rationalizing Behavioral Portfolio Choice

Stephan Sturm, Worcester Polytechnic Institute, Worcester, MA, United States of America, ssturm@wpi.edu, Carole Bernard

Classical portfolio optimization theory postulates that investors' preferences are rational and the optimization criterion is expected utility, for some increasing and concave utility function. This contrasts with with empirical finding of cognitive psychology. In this talk we try to answer the question if a given behavioral portfolio choice in a general incomplete semimartingale market can be replicated

in the rational expected utility framework.

3 - Sequential Monte Carlo with Parameter Learning for Long-memory Processes

Konstantinos Spiliopoulos, Assistant Professor, Boston University, Department of Mathematics and Statistics, 111 Cummington Mall, Boston, MA, 02215, United States of America, kspiliop@math.bu.edu

We consider state-space models specified up to an unknown vector of parameters and in which the unobserved state process exhibits long-memory. We estimate both the state process and the parameter vector and propose a sequential Monte Carlo method that is based on smoothing of the sample points of model parameters. We establish a central limit theorem for the state and parameter filter. We apply the approach to S&P 500 data in the context of a stochastic volatility model with long memory.

4 - Leveraged ETF Portfolios with Delta-vega Control

Zheng Wang, Columbia University, 116th Street, New York, NY, 10027, United States of America, zw2192@columbia.edu, Tim Leung

We analyze a collection of static portfolio strategies that allow an investor to control portfolio sensitivity with respect to the short-term return and realized volatility of a reference asset. This is done by choosing appropriate weights of each constituent in a portfolio of leveraged ETFs. We backtest our proposed strategies using empirical data of major equity leveraged ETFs and illustrate the efficacy of our methodology.

■ TD08

08-Room 308, Marriott

Tutorial in Financial Services

Sponsor: Financial Services

Sponsored Session

Chair: Bo Zhang, IBM Research, 1101 Kitchawan Road, Route 134, Yorktown Heights, NY, 10594, United States of America, zhangbo@us.ibm.com

1 - Reduced Form and Structural Models in Energy Finance

Stathis Tompaidis, Professor, University of Texas at Austin, Office of Financial Research, Austin, TX, 78712, United States of America, Stathis.Tompaidis@mcombs.utexas.edu

We present both reduced form and structural models used in Energy Finance. The models span the oil, gasoline, refinery, natural gas, and electricity markets, and can be used to value generators, oil and natural gas fields, and electricity generators.

■ TD09

09-Room 309, Marriott

Collaborative R&D

Sponsor: Technology, Innovation Management & Entrepreneurship

Sponsored Session

Chair: Niyazi Taneri, SUTD, 8 Somapah Rd, Singapore, Singapore, niyazitineri@sutd.edu.sg

1 - Incentivizing External Experts in New Product Development

Shantanu Bhattacharya, Singapore Management University, Lee Kong Chain School of Business, Grange Heights, Singapore, 238145, Singapore, shantanub@smu.edu.sg, Sameer Hasijsa

We create a model of new product development where information on external factors like market potential and technology feasibility is sought from external experts. The firm has to adequately incentivize these experts to truthfully reveal their judgment. Contracts are presented to alleviate the resulting adverse selection problem.

2 - Supplier Incentives in Collaborative Product Development with Internal Competition

Timofey Shalpegin, Lecturer, University of Auckland, 12 Grafton Road, Auckland, 1010, New Zealand, t.shalpegin@auckland.ac.nz

Internal competition in new product development has a profound, yet unexplored effect on the incentives of the suppliers involved in a development project through collaboration with the manufacturer's competing development teams. We study the optimal assignment of development teams to different suppliers. We find that due to the effect of competition on supplier incentives, the manufacturer may find it optimal to allocate more development teams to a supplier with lower capabilities.

3 - Dynamic Delegated Search

Morvarid Rahmani, Assistant Professor, Georgia Tech,
Atlanta, GA, morvarid.rahmani@scheller.gatech.edu,
Karthik Ramachandran

Firms often delegate the search for solution of their innovative problems to third parties (e.g., search for designs, advertisements, executive leaders, etc.) In this paper we study how the client's choice of search process (i.e., defined or open-ended) depends on the strategic behavior of the provider. Taking the client's and provider's perspective, we identify conditions for which a defined search is preferred to an open-ended search.

4 - The Impact of Health Information Technology Bundles on Hospital Performance: An Econometric Study

Aravind Chandrasekaran, Associate Professor, The Ohio State
University, 2100 Neil Avenue, Columbus, OH, 43210, United
States of America, chandrasekaran.24@osu.edu, Luv Sharma

We examine how two HIT bundles: Clinical (used for patient data collection, diagnosis and treatment) and Augmented Clinical (used for integrating patient information and decision making) jointly impact operating cost and process quality. Results suggest complementarities between these bundles with respect to process quality but not cost. A posthoc analyses offers additional explanation on the lack of association with cost.

TD10

10-Room 310, Marriott

Platform-Based Markets in the Digital Era

Sponsor: E-Business

Sponsored Session

Chair: Jason Chan, Assistant Professor, University of Minnesota, 321
19th Ave S, Minneapolis, MN, United States of America,
jchanf@umn.edu

1 - Dynamic Strategies for Successful Online Crowdfunding

Zhuoxin (Allen) Li, Assistant Professor, Boston College,
140 Commonwealth Avenue, Chestnut Hill, MA, 02467,
United States of America, zhuoxin.li@gmail.com, Jason A. Duan

This paper empirically investigates the dynamics of investors' backing behaviors in the presence of network externalities and a finite time window. Model estimation shows that investors are more likely to back a project that has already attracted a critical mass of funding. For the same amount of achieved funding, the backing propensity declines over time.

2 - The Effect of Disclosing Purchase Information on Review Helpfulness: Evidence from Amazon.com

Marios Kokkodis, Assistant Professor, Boston College,
34 E 10th, New York, NY, 10009, United States of America,
mkokkodis@stern.nyu.edu

In this work, we study how the introduction of the Verified Purchase (VP) feature affected review helpfulness on the Amazon platform. We find that all else equal, 'search' product VP reviews are on average 3.6% more helpful than nonVP reviews, and 'experience' product VP reviews are 5.6% more helpful than non-VP reviews.

3 - The Business Value of Recommendations: A Privacy-preserving Econometric Analysis

Panagiotis Adamopoulos, Doctoral Candidate, New York
University, 44 W 4th St, New York, NY, United States of America,
padamopo@stern.nyu.edu, Alexander Tuzhilin

We study the effectiveness of different types of mobile recommendations and their impact on economic demand, using a privacy-preserving econometric analysis. Our observational data set is based on a real-world mobile recommender system, which we further supplement with climate, geospatial, and population and household data. Based on our findings, an increase by 10% in the number of times a venue is recommended raises the demand by about 6.7%.

4 - Effect of Valuation Uncertainty on Buyer Indecision and Bidder Regret in Online Labor Markets

Kevin Hong, Assistant Professor, Arizona State University,
400 E Lemon St, Tempe, AZ, United States of America,
hong@asu.edu, Paul Pavlou, Alvin Zheng

In online labor markets, 60% of projects fail to reach to a contract, and significant bidder remorse is observed, indicating a waste of time and effort for both buyers and freelancers. This paper empirically examines how valuation uncertainty - measured as bids price dispersion - affects buyer's contract indecision and bidders' regret after the buyer awards a contract. We find bids valuation uncertainty increases both buyer's contract indecision and bidders' regret.

TD12

12-Franklin 2, Marriott

MAS Tutorial: The State of Operations Research in the US Military: A 75th Anniversary Perspective

Sponsor: Military Applications

Sponsored Session

Chair: Greg Parlier, Past President, MAS of INFORMS, 255 Avian Lane,
Madison, AL, 35758, United States of America, gparlier@knology.net

1 - The State of Operations Research in the U.S. Military: A 75th Anniversary Perspective

Greg Parlier, Past President, MAS of INFORMS, 255 Avian Lane,
Madison, AL, 35758, United States of America,
gparlier@knology.net

This extended presentation offers perspectives on the past, present, and future of Operations Research in the US Department of Defense with emphasis on the Army. The need for a critical review is argued, and a framework for a comprehensive assessment is developed. Enduring principles are suggested and new concepts are presented, including both strategic and transformational analytics.

TD14

14-Franklin 4, Marriott

Engineering Systems Applications

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Honggang Wang, Assistant Professor, Rutgers University,
96 Frelinghuysen Rd, 201 CoRE, Piscataway, NJ, 08854,
United States of America, honggang.w@rutgers.edu

1 - Optimization of Maintenance Planning for Water Distribution Network under Stochastic Failures

Xin Chen, Assistant Professor, Southern Illinois University,
P.O. Box 1805, Edwardsville, IL, 62034, United States of America,
xchen@siue.edu, Honggang Wang

Cost-effective and preventive maintenance for water distribution networks (WDN) is essential for sustainable and reliable use of water resources. We develop mathematical models and apply optimization procedures for optimal WDN maintenance planning under stochastic failures. We demonstrate the mathematical models and optimization approach using a regional WDN in a large U.S. city. We apply genetics algorithms to solve the optimization problem and find the optimum maintenance plan for the WDN.

2 - Optimal Development of Shale Gas Field

Honggang Wang, Assistant Professor, Rutgers University,
96 Frelinghuysen Rd, 201 CoRE, Piscataway, NJ, 08854,
United States of America, honggang.w@rutgers.edu

Optimal development of shale gas involves determining the most-productive fracturing network via hydraulic stimulation processes in shale reservoirs. Shale gas development problems can be formulated with mixed-integer optimization models. We apply a simplex interpolation based optimization method to solve mixed integer optimization problems associated with shale gas production projects. The optimization performance is demonstrated with the example case of developing the Barnett shale field.

3 - Resource Abstraction in Planning and Design of Virtual Data Centers

Dimitri Papadimitriou, Copernicuslaan 50, 2018, Antwerp, 2018,
Belgium, dimitri.papadimitriou@alcatel-lucent.com

Virtual data centers enable flexible allocation of capacity to customer demands by aggregating physical resources taken out of a subset of data centers (facilities) to satisfy customer demands. The goal is to determine the capacity to be provisioned on opened facilities and the assignment that minimize the cost of opening, supplying demands and connecting each customer to a subset of facilities. We compare the resulting cost against the corresponding capacitated facility location problem.

■ TD15

15-Franklin 5, Marriott

Capacity Management in Healthcare Operations

Sponsor: Optimization in Healthcare

Sponsored Session

Chair: Sandeep Rath, PhD Candidate, UCLA Anderson, B501 Gold Hall, UCLA Anderson, Los Angeles, CA, 90024, United States of America, Sandeep.Rath.1@anderson.ucla.edu

1 - Workforce Optimization with Patient Volume Variations and Scheduling Pattern Generation for Hospital

Xuanqi Zhang, Philips Research North America, 345 Scarborough Rd, Briarcliff Manor, NY, 10510, United States of America, Xuanqi.Zhang@philips.com, Jingyu Zhang

A two-stage model is created to optimize hospitals' workforce which directly affects hospital cost and patients satisfaction. The model uses simulation-based stochastic optimization and heuristics to reduce staffing cost, avoid understaffing and improve scheduling efficiency. The two-stage solution mechanism helps diminish the gap between staffing optimization research and hospital scheduling practice. Results were delivered to and tested in hospitals.

2 - Integer Programming Model to Solve Bloodmobiles Routing Problem

Grisselle Centeno, Associate Professor, Univ. of South Florida, 4202 E. Fowler Ave., Tampa, FL, 33620, United States of America, gcenteno@usf.edu, Serkan Gunpinar

Blood is a scarce and perishable resource. Approximately 80% of the blood donations are handled remotely via bloodmobiles. Blood center must determine the number of bloodmobile units to operate, and designate their daily location(s) to avoid shortfalls. In this study, a vehicle routing problem is developed using IP. Optimal routing for each bloodmobile is identified using CPLEX solver & column generation algorithm. Computational results will be discussed.

3 - A Binary Integer Programming Approximation for Vaccine Vial Distribution

Zahra Azadi, Clemson University, 854 Issaqueena Trl. Apt#902, Central, SC, 29630, United States of America, zazadi@clemson.edu, Sandra Eksioglu

One of the challenges faced by health care providers is designing an inventory replenishment policy for vaccines to ensure a successful immunization of patients while minimizing purchasing, inventory and wastage costs. Wastage incurs when doses are disposed from opened vials after their safe use time. We propose an (s, S) policy which determines the vial size, the reorder quantity, and the order up to point which optimizes system-wide costs.

■ TD16

16-Franklin 6, Marriott

Inverse Optimization

Sponsor: Optimization/Linear and Conic Optimization

Sponsored Session

Chair: Daria Terekhov, Concordia University, 1455 De Maisonneuve Blvd. W., Montreal, Canada, dterekho@encs.concordia.ca

1 - A Goodness-of-fit Measure for Inverse Optimization

Daria Terekhov, Concordia University, 1455 De Maisonneuve Blvd. W., Montreal, Canada, dterekho@encs.concordia.ca, Taewoo Lee, Timothy Chan

Using an analogy between regression and inverse optimization, we develop a framework for cost function estimation in linear optimization consisting of a general inverse optimization model and a corresponding goodness-of-fit metric. We propose several natural specializations of the framework that evaluate goodness-of-fit in both the space of decisions and objective value.

2 - Inverse Optimization for the Analysis of Competitive Markets

Michael Pavlin, Wilfrid Laurier University, 75 University Ave, Waterloo, ON, Canada, mpavlin@wlu.ca, John Birge, Ali Hortacsu

We consider use of inverse optimization as an empirical tool for uncovering unobservable parameters in competitive markets. In particular, we apply these techniques to the recovery of transportation and production cost parameters in natural gas markets.

3 - Three Newsvendor Models for Capacity Allocation

Sam Choi, Assistant Professor, Shenandoah University, 1460 University Dr., Winchester, VA, 22601, United States of America, schoi@su.edu

We propose three newsvendor models to allocate capacity under uncertainty: inverse newsvendor, sequential newsvendor, and inverse sequential newsvendor models. The inverse newsvendor model tries to find optimal demand size under capacitated environment. The sequential newsvendor model deals with optimal time durations given that demand sizes. Lastly, the inverse sequential newsvendor model determines optimal demand sizes given that time durations. We apply three models to healthcare settings.

■ TD17

17-Franklin 7, Marriott

Routing and Multidimensional Assignment Applications

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Jose Walteros, University at Buffalo, 342 Bell Hall, Buffalo, NY, United States of America, josewalt@buffalo.edu

1 - Gasoline Replenishment and Routing Problem with Variable Demands and Time Windows

Yan Cheng Hsu, University at Buffalo (SUNY), 412 Bell Hall, Buffalo, NY, 14228, United States of America, yhsu8@buffalo.edu, Rajan Batta, Jose Walteros

An iterative procedure is presented to tackle the gasoline replenishment problem of gas stations and vehicle routing problem. The problem is formulated as inventory model with a send-back cost due to the gasoline delivery property that gas stations should accept ordered quantity completely, to find order quantity and time window of gas stations, minimizing expected total cost, and as MIP model to resolve vehicle routing problem, maximizing total profit for transporters.

2 - Solving Multidimensional Assignment Problems with Combinatorial Decomposable Cost Functions

Hadi Feyzollahi, State University of New York at Buffalo, 316 Bell Hall, Buffalo, NY, United States of America, hadifeyz@buffalo.edu, Jose Walteros

We consider several variants of the multidimensional assignment problem (MAP) where the costs of the optimal assignments are calculated by solving combinatorial optimization problems. We focus our attention on the cases where the assignments represent optimal TSP tours, spanning trees, and cliques. We formulate these MAPs as set partitioning problems and solve them via branch and price. We develop specific algorithms for solving the corresponding subproblems for each of the aforementioned cases.

3 - Location-capacity-routing Problem of All-electric Delivery Vehicles

Nan Ding, University of Buffalo, Buffalo, NY, United States of America, nanding@buffalo.edu, Rajan Batta

All-electric truck adoption becomes one of the main addressees of green logistic activities, with challenges of limited driving range and long charging time to route these trucks. This problem aims to handle the challenges of congestion and waiting at the charging stations. A joint location-capacity-routing (LCR) problem to determine the optimal location and capacity of charging stations is formulated and a meta-heuristic approach is proposed to solve this LCR problem.

4 - Large-scale Neighborhood Search for the Multi-dimensional Assignment Problem

Alla Kammerdiner, New Mexico State University, P.O. Box 30001, MSC 4230, Las Cruces, NM, 88003, United States of America, alla@nmsu.edu, Charles Vaughan

The multi-dimensional assignment problem is an NP-hard problem in high-dimensional combinatorial optimization. This problem arises in the military surveillance applications (e.g. sensor data fusion and target tracking) and in healthcare for ranking exposures to falls. We propose and investigate a new large-scale search algorithm for this computationally difficult problem. We evaluate the performance of new algorithm on various instances and compare it to other state-of-the-art procedures.

■ TD18

18-Franklin 8, Marriott

Recent Advances in First Order Methods for Large-Scale Optimization

Cluster: Modeling and Methodologies in Big Data

Invited Session

Chair: Mingyi Hong, Iowa State University, 3015 Black Engineering, Ames, IA, 50011, United States of America, mingyi@iastate.edu

1 - On the Information-adaptive Variants of the Admm: An Iteration Complexity Perspective

Shuzhong Zhang, Professor, University of Minnesota, Department of Industrial and Systems Eng, Minneapolis, MN, 55455, United States of America, zhangs@umn.edu, Xiang Gao, Bo Jiang

We present a suite of variants of the ADMM, where the trade-offs between the required information on the objective and the computational complexity are explicitly given. The new variants allow the method to be applicable on a much broader class of problems where only noisy estimations of the gradient or the function values are accessible, yet the flexibility is achieved without sacrificing the computational complexity bounds.

2 - An Optimal Randomized Incremental Gradient Method

Guanghui Lan, University of Florida, Gainesville, FL, United States of America, glan@ise.ufl.edu

We present a randomized incremental gradient method and show that this algorithm possesses unimprovable rate of convergence for convex optimization. We provide a natural game theoretic interpretation for this method as well as for the related Nesterov's optimal method. We also point out the situations when this randomized algorithm can significantly outperform the deterministic optimal method.

3 - On the Expected Convergence of Randomly Permuted ADMM

Ruoyu Sun, Stanford University, Menlo Park, CA, 94025, United States of America, sundirac@gmail.com, Zhi-Quan Luo, Yinyu Ye

Recently, it has been shown that the direct extension of the alternating direction method of multipliers (ADMM) to the multi-block case fails to converge when solving a simple square system of linear equations. In this paper, however, we prove that, if in each step one randomly and independently permutes the updating order of any given number of blocks, the method will converge in expectation for solving the square system of linear equations.

4 - Alternating Direction Method of Multipliers for Distributed Sparse Principal Component Analysis

Davood Hajinezhad, Iowa State University, 62 B Schilleter village, Ames, IA, 50010, United States of America, dhaji@iastate.edu, Mingyi Hong

We propose distributed algorithms to perform sparse PCA. They are quite flexible, in the sense that they are able to handle different forms of data partition (i.e., partition across rows or columns of the data matrix). Numerical experiments based on both real and synthetic data sets, conducted on high performance computing clusters, demonstrate the effectiveness of our approaches.

■ TD19

19-Franklin 9, Marriott

Network Inference

Sponsor: Computing Society

Sponsored Session

Chair: Nediako Dimitrov, Assistant Professor, UT Austin, University of Texas at Austin, Austin, United States of America, ned@austin.utexas.edu

1 - Fast, Approximate Inference on Graphical Models by Reducing Treewidth

Areesh Mittal, University of Texas at Austin, 1626 West 6th St. Apt. F, Austin, TX, 78703, United States of America, areesh0612@gmail.com, Nediako Dimitrov

Complexity of exact inference algorithms in graphical models is exponential in treewidth. We develop technique to perform approximate inference by removing edges and updating factors, leading to reduced treewidth. We prove bounds on error in approximation. Finding updated factors involves solving a geometric program (GP) with exponential number of constraints. We develop row generation technique to solve the GP. We demonstrate the results on discrete graphical models applied to social networks.

2 - Non-aggressive Adaptive Traffic Routing

Madhushini Narayana Prasad, Graduate Research Assistant, Cockrell School of Engineering, University of Texas at Austin, Austin, TX, 78712, United States of America, madhushini@utexas.edu, Nediako Dimitrov

Routing a person through a traffic network presents a dilemma to choose between fixed route which is an easier to navigate route and adaptive route which minimizes the travel time by adjusting to the traffic conditions. We investigate methods for non-aggressive, adaptive routing that is middle-ground seeking the best of both these extremes, i.e. adaptive routes restricted in number of route shifts allowed at a critical juncture, and investigate the trade-offs between the extremes.

3 - Social Network Echo Chambers and Popularity

Yinhan Liu, University of Texas Austin, 1901 Crossing Place #3301, Austin, TX, 78741, United States of America, yinhan.liu@utexas.edu, Nediako Dimitrov

Social network users often have the goal of building a large follower base. Some users are members of what we term echo chambers, a small group of users that re-share each other's messages. We present an empirical study on the impact of echo chambers on the popularity of users using historical data from Twitter. Specific questions we address are: Does echo chamber membership increase re-shares outside the echo chamber? Does echo chamber membership increase follower base?

■ TD20

20-Franklin 10, Marriott

Banking and Insurance

Contributed Session

Chair: Linna Du, Data Scientist, CACS, 2259 Adam Clyton Powell, New York, NY, 10027, United States of America, linna.du@gmail.com

1 - Success Drivers of Online Equity Crowdfunding Campaigns for Unaccredited Investors

Anna Lukkarinen, Aalto University, P.O. Box 21220, Helsinki, 00076, Finland, anna.lukkarinen@aalto.fi, Jeffrey Teich, Hannele Wallenius, Jyrki Wallenius

Using data from a leading equity crowdfunding platform in Northern Europe, we explore success factors of campaigns. The results suggest that the investment criteria traditionally used by professional investors are not of prime importance for success in equity crowdfunding. Instead, success is related to pre-selected crowdfunding campaign characteristics and networks. Understanding the success factors of online equity crowdfunding campaigns is important to the design of online platforms.

2 - The Mover-Stayer Process for the Credit Data

Anna Matuszyk, Assistant Professor, Warsaw School of Economics, Niepodleglosci 162, Warsaw, 02-554, Poland, amatuszyk@matuszyk.com, Halina Frydman

Using the credit data set, coming from the European bank, we estimate the mover-stayer model, which is an extension of the Markov chain. This model assumes that the population is heterogeneous: there are "stayers" and "movers". "Movers" evolve according to a Markov Chain with the one-step transition matrix, while "stayers" never leave their initial states. The probability of a customer being a stayer in a paid up state is modeled using the logistic regression.

3 - Monopolistic Dealer Versus Broker: Impact of Proprietary Trading with Transaction Fees

Yuan Tian, Ryukoku University, 67 Tsukamoto-cho, Fukakusa, Fushimi-ku, Kyoto, Japan, tian@econ.ryukoku.ac.jp, Katsumasa Nishide

We consider a one-period financial market with a monopolistic dealer/broker and an infinite number of investors. While the dealer (with proprietary trading) simultaneously sets both the transaction fee and the asset price, the broker (with no proprietary trading) sets only the transaction fee, given that the price is determined according to the market-clearing condition among investors. We effectively demonstrate how proprietary trading affects market equilibrium and welfare of investors.

4 - A Data Analytics Based Approach for Building 360 View of Banking Customer

Tianzhi Zhao, IBM, Diamond Bld, ZGC Software Park, Beijing, China, zhaotzhi@cn.ibm.com, Zhen Huang, Ming Xie, Bing Shao, Yuhang Liu, Jian Xu, Wenjun Yin, Yuhui Fu

Banks today are experiencing transformation from product centricity to customer centricity. With advent of big data, it enables banks to fully and deeply understand customers by building 360 degree customer view. In this paper, a data analytics based approach for 360 degree view of banking customer is proposed. It can help banks quick build customer centricity for customer segments, targeted marketing, personalized recommend, etc.

5 - Credit Scoring using Dynamic State Space Model under Statistical Volatility

Linna Du, Data Scientist, CACS, 2259 Adam Clayton Powell,
New York, NY, 10027, United States of America,
linna.du@gmail.com

In emerging market where the credit score and credit history are not trustworthy, the estimation and prediction of the credit score and prepayment risks are very important. In the paper, we propose a dynamic state space model considering the volatility and dynamic feature of the lending market. We found that the time varying volatility model provides better prediction than other time series models. We also identify the key factors that drive the lending risks.

■ TD21

21-Franklin 11, Marriott

Disease Modeling in OR

Sponsor: Health Applications

Sponsored Session

Chair: Emine Yaylali, Senior Service Fellow, Centers for Disease Control and Prevention, 1600 Clifton Road, Atlanta, GA, 30333, United States of America, wq3@cdc.gov

1 - The Potential Impact of Reducing Indoor Tanning on Melanoma Prevention in the United States

Yuanhui Zhang, CDC, Chamblee GA 30341,
United States of America., yfp5@cdc.gov, Donatus Ekwueme,
Sun Hee Rim, Meg Watson, Gery Guy

More than 700,000 adults in the United States are treated for melanoma each year, resulting in annual direct medical costs of \$3.3 billion dollars and 9,000 deaths. We developed a Markov model to estimate the health and economic impacts of reducing indoor tanning for melanoma prevention in the United States under certain assumptions. According to this model, reducing indoor tanning may result in favorable savings in medical costs and life-years, comparable to other national prevention efforts.

2 - Estimating the Impact of HIV Care Continuum Interventions on the Reproduction Number

Yao-Hsuan Chen, CDC, Chamblee GA 30341,
United States of America, xhj1@cdc.gov, Andrew Hill,
Paul G. Farnham, Stephanie L. Sansom

We used a compartmental model to study HIV transmission in the United States from 2006 through 2020 among heterosexuals, men who have sex with men, including bisexual men, and injection drug users. We analyzed the impact of interventions to improve HIV diagnosis, care, and treatment on the reproduction number. Analyses using this model can provide insights into the long-term effectiveness of HIV prevention strategies.

3 - Stratifying Risk Groups in Compartmental Epidemic Models: Where to Draw the Line?

Margaret L. Brandeau, Professor, Stanford University, MS&E
Department, Stanford, CA, 94305, United States of America,
brandeau@stanford.edu, Jeremy D. Goldhaber-fiebert

Disease models used to support cost-effectiveness analyses of health interventions are often stratified to reflect population heterogeneity (e.g., age, gender, risk behaviors). We examine the impact of population stratification in dynamic disease transmission models: specifically, the impact of different divisions of a population into a low-risk and a high-risk group. We show that the way in which the population is stratified can significantly affect cost-effectiveness estimates.

4 - Developing a Dynamic Compartmental Model of HIV in the United States

Emine Yaylali, Senior Service Fellow, Centers for Disease Control and Prevention, 1600 Clifton Road, Atlanta, GA, 30333, United States of America, wq3@cdc.gov, Paul G. Farnham, Stephanie L. Sansom, Katherine A. Hicks, Emily L. Tucker, Amanda Honeycutt

Over 1 million people in the US are living with HIV. To observe trends in HIV and evaluate the effectiveness of prevention interventions, we developed a dynamic compartmental model of disease progression and transmission. The population was stratified by age, sex, circumcision status, race/ethnicity, transmission group, and risk level. People progressed between compartments defined by disease status and care and treatment stage. Outcomes included HIV incidence, prevalence, and care status.

■ TD22

22-Franklin 12, Marriott

Contact Centers

Sponsor: Applied Probability

Sponsored Session

Chair: Rouba Ibrahim, University College London, London, N7 8EP, United Kingdom, rouba.ibrahim@ucl.ac.uk

1 - Telephone Call Centers: Asymptotic Optimality of Myopic Forecasting-scheduling Scheme

Han Ye, University of Illinois at Urbana Champaign, 350 Wohlers Hall, 1206 South Sixth Street, Champaign, IL, 61820, United States of America, hanye@illinois.edu, Noah Gans, Haipeng Shen, Yong-Pin Zhou

We determine workforce schedules for call center arrivals that are doubly stochastic. Period-by-period arrival rates follow a hidden AR(1) process, and only arrival counts are observed. We formulate stochastic programs to minimize long-run average staffing costs, subject to a long-run average constraint on abandonment. We show that, in steady state, repeated, myopic solution of the single-period problem is stable, has low cost, and meets the abandonment constraint.

2 - A Structural Model for Agents' Strategic Behavior in Call Centers

Dongyuan Zhan, University of Southern California, Los Angeles, CA, United States of America, Dongyuan.Zhan.2015@marshall.usc.edu, Amy Ward, Seyed Emadi

We do an empirical study of agent behavior in call centers. We begin by observing that regression analyses have low explanatory power, even though the data shows that agents speed up or slow down depending on the system load and their fatigue level. This leads us to investigate utility based structural models for agent behavior.

3 - Capacity Sizing with a Random Number of Agents

Rouba Ibrahim, University College London, London, N7 8EP, United Kingdom, rouba.ibrahim@ucl.ac.uk

We study the problem of staffing many-server queues with general abandonment and a random number of servers. For example, uncertainty in the number of servers may arise in virtual call centers where agents are free to set their own schedules. We rely on a fluid model to determine optimal staffing levels, and demonstrate the asymptotic accuracy of the fluid prescription. We also characterize the optimal staffing policy with self-scheduling agents.

■ TD23

23-Franklin 13, Marriott

Markov Decision Models and Approximations for Manufacturing

Cluster: Stochastic Models: Theory and Applications

Invited Session

Chair: Tugce Martagan, Eindhoven University of Technology, 5600 MB Eindhoven, Eindhoven, Netherlands, T.G.Martagan@tue.nl

1 - Robust Approximate Dynamic Programming and Structured Policies for Degradable Energy Storage

Marek Petrik, IBM, 1101 Kitchawan Rd., Yorktown Heights, NY, 10598, United States of America, mpetrik@us.ibm.com

Batteries hold great promise for energy storage in arbitrage in electric grids but can degrade rapidly with use. In this talk, we analyze the impact of storage degradation on the structure of optimal policies and describe robust approximate dynamic programming methods that take advantage of the policy structure.

2 - Component Reservation for Asymptotically Optimal Allocation in Assemble to Order Production Systems

Haohua Wan, University of Illinois at Urbana-Champaign, 104 South Mathews Ave., Urbana, IL, United States of America, hwan3@illinois.edu, Qiong Wang

Component reservation is not myopically optimal as it sometimes holds back components from existing demands. We prove that in many cases, without reservation, component allocation cannot be asymptotically optimal, i.e., the percentage difference of the discounted inventory cost from its lower bound does not converge to zero as demand and production volumes increase, even though such convergence is achievable under other policies that reserve components for high-value product demands.

3 - Replenishment and Fulfillment Based Aggregation for General Assemble-to-Order Systems

Emre Nadar, Assistant Professor, Bilkent University, Department of Industrial Engineering, Bilkent University, Ankara, Turkey, emre.nadar@bilkent.edu.tr, Alan Scheller-wolf, Alp Akcay, Mustafa Akan

We present an approximate dynamic programming method to optimizing Markovian assemble-to-order systems. We alleviate the computational burden by reducing the large state space of the problem via a novel aggregation method that builds upon certain component and product characteristics. We show the optimality of a lattice-dependent base-stock and rationing policy for the aggregate problem. We also derive finite error bound for the cost function of the aggregate problem under a mild condition.

4 - Optimal Manufacturing Policies for Engineer-to-Order Proteins

Tugce Martagan, Eindhoven University of Technology, 5600 MB Eindhoven, Eindhoven, Netherlands, T.G.Martagan@tue.nl, Ananth Krishnamurthy

We develop continuous state Markov decision models to optimize design decisions related to protein purification operations. We focus on engineer-to-order proteins with strict production requirements on quality and yield. We present a state aggregation mechanism to solve industry-size problems. Our models and insights are implemented in practice.

■ TD24

24-Room 401, Marriott

Social Network Analytics

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Xi Wang, The University of Iowa, S343 PBB, Iowa City, IA, 52242, United States of America, xi-wang-1@uiowa.edu

1 - Optimizing Hurricane Warning Dissemination Problem for Evacuation Decision Making

Dian Sun, Harbin Engineering University, 172 Princeton Ave. Apt 1, Buffalo, NY, 14226, United States of America, sundian@hrbeu.edu.cn, Yan Song, Zifeng Su

Individual make evacuation decisions based on risk perception which can be socially influenced as evacuation warnings spread through social networks. In this study a formal model for evacuation warning dissemination in social networks through time is presented to characterize the social influence of the risk perception in the evacuation decision making process. Simulation models are developed to investigate the effects of community mixing patterns and the strength of ties on evacuation decision.

2 - Inferring User Location from Geographic and Social Network

Da Xu, PhD Student, University of Utah, 1032 E 400 S, Apt 504B, Salt Lake City, UT, 84102, United States of America, Da.Xu@business.utah.edu, Xiao Fang

The lack of tools to monitor the time-resolved locations of individuals constrains us to gain a deep understanding of human mobility. While, despite the diversity of people's travel history, human mobility follows a high of temporal and spatial regularity. In this paper, we study the human mobility through social and geographic networks, give a deep insight to how individual mobility pattern and social network impact with each other, and build a probabilistic model to depict human mobility.

3 - Concurrent Diffusions of Information and Behaviors in Online Social Networks

Shiyao Wang, University of Iowa, 634 Westgate St. Apt. 55, Iowa City, IA, 52246, United States of America, shiyao-wang@uiowa.edu, Kang Zhao

Using the spread of the Ice Bucket Challenge (IBC) on Twitter as a case study, this research compared the concurrent diffusion patterns of both information and behaviors in online social networks. Individual behaviors related to IBC were detected by text mining techniques. Comparison between diffusion dynamics of information and behaviors at different levels revealed interesting differences and interactions between the two diffusion processes and laid foundations for future analytics.

■ TD25

25-Room 402, Marriott

Economic Models and Analysis of Networks and Platforms

Sponsor: Information Systems

Sponsored Session

Chair: Soumya Sen, University of Minnesota, Minneapolis, MN, United States of America, ssen@umn.edu

1 - Payments for Transactions Versus Payments for Discoveries: Theoretical Analyses

Karthik Kannan, Purdue University, 403 W.State Street, West Lafayette, IN, 47907, United States of America, kkarthik@purdue.edu, Rajib Saha

eBay.com in the U.S. charges payments for transactions but Taobao.com in China charges for discoveries. We theoretically study such payment schemes used by the platforms. We surprisingly find that when payments are for discoveries, the platform has an incentive to make welfare-decreasing matches between sellers and buyers. Similarly, in order for payments for transactions to be sustained, buyers and sellers should sufficiently value factors such as trust provided by the platform.

2 - The Impact of Online Word of Mouth on Channel Disintermediation for Information Goods

Brian Lee, University of Connecticut, 2100 Hillside Road Unit 1041, Storrs, CT, 06268, United States of America, brian.lee@business.uconn.edu, Xinxin Li

With the advance in digital technology, creators of intellectual products can sell their work directly to consumers without the help of publishers. In this study, we construct an analytical model to examine the role of online word of mouth (eWOM) in this trend of disintermediation. We find that eWOM may encourage creators to reintermediate publishers for high quality work. Our model makes predictions on when eWOM benefits publishers and for what types of products/creators it has the most impact.

3 - Electric Vehicle Power Plants: Carsharing Optimization with Smart Electricity Markets

Micha Kahlen, Erasmus University Rotterdam, Burgemeester Oudlaan 50, Rotterdam, Netherlands, kahlen@rsm.nl, Wolf Ketter

We study electric vehicles as power plants to bridge weather dependent energy shortages from wind and solar energy. Particularly, we are interested in the allocation of electric vehicles by making a trade-off between driving and storing electricity. This allocation is optimized in a first-price sealed bid auction with pricing signals from smart electricity markets and the availability of electric vehicles. Results show positive effects for drivers, carsharing operators, and the environment.

4 - Should You Go with "Pay as You Go"?:

Optimal Design of Bucket Plans for Multi-unit Goods

Manish Gangwar, Assistant Professor, ISB, ISB Campus, Gachibowli, Hyderabad, India, manish_gangwar@isb.edu, Hemant Bhargava

Among the class of nonlinear tariffs, "Three Part Tariff" is the most general tariff but it tends to focus on heavy users. Given the evident optimality of a bucket plan, we ask what are the pros and cons of alternative pricing models? We derive the closed-form expressions for commonly used demand function and specify a system of equations with economic interpretation for the general problem. We also examine the properties of optimal "Three Part Tariff" in the presence of a per-unit plan.

■ TD26

26-Room 403, Marriott

Production and Scheduling I

Contributed Session

Chair: Srimathy Mohan, Associate Professor, Arizona State University, Department of Supply Chain Management, Tempe, AZ, United States of America, srinathy@asu.edu

1 - Weekly Production Planning on the Basis of Average Value-at-Risk by Shapley Value

Nobuyuki Ueno, Hiroshima University of Economics, 5-37-1 Gion Asaminami-ku, Hiroshima, Japan, ueno@pu-hiroshima.ac.jp, Hiroshi Morita, Koji Okuhara

Under demand uncertainty, they used stock-out ratio for estimating the risk. In this presentation, we propose a formulation for weekly production planning problem that reflects the AVaR (Average value-at-risk) for weighing tail risk and a solution by Shapley value. The characteristics of the solution procedure is proved. It has the features that it does not require strict probability distribution of stock-out and it enables an extension to the case where demand for each period is correlated.

2 - A Generalized Dantzig-Wolfe Decomposition Algorithm for Mixed Integer Programming Problems

Xue Lu, London School of Economics and Political Science, Houghton Street, London, WC2A 2AE, United Kingdom, X.Lu7@lse.ac.uk, Zeger Degraeve

We propose a generalized Dantzig-Wolfe decomposition algorithm for mixed integer programming. By generating copy variables, we can reformulate the original problem to have a diagonal structure which is amendable to the Dantzig-Wolfe decomposition. We apply the proposed algorithm to multi-level capacitated lot sizing problem and production routing problem. Rigorous computational results show that our algorithm provides a tighter bound of the optimal solution than all the existing methods.

3 - The Impact of Postponement Practices on the Lot-sizing Decisions of a Wine Bottling Plant

Sergio Maturana, Professor, Pontificia Universidad Catolica de Chile, Vicuna Mackenna 4860, Santiago, Chile, smaturan@ing.puc.cl, Mauricio Varas

Export-focused wineries face a difficult problem when planning their bottling lines due to the number of different products they have to bottle and label. A way of reducing misallocation due to demand variability is by postponing the labeling process. We propose two MIP planning models that support tactical lot-sizing decisions. We tested both models in a rolling horizon framework, under different conditions of capacity tightness, horizon length, and demand uncertainty and we report the results.

4 - Scheduling of Maximizing Total Job Value with Machine Availability Constraint

Eun-Seok Kim, Middlesex University, The Burroughs, London, NW4 4BT, United Kingdom, e.kim@mdx.ac.uk, Joonyup Eun

We study a single machine scheduling problem of maximizing total job value with machine availability constraint. The value of each job is given as a non-increasing step function of its completion time. We develop a branch-and-bound algorithm and a heuristic algorithm for the problem. Finally, we perform computational experiments showing that the developed algorithms provide efficient and effective solutions.

■ TD27

27-Room 404, Marriott

Applications of Multi-objective Optimization

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Matthias Ehrgott, Professor, Department: Management Science, Lancaster University, The Management School, Lancaster, 00, LA1 4YX, United Kingdom, m.ehrgott@lancaster.ac.uk

1 - A Hybrid Decision Making Approach for Multi-Objective Infrastructure Planning

Hana Chmielewski, North Carolina State University, Campus Box 7908, Raleigh, NC, 27695, United States of America, hchmiel@ncsu.edu, Ranji Ranjithan

A hybrid approach using evolutionary computation and dynamic programming is used to optimize investments and operational decisions in a water supply case study system. Solutions are categorized by network centralization metrics, and analyzed with respect to multiple planning objectives.

2 - Evaluating Lignocellulosic Biomass Supply Chains Considering a Multi-objective of Optimizing Cost

Burton English, Professor, The University of Tennessee, 2621 Morgan Hall, Knoxville, TN, 37922, United States of America, benglish@utk.edu, James Larson, Edward Yu, Jia Zhong

A switchgrass supply chain that considers the optimization of cost, GHG emissions and soil erosion for a cellulosic biofuel plant is developed. Using an augmented epsilon constraint multi-objective optimization model and a compromise solution method, along with high-resolution spatial data the optimal placement of feedstock supply chains can be estimated. Spatial characteristics, including land coverage and infrastructure availability, are crucial to both the cost and the environmental results.

■ TD28

28-Room 405, Marriott

Dynamic Matching Markets

Cluster: Auctions

Invited Session

Chair: John Dickerson, CMU, 9219 Gates-Hillman Center, Pittsburgh, PA, 15213, United States of America, dickerson@cs.cmu.edu

1 - Global Kidney Exchange

Afshin Nikzad, Stanford University, 37 Angell Court, Apt 116, Stanford, CA, 94305, United States of America, afshin.nikzad@gmail.com, Mohammad Akbarpour, Alvin Roth

In some countries, many patients die after a few weeks of diagnosis mainly because the costs of kidney transplantation and dialysis are beyond the reach of most citizens. We analyze the two proposals in which patients with financial restrictions who have willing donors participate in kidney exchange without paying for surgery. Our proposals can save thousands of patients, while substantially decreasing the average dialysis costs; in particular, we prove that they are "self-financing"

2 - Matching with Stochastic Arrival

Neil Thakral, Harvard, 1805 Cambridge Street, Cambridge, MA, United States of America, nthakral@fas.harvard.edu

We study matching in a dynamic setting, with applications to public-housing allocation. Objects of different types that arrive stochastically over time must be allocated to agents in a queue. When objects share priorities over agents, we propose an efficient, envy-free, and strategy-proof mechanism. The mechanism continues to satisfy these properties if and only if the priority relations are acyclic. Estimated welfare gains over existing housing-allocation procedures exceed \$5000 per applicant.

3 - Dynamic Kidney Exchange with Heterogeneous Types

Maximilien Burq, Student, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, mburq@mit.edu, Itai Ashlagi, Vahideh Manshadi, Patrick Jaillet

Kidney exchange programs face growing number of highly sensitized patients. We develop an online model that models such heterogeneity, and we prove that having some easy-to-match patients in the pool greatly reduces waiting times both in the presence of bilateral matching and chain matching. We provide simulations showing that some prioritizing leads to improved overall efficiency.

4 - Competing Dynamic Matching Markets

Sanmay Das, WUSTL, One Brookings Dr, CB 1045, St. Louis, MO, 63130, United States of America, sanmay@wustl.edu, John Dickerson, Zhuoshu Li, Tuomas Sandholm

We extend a framework of dynamic matching due to Akbarpour et al. to characterize outcomes in cases where two rival matching markets compete. One market matches quickly while the other builds thickness by matching slowly. We present analytical and simulation results, both in general and for kidney exchange, demonstrating that rival markets increase overall loss compared to a single market that builds thickness.

■ TD29

29-Room 406, Marriott

Joint Session Analytics/HAS: The Emerging Role of Health Systems Engineering and its Impact on Clinical Informatics and Analytics

Sponsor: Analytics

Sponsored Session

Chair: John Zaleski, Chief Informatics Officer, Nuvon, Inc.,
4801 S. Broad Street, Suite 120, Philadelphia, PA, 19112,
United States of America, jzaleski@nuvon.com

1 - How to Make Clinically Actionable Alarms

Jeanne Venella Dnp, Chief Nursing Officer, Nuvon,
4801 S Broad St, Philadelphia, PA, 19112,
United States of America, jvenella@nuvon.com

How to Make Clinically Actionable Alarms The very alarm systems that were created to enhance patient safety have themselves become an urgent patient safety concern. We need to fix our current state of alarm systems. We must achieve both a higher level of sensitivity and specificity. Therefore; reducing both false and non-actionable alarms. Our goal is ignite the talk on alarm fatigue, begin to define algorithms for smarter actionable alarms and provide a safer health care environment.

2 - The Kalman Filter and its Application to Real-time Physiologic Monitoring of High-acuity Patients

John Zaleski, Chief Informatics Officer, Nuvon, Inc.,
4801 S. Broad Street, Suite 120, Philadelphia, PA, 19112,
United States of America, jzaleski@nuvon.com

The Kalman Filter (KF) has seen application in many fields owing to its rapid computational framework and intrinsic optimality in tracking time-series. In this presentation, the KF is used to optimally track and smooth signal artifact associated with patient physiologic monitoring.

3 - Predicting the Effect of Introducing Walk in Hours on Staff Workload at a Pediatrics Practice

Saurabh Jha, University of Pittsburgh, 1048 Benedum Hall,
Department of Industrial Engineering, Pittsburgh, PA, 15261,
United States of America, saj79@pitt.edu, Louis Luangkesorn,
Diana Hoang, Lindsey Jones, Tricia Pil

A local pediatrics practice has introduced patient walk-in hours in response to competition from urgent care clinics and has asked to determine the effect on staff workload. We evaluate the effect of walk-in hours on the practice workload, then develop and validate a predictive model for the various types of visits and phone calls. After validating the predictive model, we develop a forecast for the remainder of the 12 months period following the introduction of all-day walk-ins.

■ TD30

30-Room 407, Marriott

Decision Support Systems II

Contributed Session

Chair: Rohit Nishant, Assistant Professor, ESC Rennes School of Business, 2 rue Robert d'Arbrissel CS 76522, Rennes, 35065, France,
rohit.nishant@esc-rennes.com

1 - Routing Recommendation System for Uber

Yuhan Wang, University of California Irvine, 6478 Adobe Cir,
Irvine, CA, 92617, United States of America,
wangyuhan1101@gmail.com

Paper not available at this time.

2 - Optimising Allocation of Investor Funds in Multi-objective Public Infrastructure Investment Programs

Martin Spollen, Queens University Belfast, David Bates Building,
University Road, Belfast, BT7 1NN, United Kingdom,
mspollen01@qub.ac.uk

This session will examine the development and application of Strategic Infrastructure Planning Models (SIPMs) as an emerging class of investment appraisal techniques for public investment management. The techniques focus attention on the network effects of investment on total portfolio performance. Application to a major regional schools investment and rationalization program is demonstrated.

3 - A Decision Support System for Traffic Diversion around Construction Closures

Arezo Memarian, Graduate Research Assistant, University of Texas at Arlington, 425 Nedderman Hall, 416 Yates St.,
Box 19308, Arlington, TX, 76019, United States of America,
arezo.memarian@mavs.uta.edu, Siamak Ardekani

The objective of this study is to develop a PC-based decision support tool with a user-friendly graphical interface to allow development of optimal traffic management plans around highway construction sites. In addition to the capability to identify optimum traffic diversion routes, such a tool would also allow simulation of various traffic management plan scenarios envisioned by experts.

4 - Can Virtualization Maturity Impact Software Development Project Performance: An Empirical Study

Rohit Nishant, Assistant Professor, ESC Rennes School of Business, 2 Rue Robert d'Arbrissel CS 76522, Rennes, 35065,
France, rohit.nishant@esc-rennes.com, Bouchaib Bahli

In this article we invoke IT asset classes' taxonomy and IT capability maturity model to examine the impact of virtualization maturity on software development project performance. Our findings suggest that virtualization capability has a distinct impact on software development project and process performance. Finally, this study extends virtualization maturity model's validity. Implications for research and practice are discussed.

■ TD31

31-Room 408, Marriott

Time Series Data Mining

Sponsor: Data Mining

Sponsored Session

Chair: Mustafa Gokce Baydogan, Assistant Professor, Bogazici University, Department of Industrial Engineering, Bebek, Istanbul, 34342, Turkey, mustafa.baydogan@boun.edu.tr

1 - On the Parameter Identification of a New Knot Selection Procedure in Mars

Cem Iyigun, Associate Professor, Middle East Technical University, ODTU Kampusu Endustri Muhendisligi Bolum,
Oda 331 Cankaya, Ankara, 06801, Turkey, iyigun@metu.edu.tr,
Elcin Kartal Koc

Multivariate Adaptive Regression Splines (MARS) is a popular nonparametric regression for estimating the nonlinear relationship within data via piecewise functions. A clustering based knot selection method has been proposed to the literature recently. This study proposes a parameter selection criteria based on Schwarz's Bayesian Information for determining the optimum grid size and threshold value of this new procedure. Numerical studies are conducted via artificial and real datasets.

2 - Discovering Interpretable Nonlinear Variation Patterns in High-Dimensional Data over Spatial Domains

Phillip Howard, Arizona State University, 699 S Mill Ave, Tempe, AZ, 85281, United States of America, prhoward@asu.edu,
Daniel Apley, George Runger

The objective of this research is the identification of distinct and interpretable nonlinear variation patterns in high-dimensional data through dimensionality reduction. We present a new method for learning reduced dimension representations which characterize interpretable variation sources when mapped to the original feature space. A new metric for measuring how well the solution can be interpreted is also proposed. We compare our work to alternative methods using several examples.

3 - EEG Signal Classification using Functional Principal Component Analysis

Woo-Sik Choi, Mr., Korea University, 145, Anam-Ro, Seongbuk-Gu, Innovation Hall, 816, Korea University, Seoul, Korea,
Republic of, etpist@korea.ac.kr, Seoung Bum Kim

Electroencephalogram (EEG) is recordings of the electrical potentials of the brain. Identifying human activities from EEG is the main goal of brain computer interface area. To analyze events, selecting important features is a crucial step. In this study, we propose a feature extraction using functional principal component analysis with general classification methods. The effectiveness of the proposed method is demonstrated through a real data from the brain computer interface competition 2003.

4 - Modeling Time-varying Autocorrelation for Time Series Classification

Mustafa Gokce Baydogan, Assistant Professor, Bogaziçi University, Department of Industrial Engineering, Bebek, Istanbul, 34342, Turkey, mustafa.baydogan@boun.edu.tr, George Runger

We introduce a novel approach to model the dependency structure in time series (TS) that generalizes the concept of autoregression to local auto-patterns. A learning strategy that is fast and insensitive to parameter settings is the basis for the approach. This unsupervised approach to represent TS generally applies to a number of data mining tasks. We provide a research direction that breaks from the linear dependency models to potentially foster other promising nonlinear approaches.

■ TD32

32-Room 409, Marriott

Data Mining

Contributed Session

Chair: Gustavo Lujan-Moreno, Arizona State University, Tempe, AZ, United States of America, glujanmo@asu.edu

1 - Open-source Statistical Packages: The True Cost of “Free” Software

Ronald Klimberg, Saint Joseph’s University, 35 Moorlinch Blvd., Medford, NJ, 08055, United States of America, klimberg@sju.edu, Rick Pollack, Susan Foltz Boklage

Open source software is typically free and widely accessible to the public. In the statistical realm, R is the dominant open-source player. Is it really free? Where do you go for support? Are there possible significant costs associated with using R? Further, to what degree should open-source statistical software be used and taught in academia? This article will explore these questions, as well as others, in discussing what are often the hidden costs of using open-source statistical software

2 - Study on Effects on Emotional Intensities of Negative Online Reviews on its Usefulness

Cuiping Li, Huazhong University of Science and Technology, 1037 Luoyu Rd, Hongshan District, Wuhan, Hubei, 430074, China, 412543536@qq.com, Qian Yuan, Shuqin Cai

Aimed at recognizing high quality reviews from mass data, this paper explores how reviews’ negative emotions influence the usefulness of negative online reviews by using data mining technology and regression analysis. The result reveals that strong negative emotions reduce negative reviews’ usefulness and moderate negative emotions have opposite effect. Results also show that different intensities of negative emotions have significant interactions on reviews’ usefulness.

3 - Impact of Library Online Resource use on Students Academic Outcome

Fan Zhang, University of Pittsburgh, 1048 Benedum Hall, Department of Industrial Engineering, Pittsburgh, PA, 15261, United States of America, faz31@pitt.edu, Louis Luangkesorn, Ziyi Kang, Yunjie Zhang, Shi Tang

University libraries have a need to demonstrate the impact of their resources on the University mission: academics and research. However, for electronic resources, research has shown that students often do not recognize they are using library resources, making surveys and other assessments not useful. We use undergraduate demographic and academic outcome data along with logs of online library resource access to determine if relationship exists between online resource use and academic outcome.

4 - A Case-Crossover Study to Evaluate the Effect of Player Affective State on Performance in Video Game

Gustavo Lujan-Moreno, Arizona State University, Tempe, AZ, United States of America, glujanmo@asu.edu

Using an electroencephalogram (EEG) headset we examined whether there was a significant change in the affective state reported by the EEG when a participant made a mistake while playing a popular video game. There were five affective constructs that were examined: engagement, frustration, meditation, short and long term excitement. We propose a case-crossover methodology to analyze this type of events. Results show that there is a significant difference in three affective states.

5 - Enterprise Social Networking and Firm Creativity

Donghyun Kim, Delta State University, 1003 West Sunflower Road, Cleveland, MS, 38733, United States of America, dskim@deltastate.edu, Jaemin Kim

This study examines the influence of firm’s IT social networking (SN) capacity on the firm’s creativity and innovation. Analyzing data on utility patents of 7 firms using enterprise SN, we tested our predictions on a balanced panel of the firms’ data. The results illustrate how IT SN capacity can aid in the generation of an idea.

■ TD33

33-Room 410, Marriott

Decision and Prediction Models in Healthcare

Sponsor: Health Applications

Sponsored Session

Chair: Jakob Kotas, University of Washington, Dept. of Applied Mathematics, Box 353925, Seattle, WA, 98195, United States of America, jkotas@uw.edu

1 - A Stochastic Program with Chance-constrained Recourse for Surgery Scheduling and Rescheduling

Gabriel Zenarosa, PhD Candidate, University of Pittsburgh, 3700 O’Hara Street, Benedum Hall 1048, Pittsburgh, PA, 15261-3048, United States of America, glz5@pitt.edu, Andrew J. Schaefer, Oleg Prokopyev

Aggregate surgical expenditures in the US amount to a significant percentage of GDP. About 42% of hospital revenues are generated by operating rooms (ORs), yet ORs run at only 68% capacity on average. The most important issues in OR management are centered on scheduling. Advance schedules improve OR efficiency; however, surgeries are rescheduled in practice as they rarely go as planned. We present a stochastic program with chance-constrained recourse for surgery scheduling and rescheduling.

2 - Dynamic Scheduling of a Post-discharge Follow-up Organization to Reduce Readmissions

Sean Yu, Indiana University-Bloomington, 1275 E. Tenth Street, Bloomington, IN, 47405, United States of America, xy9@indiana.edu, Shanshan Hu, Jonathan Helm

Hospital readmissions are a growing problem. Many readmissions are preventable by properly monitoring patients post-discharge. We consider an organization that dynamically will schedule and staff post-discharge monitoring schedules for a cohort of patients being randomly discharged from client hospitals. We formulate this problem as an infinite horizon dynamic program that can be solved using approximate dynamic programming.

3 - Predictive Capabilities in Hierarchical Node-based Clustering of Time Series

Hootan Kamran, PhD Candidate, University of Toronto, 12 Rodney Blvd., North York, ON, M2N4B6, Canada, hootan@mie.utoronto.ca, Dionne Aleman, Kieran Moore, Mike Carter

Flu activity is shown to be affected by local variables such as climate. Therefore, localized activity must be monitored to study spatiotemporal spread patterns of the disease. Using a 10-year flu dataset from 103 hospitals in Ontario, we compare predictive capabilities extracted from existing aggregation scheme (LHIN) with those extracted from the novel hierarchical node-based clustering scheme and show that the new method will extract more statistically significant predictive capabilities.

4 - A Stochastic Dynamic Programming Model for Response-guided Dosing

Jakob Kotas, University of Washington, Dept. of Applied Mathematics, Box 353925, Seattle, WA, 98195, United States of America, jkotas@uw.edu, Archis Ghate

We discuss a stochastic dynamic programming (DP) model to assist with dosing decisions in response-guided dosing (RGD). The goal in this framework is to deliver the right dose to the right patient at the right time. We present robust, optimal learning, and optimal stopping variants of this problem. The structure of optimal policies in these problems will be explored both analytically and numerically.

■ TD34

34-Room 411, Marriott

Joint Session HAS/MSOM-Healthcare: Operational Issues and Information Sharing in Healthcare

Sponsor: Health Applications

Sponsored Session

Chair: Subodha Kumar, Carol And G. David Van Houten, Jr. '71 Professor, Mays Business School, Texas A&M University, Wehner 301F - 4217 TAMU, College Station, TX, 77843, United States of America, skumar@mays.tamu.edu

1 - Sustainability Planning for Healthcare Information Exchanges

Tharanga Rajapakse, Assistant Professor, University of Florida, W. University Ave, Gainesville, FL, 32611, United States of America, tharanga@ufl.edu

We develop an analytical framework to study sustainability of Healthcare Information Exchanges and to demonstrate its use when the revenue is generated (i) under one revenue model (like membership fee), and (ii) under a combination of multiple revenue models (like membership fee and rebate structure for the practice from supporting vendors).

2 - The Impacts of Healthcare Information Exchanges:

An Empirical Investigation

Emre Demirezen, Assistant Professor, Binghamton University SUNY, 4400 Vestal Parkway East, AA-242, Binghamton, NY, 13902, United States of America, edemirezen@binghamton.edu, Subodha Kumar, Ramkumar Janakiraman

In the last decade, the U.S. government has been aggressively promoting the use of electronic health records and the establishment of regional healthcare information exchanges (HIEs). HIEs facilitate electronic health information exchange among healthcare providers that is considered to be beneficial for the society. However, the real benefits of HIEs are not well understood. Hence, in this study, we work with an HIE provider based in the state of New York to investigate the benefits of HIEs.

3 - Chance Constrained Operating Room Scheduling with Uncertain and Ambiguous Information

Zheng Zhang, University of Michigan, 1205 Beal Ave, Ann Arbor, MI, 48105, United States of America, zzhang0409@gmail.com, Brian Denton, Xiaolan Xie

We describe stochastic programming and distributionally robust optimization models that allow for uncertain or ambiguous surgery duration data, respectively. Each of the models considers surgery-to-OR allocation decisions in the context of probabilistic constraints on completion time that vary by OR. We describe column generation approaches that are tailored to these two model formulations. Results are presented to illustrate the potential use of these models in practice.

4 - Bundled Payments for Healthcare Services: A Framework for the Healthcare Provider Selection Problem

Seokjun Youn, PhD Student, Research Assistant, Mays Business School, Texas A&M University, 320R Wehner Building, 4217 Texas A&M University, College Station, TX, 77843, United States of America, syoun@mays.tamu.edu, Chelliah Sriskandarajah, Subodha Kumar

Identifying competitive healthcare providers is an important issue for the successful operation of bundled payments. We develop a selection framework via data envelopment analysis and combinatorial auction (CA). Based on efficiency and effectiveness measures, outstanding performers are pre-selected. Finally, CA determines winners. To evaluate the impact of design issues on the CA performance, we combine and utilize several real dataset from the healthcare sector.

■ TD35

35-Room 412, Marriott

Disaster and Emergency Management II

Contributed Session

Chair: Shaligram Pokharel, Professor, Qatar University, Doha, Qatar, shaligram@qu.edu.qa

1 - Solution Methodologies for Debris Removal in Disaster Response

Bahar Y. Kara, Associate Professor, Bilkent University, Industrial Engineering, Ankara, Turkey, bkara@bilkent.edu.tr, Oya E. Karasan, Nihal Berktaş

In this study we provide solution methodologies for debris removal problem in the response phase. Debris removal activities on certain blocked arcs have to be scheduled in order to reach a set of critical nodes such as schools and hospitals. Two mathematical models are developed with different objectives. The models are tested over real data from districts of Istanbul.

2 - Service-based Distribution Network Model for Location of Temporary Relief Facilities

Shaligram Pokharel, Professor, Qatar University, Doha, Qatar, shaligram@qu.edu.qa, Rojee Pradhananga, Fatih Mutlu, Jose Holguin-Veras

A supply allocation and distribution model is proposed to minimize the total waiting times at the demand points by considering the possibilities of transferring excess resources between the temporary facilities and backordering of demand in different time periods. Model is applied on a test instance to analyze the service and cost trade-offs. (This research is made possible by a NPRP Award NPRP 5-200-5-027 from the Qatar National Research Fund (a member of the Qatar Foundation). The statements herein are solely the responsibility of the authors.)

3 - The Network Structure: What it Can Tell About Disaster Warning Effectiveness?

Xiangyang Guan, University of Washington, 201 More Hall, Box 352700, Seattle, WA, 98195-2700, United States of America, guanxy@uw.edu, Cynthia Chen

Knowing how public awareness and action change after disaster warning is critical for effectiveness of warning issuance. Multiple data sources – social media, taxi trips and subway ridership – are leveraged. Temporal evolutions of the structure (motifs) of social media network and subway network are established as measures of public awareness and action. Our result identified a lag of one day in average between warning issuance and public awareness, and between public awareness and action.

■ TD36

36-Room 413, Marriott

Fire and Emergency Medical Services

Sponsor: Public Sector OR

Sponsored Session

Chair: Laura Mclay, Associate Professor, University of Wisconsin, 1513 University Ave, ISYE Department, Madison, WI, 53706, United States of America, lmclay@wisc.edu

1 - Predicting the Spatial Distribution of Heart Attack Incidence in Alberta

Armann Ingolfsson, University of Alberta, Edmonton, Canada, aingolfs@ualberta.ca, Amir Rastpour, Reidar Hagtvedt

We use Poisson regression with a linear-without-intercept link function to predict the incidence of heart attacks by geographic region, as a function of age, gender, education, and income characteristics. We discuss model specification and validation and we present results based on 10 years of empirical data.

2 - Dynamic Ambulance Allocation Utilizing Demand Data Analytics for Pre-hospital EMS

Yu-Ching Lee, Assistant Professor, Department of Industrial Engineering and Engineering Management, National Tsing Hua University, No. 101, Section 2, Kuang-Fu Road, Hsinchu, Taiwan - ROC, ycllee@ie.nthu.edu.tw, Albert Chen, Yu-shih Chen

Pre-hospital Emergency Medical Services (EMS) provide the critical function of on-site medical treatment and stabilization of patients. The quality of EMS affects the survival of patients in emergency situations. A better management of ambulances could potentially improve the effectiveness and efficiency of EMS. We study a real-time decision support system featuring demand prediction, distribution estimation, scenario generation, robust ambulance deployment, and the optimal ambulance dispatching

3 - A Simulation Optimization Method for Emergency Service Location

Rozhin Doroudi, PhD Student, Northeastern University, 260 Washington St. Apt. 305, Malden, MA, 02148, United States of America, doroudi.r@husky.neu.edu, Gerald Evans, Gail Depuy

A fire department with an available fleet wants to determine the location of its fire stations and how to distribute its fleet among those locations. An iterative approach involving the use of a linear program and a simulation model is proposed for the problem

■ TD37

37-Room 414, Marriott

Therapy and Treatment

Contributed Session

Chair: Animesh Garg, PhD Student, UC Berkeley, 4141 Etcheverry Hall, Berkeley, CA, 94720-1777, United States of America, garg.animesh@gmail.com

1 - Assessment of a Novel Device for Elbow Rehabilitation in Humans

Aline Callegaro, Researcher, UFRGS, 99 Osvaldo Aranha Avenue, 5 Floor, Porto Alegre, RS, 90035190, Brazil, nimacall@gmail.com, Carlos Fernando Jung, Clarissa Brusco, Marcelo Gava Pompermayer, Márcia Elisa Echeveste, Carla Schwengber ten Caten

This study aimed to assess a novel device for elbow rehabilitation in humans. The functional prototype assessment was based on data collection in two stages: application of local muscle vibration; and its association with Continuous Passive Motion. Two way ANOVA was used to analyse the main factors. An average increase of the muscle electrical activation resulted in first stage. The main factors (frequency, sex, and treatment) had significant effect, as well as a few interactions.

2 - Minimizing Metastatic Risk in Radiotherapy Fractionation Schedules

Hamidreza Badri, Graduate Student, University of Minnesota, ISyE Departemnt, 111 Church Street S.E., Minneapolis, MN, 55455, United States of America, badri019@umn.edu, Jagdish Ramakrishnan, Kevin Leder

The treatment of metastatic cancer remains an extremely challenging problem. Here we consider the problem of developing fractionated irradiation schedules that minimize production of metastatic cancer cells. We observe that the resulting fractionation schedules are different than those that result from more standard objectives such as minimization of final primary tumor volume. Delivering large doses in small fractions is suggested even in cases when a/b value of the tumor is large.

3 - Customized 3D Printed Implants with Internal Channels for Intracavitary High Dose Rate Brachytherapy

Animesh Garg, PhD Student, UC Berkeley, 4141 Etcheverry Hall, University of California, Berkeley, CA, 94720-1777, United States of America, garg.animesh@gmail.com, Jean Pouliot, J. Adam M. Cunha, I-Chow Hsu, Alper Atamturk, Ken Goldberg

High-Dose Rate Brachytherapy is an internal radiation therapy frequently used for cancer treatment. Radioactive sources are briefly placed proximal to tumors. Current methods for intracavitary HDR-BT use generic templates which limits dose distribution to a small set of linear channels. We propose the use of algorithmically customized 3D Printed implants with curved internal channels that fit cavities without tissue puncture and aim to improve dose distribution and treatment quality.

4 - Surgery Sequencing and Scheduling in Multiple ORs with PACU Constraints

Miao Bai, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, mib411@lehigh.edu, Gregory Tonkay, Robert Storer

We study a multiple-OR surgery sequencing and scheduling problem with PACU constraints. To minimize the cost incurred by waiting, idleness, OR blocking and overtime, a two-stage solution scheme is proposed. In the first stage, a time-indexed integer program is formulated and solved by Lagrangian relaxation and dynamic programming to determine surgery sequences. Given surgery sequences in all ORs, scheduled times of patients are found in the second stage by a sample-gradient-based algorithm.

■ TD38

38-Room 415, Marriott

Probability

Contributed Session

Chair: Gene Hahn, Associate Professor, Salisbury University, 1101 Camden Ave., Salisbury, MD, 21801, United States of America, edhahn@salisbury.edu

1 - Fluctuation Analysis and the Marked Poisson Process

Randy Robinson, Bemidji State University, Bemidji, MN, United States of America, rrobinson@bemidjistate.edu

This presentation studies the marked point process with position dependent marking. The focus was on predicting the first passage time of the marked random walk when exiting a given rectangular set and the value of the process upon the exit. A new density function for the related processes has been obtained: a product of a negative exponential and modified Bessel functions

2 - Moments of a Random Set

Kemal Gursoy, Rutgers University, 100 Rockafeller Road, Department of MSIS, Piscataway, NJ, 08854, United States of America, kgursoy@rci.rutgers.edu

Let X be a random subset of the n -dimensional Euclidean space. Then the moments of the measure of X could be constructed by the Lebesgue integral of the probability measure of every point in X , over the n -dimensional Euclidean space.

3 - A New Representation for the Stationary Distribution of Markov Chains

Patrick Buckingham, Clemson University, Mathematical Sciences, Clemson, SC, United States of America, pbuckin@clemson.edu, Brian Fralix

We present a new representation for the stationary distribution of ergodic Markov chains, as well as analogous representations for Laplace transforms of transition functions associated with such chains. Applications to hysteretic queues and other models will be discussed.

4 - Queueing Systems with Adaptive Service Rates

Raik Stollertz, University of Mannheim, Room SO 230, Schloss Schneckenhof Ost, Mannheim, Germany, stollertz@bwl.uni-mannheim.de, Jannik Vogel

In many service systems, for example call centers, the service rate could be considered as a time-dependent decision variable to improve and stabilize the performance of a queueing system. We present an $M(t)/M(t)/c$ queueing model with adaptive service rates. The SBC-approach is used to approximate the time-dependent behaviour of by stationary models. This results in non-linear optimization problem. Numerical examples show the benefits of assuming the service rate as a decision variable.

5 - Modeling with the Tilted Beta Distribution

Gene Hahn, Associate Professor, Salisbury University, 1101 Camden Ave., Salisbury, MD, 21801, United States of America, edhahn@salisbury.edu

The beta distribution has an important limitation for the modeling of bounded data. Its density is either zero or infinite at the endpoints except for special cases. This makes modeling certain kinds of data difficult. The tilted beta distribution can be used to easily model this data. We adopt a Bayesian perspective and examine its usage in modeling real-world data.

■ TD39

39-Room 100, CC

Product Brand Differentiation and Pricing Decisions

Cluster: Operations/Marketing Interface

Invited Session

Chair: Ruixia Shi, California State University, Fullerton, 800 N. State College Blvd., Fullerton, CA, 92834, United States of America, sandy.shi@gmail.com

1 - New Product Pricing Strategy in the Social Media Era

Gou Qinglong, Associate Professor, University of Science & Technology of China, No.96, JinZhai Road Baohe District, Hefei, China, tslg@ustc.edu.cn, Kumar Subodha, Xiuli He, Juzhi Zhang

With the popularity of various social media platforms, the impacts of the word of mouth effect and the reference price effect on a consumer's purchasing behavior have been significantly amplified in the current era. We incorporate these two effects into a two period pricing model to investigate whether and in which condition should a firm utilize a skimming or a penetration price strategy. Our results show how these two effects influence a firm's pricing strategy when he launches a new product.

2 - Competition and Coordination in Online Retailers and Express Companies

Yihong Hu, Assistant Professor, Tongji University, yhhu@tongji.edu.cn

We consider an online market as Taobao with homogenous and heterogeneous consumers sensitive to service quality. Retailers collect a separate product price plus shipping fee from consumers. They treat shipping fee as a source of revenue by asking a large discount of shipping fee from shippers. We use game-theoretic framework to study the competition and coordination between retailers and shippers under different scenarios. The study finds that retailers' behavior increases consumers' benefit.

3 - Supply Chain Power and Store Brand

Jun Ru, Assistant Professor, University at Buffalo, 326D Jacobs,
Buffalo, NY, 14260, United States of America, junru@buffalo.edu,
Ruixia Shi, Jun Zhang

This paper relates a retailer's store brand strategy to the relative powers of channel members and offers a new explanation for the differences in retailers' store brand strategies. Our analysis shows that store brands become less appealing to a retailer as it becomes more powerful.

4 - Consumer Preference Mismatch and Channel Choice Decisions under Competition

Kunpeng Li, Utah State University, 3555 Old Main Hill,
Logan, UT, United States of America, kunpeng.li@usu.edu,
Suman Mallik, Dilip Chhajed

We consider a product consisting of two components sold by two firms. A product/firm is integrated when both components are designed by a single firm, and is non-integrated otherwise. The consumers choose to purchase a product that better matches the specifications of their ideal product. Using a duopoly model, we study the effects of consumer preference mismatch on channel integration strategies.

TD40

40- Room 101, CC

Marketing II

Contributed Session

Chair: Faryal Salman, Assistant Professor, SZABIST, 90 Clifton,
Karachi, Pakistan, faryal.salman@szabist.edu.pk

1 - An Analysis of Menus of Multi-Part Tariffs

Ryan Choi, PhD Candidate, UC Irvine, 6219 Adobe Circle, Irvine,
CA, 92617, United States of America, jihungc@uci.edu

This paper study which characteristics of three-part tariffs make the seller more profitable than two-part tariffs. Given a full extraction of low type segment's surplus, the seller can extract more of high type surpluses, whose magnitude is dependent on both of the level of quantity allowances and the fixed fee for high type consumers. With 3PTs, firms earn more rent from the high type, and so offers both high and low contracts regardless of the taste parameter and of the low type proportion.

2 - Research and Practice – Friends of Foes? Perceptions of Marketing Academicians and Practitioners.

Salma Rahman, Assistant Professor, SZABIST, 100 Clifton,
Block 5, Shabrae Iran, Karachi, Pakistan, sal_haider@yahoo.com,
Sana Rehman

This research is more of an exploratory nature that focuses initially on precipitating the perceptions of marketing academicians as well as marketing practitioners regarding the existence of the research practice gap using diffusion of innovations theory. The results indicated that generally both agree on the prevalence of the gap. Further, their perception is the same for discovery and translations stage whereas it differs for the dissemination and change stage.

3 - Customer Commitment in Customer Churn Prediction

Huili Liu, Beijing University of Posts and Telecommunications,
Xitucheng Road, No 10, Beijing, BJ, 100876, China,
yucaihl@163.com

We present a customer commitment model to predict the customer churn. Instead of probability method, we use consumer learning to get the customer commitment from his/her purchase history, and then use it to predict the customer churn. In comparison to existing models, we consider the customer commitment model is more feasible with an accurate prediction. Thereby we provide a new insight into the customer base analysis.

4 - Socio-economic Class Difference in Movie Consumption Among Pre-adolescents

Saima Husain, Lecturer, Institute of Business Administration,
University Campus, University Road, Karachi, Si, Pakistan,
shusain@iba.edu.pk

This research uses the laddering technique, in semi-structured in depth interviews, to study hierarchical constructs explaining personal value system that drive movie consumption behaviour among children aged 9 - 12 years. Young informants were recruited from different socio economic class (SEC) households in Pakistan. Findings show that children from higher SECs are significantly different in the type of movie selection, consumption setting and medium used for movie consumption.

5 - An Empirical Study to Examine Consumer Behavior towards Luxury Brands in Pakistan

Faryal Salman, Assistant Professor, SZABIST, 90 Clifton, Karachi,
Karachi, Pakistan, faryal.salman@szabist.edu.pk, Usman Warraich

Current study seeks to expand an understanding of consumer behavior towards branded goods. The data for this exploratory study was collected from urban youth of Pakistan. The study postulates significant relationship between consumer behavior and the predictors for various product categories. Regression analysis shows that these variables pose the positive impact on the buying behavior (p value (0.05) and this model shows R2 of 0.73.

TD41

41-Room 102A, CC

Healthcare Supply Chain Decision Making

Sponsor: Manufacturing & Service Oper
Mgmt/Healthcare Operations
Sponsored Session

Chair: Xinghao Yan, Assistant Professor, Ivey Business School, Western
University, 1255 Western Road, London, On, N6G0N1, Canada,
xyan@ivey.uwo.ca

1 - Determinants of Distribution Channel Choice in Pharmaceutical Industry – Specialty Drugs

Liang (Leon) Xu, University of Missouri-St. Louis, St. Louis, MO,
United States of America, lxpx2@umsl.edu, Vidya Mani, Hui Zhao

We use privately collected multi-year transaction data to study determinants of the choice of distribution channels for specialty and non-specialty drugs. Further, we explore how this channel choice explains observed variations in supply chain metrics in this industry.

2 - Transforming Drug Development via System Computational Modeling

Jinha Lee, Georgia Institute of Technology, 755 Ferst Dr. NW,
Atlanta, GA, United States of America, jlee68@gatech.edu,
Eva Lee

We describe the first-in-silico drug design system model to accelerate drug discovery. The model spans preclinical, clinical, IND and NDA tasks; and allows global risk analysis. It identifies bottlenecks, and performs system optimization that offers a holistic view of discovery pathways. Rapid development is achieved through parallel processes that shorten critical paths from start to registration of a new drug. The generalizable design allows rapid testing, and minimizes risk, cost, and time.

3 - Operational Performance Evaluation of Reverse Referral Partnership in the Chinese Healthcare System

Nan Kong, Associate Professor, Purdue University, 206 S. Martin
Jischke Dr., West Lafayette, IN, United States of America,
nkong@purdue.edu, Quanlin Li, Na Li, Zhibin Jiang

Reverse referral of patients from upper-level hospitals to lower-level hospitals after their acute care, has been promoted in the tiered Chinese care system to alleviate resource pressure at high-level hospitals and balance utilizations throughout the system. However, it remains unclear how to implement reverse referral partnerships given the conflicting interests. We develop a two-level queueing network model to capture patient flows and derive analytical results on queueing performance measures. Our work is expected to guide the establishment of hospital alliances in China.

4 - Influenza Vaccine Supply Chain with Vaccination Promotion Effort and its Coordination

Xinghao Yan, Assistant Professor, Ivey Business School, Western
University, 1255 Western Road, London, ON, N6G0N1, Canada,
xyan@ivey.uwo.ca, Gregory Zaric

We develop an influenza vaccine supply chain model consisting of a health authority, a vaccine manufacturer, and population. The health authority decides order quantity and effort exerted to increase vaccination demand; the manufacturer decides production effort; and population decides the vaccination probability. We find that the three parties' decisions at equilibrium and different coordinating contract formats, such as a contract with payment linear/piecewise linear w. r. t. order quantity.

■ TD42

42-Room 102B, CC

Patients and Practice: Using the Right Resources to Deliver Care

Sponsor: Manufacturing & Service Oper

Mgmt/Healthcare Operations

Sponsored Session

Chair: Jonathan Helm, Indiana University Bloomington, 1309 E. Tenth Street, Bloomington, IN, United States of America, helmj@indiana.edu

1 - An Empirical Study of The Impact of Physician Assistants During Critical Care Consultations

Yunchao Xu, New York University, 44W 4th St, 8-152, New York, NY, 10012, United States of America, yxu4@stern.nyu.edu, Carri Chan, Mor Armony

Trained with a broad set of clinical skills, physician assistants (PAs) can be cost-effective alternatives to physicians in healthcare systems. However, not much is known on the impact of PAs on patient delivery in certain settings. Using data from a major urban hospital system, we utilize a difference-in-differences approach to explore the effects of introducing PAs into the critical care consultation process. One key finding is the reduction in boarding times due to this intervention.

2 - Missed Opportunities in Preventing Hospital Readmissions: Redesigning Post-discharge Checkup Policies

Xiang Liu, University of Michigan, 1205 Beal Ave, Ann Arbor, MI, 48109, United States of America, liuxiang@umich.edu, Jonathan Helm, Ted Skolarus, Michael Hu, Mariel Lavieri

Hospital readmissions affect hundreds of thousands of patients, placing a tremendous burden on the healthcare system. Post-discharge checkup can reduce readmissions through early detection of conditions. Our work develops optimal checkup plans to monitor patients following hospital discharge using methods including phone calls and office visits. By analyzing the structure of optimal policies, we develop checkup schedules that mitigate 32% more readmissions.

3 - Incentive-compatible Prehospital Triage in Emergency Medical Services

Eric Webb, Graduate Student, Indiana University, 1309 E. 10th Street, Bloomington, IN, 47405, United States of America, ermwebb@indiana.edu, Alex Mills

The Emergency Medical Services (EMS) system is designed to handle life-threatening emergencies, but a large and growing number of non-emergency patients seek healthcare through EMS. We evaluate the incentives underlying prehospital triage, where EMS staff are allowed to identify patients that could be safely diverted away from the hospital and toward appropriate care. Continued transition from fee-for-service payments to bundled payments may be necessary for prehospital triage implementation.

■ TD43

43-Room 103A, CC

Revenue Management with Consumer Choice Models

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Ruxian Wang, Johns Hopkins University, 100 International Dr, Baltimore, MD, 21202, United States of America, ruxian.wang@jhu.edu

1 - Dynamic Pricing for Mobile Apps

Kejia Hu, Kellogg School of Management, Northwestern University, 2169 Campus Drive, Evanston, IL, United States of America, k-hu@kellogg.northwestern.edu, Chaitanya Bandi, Srikanth Jagabathula

Mobile apps are special in the following aspects. It has no inventory constraint, almost zero marginal cost and free version updates. In our research, we will model these features and show the dynamic pricing for mobile apps.

2 - Product Line Design and Pricing under Logit Model

Anran Li, Columbia University, 345 Mudd, New York, NY, 10027, United States of America, al2942@columbia.edu, Guillermo Gallego, Jose Beltran

We study a firm who wants to design and price a set of products characterized by a number of features where each feature has one or multiple levels. We model consumers' demand by a feature-level based Logit model and optimize the assortment on the features space. We find a price independent index of each feature level that plays a key role. This makes a greedy algorithm, derived from the K-shortest paths algorithm, able to find an optimal K products' configuration in polynomial time.

3 - Optimal Pricing for a Multinomial Logit Choice Model with Network Effects

Chenhao Du, Student, University of Minnesota, 425 13th Ave SE, Apt. 1502, Minneapolis, MN, 55414, United States of America, duxxx181@umn.edu, William Cooper, Zizhuo Wang

We consider a seller's problem of determining revenue-maximizing prices for an assortment of products that exhibit network effects. Customers make purchase decisions according to a modified MNL choice model. We show that the optimal strategy is either to maintain a semblance of balanced sales among all product or to boost the sales of exactly one product. We also show the importance of taking the network effects into consideration.

4 - Pricing Ancillary Service Subscriptions

Ruxian Wang, Johns Hopkins University, 100 International Dr, Baltimore, MD, 21202, United States of America, ruxian.wang@jhu.edu, Maqbool Dada, Ozge Sahin

We investigate customer choice behavior in the presence of main products, ancillary services with options of pay-per-use and subscription, as well as the outside option. Analytical results and numerical experiments show that offering service subscriptions may result in "win-win-win" "win-win-lose" "lose-lose-win" and other situations for the firm, competitors and customers in the monopolistic and competitive scenarios.

■ TD44

44-Room 103B, CC

Recent Trends in Retailing

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Mehmet Sekip Altug, Assistant Professor, George Washington University, Washington, DC, United States of America, maltug@gwu.edu

1 - Analyzing Big-Box Retailer in an Emerging Market

Mehmet Gumus, McGill University, 1001 Sherbrooke Street West, Montreal, Canada, mehmet.gumus@mcgill.ca, Aditya Jain, Saibal Ray

We consider the impact of the entry of a big-box retailer in a market dominated by small retailers. The small retailers are characterized by local coverage of the market, whereas the big-box retailer provides services valued by customers. Since both types of retailers obtain supplies from a common manufacturer, big-box retailer's entry affects the supply conditions. Our work thus highlights roles of direct competition as well as indirect supply side effect on small retailers and customers.

2 - Dynamic Pricing with Customer Upgrades

Oben Ceryan, Assistant Professor, Drexel University, 3220 Market St., Philadelphia, PA, United States of America, oc43@drexel.edu, Ozge Sahin, Izak Duenyas

We study the impact of product upgrades on a firm's pricing and replenishment policies by considering a multiple period, two-stage model where the firm first sets prices and replenishment levels, and after observing the demand, it decides whether to upgrade any customers to a higher quality product. We characterize the structure of the optimal upgrade, pricing, and replenishment policies and find that offering upgrades assists in preserving the vertical price differentiation of the products.

3 - Return Abuse, Countermeasures, and Privacy Concerns

Serkan M. Akturk, PhD Candidate, Texas A&M University, 4217 TAMU Wehner 320 M, College Station, TX, United States of America, makturk@mays.tamu.edu, Michael Ketzenberg

This paper analytically investigates return abuse with respect to both fraudulent and opportunistic consumer returns and potential countermeasures to deal with them. The research also shows how those countermeasures impact a retailer's profitability, demand structure, and policy parameters with respect to price and refund. To some extent, our findings contradict common suggestions in the literature.

4 - Store-clearance or Secondary Markets? Evaluation of Inventory Clearance Opportunities in Retailing

Mehmet Sekip Altug, Assistant Professor, George Washington University, Washington, DC, United States of America, maltug@gwu.edu, Garrett Van Ryzin

One main assumption in the newsvendor model is that the salvage value is exogenous and retailers can sell their excess stock at this fixed salvage value. However, the salvage value of excess stock is mostly determined endogenously. We compare consolidated secondary markets vs. store clearance with myopic and strategic customers.

■ TD45

45-Room 103C, CC

Topics in Dynamic Pricing and Revenue Management

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Robert Phillips, Columbia Business School, 2790 Broadway Urin Hall, New York, NY, 10027, United States of America, rp2051@columbia.edu

1 - Dynamic Pricing with Demand Covariates

Sheng Qiang, Student, Stanford University, 41 Olmsted Road, Apt 108, Stanford, CA, 94305, United States of America, sqiang@stanford.edu, Mohsen Bayati, Michael Harrison

A firm sells products over T periods, without knowing the demand function. The firm sets prices to earn revenue and learn the demand function. In each period before setting the prices, the firm observes some demand covariates, like marketing expenditure, consumer's attributes, etc. The performance is measured by the regret, which is the expected revenue deviation from the optimal pricing policy when demand function is known. We study the asymptotic near-optimal algorithms to optimize the regret.

2 - What Really Happens in Implementing Revenue Management Capabilities and What to Expect in the Future

Vedat Akgun, Director, Revenue Analytics, 3100 Cumberland Blvd SE, Suite 1000, Atlanta, GA, 30339, United States of America, vakgun@revenueanalytics.com, Jon Higbie

Implementation of Revenue Management started more than thirty years ago and Revenue management concepts have evolved over time providing extraordinary benefits to companies. In addition to realizing great success, we also face challenges and learn lessons based on our experience and research. We want to discuss what really happens in implementing Revenue Management capabilities and what we can expect in the future.

3 - Nonparametric Algorithm for Joint Pricing and Inventory Control with Lost-sales and Censored Demand

Boxiao (Beryl) Chen, University of Michigan-Ann Arbor, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, boxchen@umich.edu, Xiuli Chao, Cong Shi

We consider the classic joint pricing and inventory control problem with lost-sales and censored demand in which the demand distribution is not known to the firm a priori. Conventional learning algorithms are not applicable as the firm can observe neither the realized value nor any derivative information of the true objective function, and the estimate of the expected profit function from data is not unimodal. We develop a data-driven algorithm which converges and provide its convergence rate.

■ TD46

46-Room 104A, CC

Service Operations

Sponsor: Manufacturing & Service Oper Mgmt/Service Operations

Sponsored Session

Chair: Gad Allon, Professor, Kellogg School of Management, Northwestern University, 2001 Sheridan Road, Evanston, IL, 60201, United States of America, g-allon@kellogg.northwestern.edu

1 - Managing Service Systems in Presence of Social Networks

Gad Allon, Professor, Kellogg School of Management, Northwestern University, 2001 Sheridan Road, Evanston, IL, 60201, United States of America, g-allon@kellogg.northwestern.edu, Dennis Zhang

We study a service system with the presence of a social network. In our model, firms can differentiate resource allocations among customers, and customers learn the service qualities from the social network. We study the interplay among network structure, customer characteristics, and information structure, and characterize the optimal policy. We further calibrate our model with data from Yelp.com and quantify the value of social network knowledge empirically.

2 - Keeping Up with the Joneses: using Social Network Information to Manage Availability

Ruslan Momot, INSEAD, Boulevard de Constance, Fontainebleau, 77305, France, ruslan.momot@insead.edu, Elena Belavina, Karan Girotra

Growing availability of data on the patterns of customers' social interactions has opened up new opportunities for businesses. We identify an optimal distribution strategy for a firm selling to socially connected customers engaged in social comparison. We build a stylized game-theoretic model of strategically interacting customers in a general network. We find that the optimal strategy is non

monotonic-neither most nor least connected customers are prime targets for making the product available.

3 - Supply Disruptions and Optimal Network Structures

Kostas Bimpikis, Stanford GSB, 655 Knight Way, Stanford, CA, 94305, United States of America, kostasb@stanford.edu, Ozan Candogan, Shayan Ehsani

This paper studies multi-tier supply chain networks in the presence of disruption risk. Firms compete with one another by participating in one of K production stages. We provide a characterization of the equilibrium prices, profits, and sourcing decisions and derive insights on how the network structure and the reliability of production in different tiers affect firms' profits and the prices of intermediate goods.

4 - Creating Reciprocal Value through Operational Transparency

Ryan Buell, Harvard Business School, Morgan Hall 429, Boston, MA, 02163, United States of America, rbuell@hbs.edu, Tami Kim, Chia-Jung Tsay

We investigate whether organizations can create value by introducing visual transparency between consumers and producers. Two field and three laboratory experiments in food service settings suggest that transparency that 1) allows customers to observe operational processes and 2) allows employees to observe customers not only improves customer perceptions, but also increases service quality and efficiency.

■ TD47

47-Room 104B, CC

Sustainable Operations Management

Sponsor: Manufacturing & Service Oper Mgmt/Sustainable Operations

Sponsored Session

Chair: David Drake, Assistant Professor, Harvard Business School, Morgan Hall 425, Boston, MA, United States of America, ddrake@hbs.edu

1 - Mobile Money Agent Inventory Management

Karthik Balasubramanian, Harvard Business School, 25 Harvard Way, Boston, MA, 02163-1011, United States of America, kbalasubramanian@hbs.edu, David Drake, Douglas Fearing

Mobile money agents exchange cash for electronic value and vice versa, forming the backbone of an emerging electronic currency ecosystem in the developing world. Unfortunately, low agent service levels are a major impediment to the further development of these ecosystems. We model the agent's inventory problem and numerically determine optimal quantities. Finally, we evaluate our recommendations with a large dataset of mobile money agent transactions in an East African country.

2 - Energy Efficiency Contracting in Supply Chains under Asymmetric Bargaining Power

Ali Shantia, HEC-Paris, 7, Avenue De La Gare, Bievres, 91570, France, ali.shantia@hec.edu, Andrea Masini

In a supply chain, consisting of a buyer and a supplier, this study analyzes the effect of relative bargaining power and technology uncertainty on the supplier's decision to invest in energy efficiency (EE) measures. We analyze price commitment and shared investment contracts and compare the two mechanisms in their ability to boost EE investment when the buyer's high bargaining power in addition to high technology uncertainty prevent the supplier from investing in EE.

3 - Competitive Industry's Response to Environmental Tax Incentives for Green Technology Adoption

Anton Ovchinnikov, Queen's University, 143 Union Str West, Kingston, Canada, anton.ovchinnikov@queensu.ca, Dmitry Krass

We consider operational aspects of how an industry composed of heterogeneous firms responds to an environmental tax by choosing production quantities and emissions-reducing technologies. We show the existence and uniqueness of the "market-only equilibrium" and demonstrate its many interesting properties. We then discuss the technology-and-market equilibria under different structural assumptions.

4 - Carbon Tariffs: Effects in Settings with Technology Choice and Foreign Production Cost Advantage

David Drake, Assistant Professor, Harvard Business School, Morgan Hall 425, Boston, MA, United States of America, ddrake@hbs.edu

When firms can choose from a set of potential production technologies and offshore facilities hold a production cost advantage, I show that carbon leakage due to offshoring and/or foreign entry can result despite the implementation of a carbon tariff. However, in such a setting, carbon leakage is shown to conditionally decrease global emissions, contradicting prevailing popular opinion and widely reported results that do not account for technology choice or foreign production cost advantage.

■ TD48

48-Room 105A, CC

New Directions at the Interface of Finance, Operations, and Risk Management

Sponsor: Manufacturing & Service Oper Mgmt/IFORM

Sponsored Session

Chair: Gerry Tsoukalas, Assistant Professor, Wharton, 3730 Walnut street, Philadelphia, PA, 19104, United States of America, gtsouk@wharton.upenn.edu

Co-Chair: Vlad Babich, Georgetown University, Washington, D.C., Volodymyr.Babich@georgetown.edu

1 - Supply Chain Contract Design under Financial Constraints and Bankruptcy Costs

Panos Kouvelis, Professor, Olin Business School, Washington University in St. Louis, St. Louis, MO, United States of America, kouvelis@wustl.edu, Wenhui Zhao

We study contract design in a supply chain of two capital constrained firms in need of short-term financing. The failure of loan repayment leads to bankruptcy with fixed and variable default costs. With only variable default costs, buyback contracts remain equivalent to revenue-sharing contracts, which coordinate with working capital adjustments. With fixed default costs, a revenue-sharing contract with working capital coordination might have higher expected profit than the one-firm system.

2 - Network Recovery using Transactional Information

John Birge, Professor, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu

Firms operate as components of complex networks of physical and financial flows. The structure of these networks is however not easily observed. This talk will discuss methodologies to uncover such hidden structure using inverse optimization techniques.

3 - Does Operational Investment Vary with Capital Structure?

Vishal Gaur, Cornell University, 321 Sage Hall, Ithaca, NY, 14850, United States of America, vg77@cornell.edu, Yasin Alan

We investigate the relationship between the operational investment of firms and their capital structure choices using data for U.S. manufacturing and retail trade sectors.

4 - Entrepreneurial Finance: Crowdfunding, Venture Capital, and Bank Financing

Vlad Babich, Georgetown University, Washington, DC, United States of America, Volodymyr.Babich@georgetown.edu, Gerry Tsoukalas

We study the interplay between bank financing, venture capital and crowdfunding, in a multi-stage bargaining game, with double-sided moral hazard. We find that while crowdfunding usually serves a positive role, enabling funding for good projects, and avoiding investments in bad projects, it may also hurt VCs, entrepreneur, and the society.

■ TD49

49-Room 105B, CC

Demand Driven Supply Chains

Sponsor: Manufacturing & Service Oper Mgmt/Supply Chain

Sponsored Session

Chair: Muge Yayla-Kullu, RPI, 110 8th St, Troy, NY, 12180, United States of America, YAYLAH@rpi.edu

1 - The Effect of Targeted Coupons on Product Quality Assortment and Competition

Amit Eynan, Professor, University of Richmond, 1 Gateway Rd, Richmond, VA, 23173, United States of America, aeynan@richmond.edu, Benny Mantin

Manufacturers who sell to customers with heterogeneous valuation of quality can segment the market by offering multiple products at different qualities and prices. We investigate the effect of targeted marketing efforts (coupons) on product line assortment of a monopolist as well as under competition. While coupons help the monopolist, in the competitive setting, we find that both firms end up exerting marketing efforts but only one of them is better off whereas the other is worse off.

2 - Competition and Perceptions of User Reviews

Michael Galbreth, Associate Professor Of Management Science, Moore School of Business, University of South Carolina, Columbia, SC, United States of America, galbreth@moore.sc.edu, Pelin Pekgun, Bikram Ghosh

We analyze the interaction of user reviews and valuation uncertainty for experience goods, with a specific focus on the potential for negative vs. positive reviews to be weighted differently by consumers. The competitive impact of this unequal weighting is not always intuitive. For example, we show that if a lower quality firm has a large user base, overweighting of negative reviews can lead to higher profits and higher prices in equilibrium than its higher quality competitor.

3 - Analysis of Consumers' Purchase Timing Decisions

Emre Ertan, PhD Candidate, UT Dallas, Sm30 Jindal School of Management, 800W Campbell Dr, Richardson, TX, 75080, United States of America, emre.ertan@utdallas.edu, Kathy Steckle, Ozalp Ozer

The consumer purchase timing decision is analyzed by using discounted expected utility theory, where consumers act to maximize their utility over time. The consumer's sequential decision-making process is formalized under uncertain product availability. An optimal purchase timing policy is identified in a market environment, in which a strategic customer knows the markdown pricing scheme, available inventory level, and remaining time to the end of the selling horizon.

4 - Product Line Design and Capacity Management:**The Role of Consumer Behavior Uncertainty**

Muge Yayla-Kullu, RPI, 110 8th St, Troy, NY, 12180, United States of America, Yaylah@rpi.edu, Jennifer Ryan, Jayashankar Swaminathan

We study the effects of uncertainty in consumer spending due to economic volatility on the product line decisions of a firm with limited resources. We consider a firm that offers products with differing qualities, unit production costs, and resource consumption rates. Making capacity allocation decisions in the face of such an uncertainty is challenging, demanding careful consideration of product variety and available resources.

5 - A Manufacturer's Outlet Decision: The Impact of Quality, Innovation and Market Awareness

Jennifer Ryan, RPI, ISE, CII, Troy, NY, 12180, United States of America, ryanj6@rpi.edu, Daewon Sun

We consider a manufacturer of a luxury good who must determine whether to sell products only through a manufacturer-owned retail store, or to also sell products through the factory outlet store. We study how this decision depends on the relative qualities of the products offered on the two channels, as well as the manufacturer's ability to innovate and introduce new product lines. In addition, our multi-period model captures the impact of market share on the manufacturer's brand awareness.

■ TD50

50-Room 106A, CC

Supply Network Management: Collaboration and Competition

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Hyoduk Shin, UC-San Diego, San Diego, CA, United States of America, hshin@rady.ucsd.edu

1 - Optimal Procurement in Assembly Supply Chains: Contracting Timing and Supplier Mergers

Bin Hu, Assistant Professor, UNC Kenan-Flagler Business School, CB#3490 McColl Bldg, University of North Carolina, Chapel Hill, NC, 27519, United States of America, Bin_Hu@kenan-flagler.unc.edu, Anyan Qi

OEMs often procure components from several suppliers to assemble into products. Such an OEM needs proportional component quantities, calling for a coordinated procurement mechanism. We propose the use of two-part tariff contracts for coordinated procurement. We further show that simultaneous and sequential contracting are equivalent. Finally, we investigate the impact of a supplier merger in an assembly supply chain.

2 - Long-Term Partnership for Achieving Efficient Capacity Allocation

Fang Liu, Assistant Professor, Nanyang Business School, Nanyang Technological University, 50 Nanyang Avenue, South Spine S3-B2A-13, Singapore, 639798, Singapore, liu_fang@ntu.edu.sg, Tracy Lewis, Nataliya Kuribko, Jeannette Song

We consider a manufacturer and a group of buyers who share a scarce but expensive-to-build capacity over a finite period. Each member has private history-dependent demand information and makes unverifiable investments. Because of the high uncertainty, achieving supply chain efficiency while sustaining under a dynamic environment is challenging for the partnership. We construct a membership agreement that enforces efficient capacity allocation and investments by introducing a novel breach remedy.

3 - The Perils of Sharing Information in a Trade-association

Noam Shamir, Assistant Professor, Tel-Aviv University, Haim Levanon, Tel-Aviv, Israel, nshamir@post.tau.ac.il, Hyoduk Shin

Studying the incentives of a group of retailers, organized as a trade association, to exchange forecast information, we compare between two industry policies: exclusionary and non-exclusionary information sharing. Although non-exclusionary policy has been advocated to promote information sharing, we show the opposite can happen and explain the reason.

4 - Aligning Incentives in Omni-channel Sale

Elnaz Jalilipour Alishah, PhD Candidate, University of Washington, Seattle, Foster School of Business, Mackenzie Hall 358, Seattle, WA, 98195-3200, United States of America, jalilipo@uw.edu, Yong-Pin Zhou, Jingqi Wang

We consider a retailer with both online and offline channels. While the online store exerts costly effort to attract customers, the offline store handles inventory for both locations – including fulfillment of online orders. We study how the retailer should appropriately credit both channels to align their incentives.

■ TD51

51-Room 106B, CC

Innovative and Entrepreneurial OM

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Onesun Steve Yoo, University College London, Gower Street, London, WC1E 6BT, United Kingdom, o.yoo@ucl.ac.uk

1 - Pricing and Capacity Planning for Flexible Consumption

Sanjiv Erat, UCSD, Gilman Drive, La Jolla, CA, United States of America, serat@ucsd.edu, Sreekumar Bhaskaran, Rajiv Mukherjee

Motivated by the emergence of flexible consumption opportunities - such as the rollover cellphone plans offered by many mobile providers - we study a firm's pricing and capacity planning decision when the timing of consumption is a choice variable for consumers. Subsequently, we explore the effect of heterogeneity in consumer preferences and its effect on a firm's decision of how much flexibility to offer.

2 - Improving Supply Chain Compliance using Buyer Consortia

Prashant Chintapalli, Anderson School of Management, University of California, Los Angeles, CA, 90095, United States of America, prashant.chintapalli.1@anderson.ucla.edu, Kumar Rajaram, Felipe Caro, Chris Tang

Motivated by the Accord on Fire and Building Safety in Bangladesh we study the effectiveness of buyer consortia. We show that a consortium can increase factory compliance and improve the buyers' profits, though possibly at the expense of the supplier. We also study the conditions under which a buyer should join the consortium and characterize the settings in which the whole supply chain is better off.

3 - Startup as a Process: Increase Your Chances of Success via a Just-in-time Approach

Christophe Pennetier, PhD Student, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, Christophe.Pennetier@insead.edu, Karan Girotra, Serguei Netessine

Using a unique and novel dataset, we study the success of startups modeled as a process: what is the best configuration for batches of funding cash –in terms of size and frequency– to exit successfully? Our results suggest that founders should not be obsessed by the amount of money they raise in any single round. It is better to raise small batches more often than the other way around.

4 - Selling Fashionable Products: Change Price or Facilitate Learning?

Yufei Huang, PhD Student, University College London, Gower Street, London, United Kingdom, yufei.huang.10@ucl.ac.uk, Onesun Steve Yoo, Bilal Gokpinar, Chris Tang

Firms selling new fashionable products are shifting their focus away from pricing and towards facilitating the learning process for customers. To understand this phenomenon, we present a stylized model with pricing and three channels through which customers learn. We find that for new fashionable products, facilitating learning can lead to greater profit than variable pricing. Moreover when firms facilitate learning, variable pricing has only a marginal effect on firm profits.

■ TD52

52-Room 107A, CC

Social Media and Internet Marketing

Sponsor: Marketing Science

Sponsored Session

Chair: Michael Trusov, University of Maryland, 3454 Van Munching Hall, College Park, MD, United States of America, mtrusov@rsmith.umd.edu

1 - Attribution Metrics and Return on Keyword Investment in Paid Search Advertising

Hongshuang Li, Indiana University, Bloomington, IN, United States of America, lhshruc@gmail.com, Siva Viswanathan, Abhishek Pani, P.k. Kannan

In this paper, we analyze the impact of the attribution metric used for imputing conversion credit to search keywords on the overall effectiveness of keyword investments in search campaigns. We model the relationship among the advertiser's bidding decision for keywords, the search engine's ranking decision for these keywords, and the consumer's click-through rate and conversion rate on each keyword, and analyze the impact of the attribution metric used on the overall return-on-investment of paid search advertising.

2 - Controlling for Self Selection Bias in Customer Reviews

Leif Brandes, University of Warwick, Coventry, CV4 7AL, United Kingdom, Leif.Brandes@wbs.ac.uk, David Godes, Dina Mayzlin

Customers frequently use user online reviews as a valuable information resource before making a purchase. This observation has motivated a large number of empirical studies, and it is now a well-established finding that customer online reviews impact product sales. However, one possible criticism of online user reviews as a source of information is the self-selection inherent in the review process. That is, consumers self-select into choosing whether to review a product, which suggests that reviews may be prone to the extremity bias: the distribution of reviews may be more polarized than the true preference distribution. This of course implies that posted review valence may not always provide an unbiased representation of customers' true product experiences. We provide survey evidence that demonstrates that customers who post an online review tend to have more extreme opinions than customers who never post a review. We hypothesize that the consumers who have more extreme opinions post their reviews quicker, while the consumers with more moderate opinions may take longer to post a review, which implies that in the limit some consumers with moderate opinions may never post a review. One implication of this is that reviews that arrive after a long time lapse are more similar to the opinions of the non-responders. Hence, a firm that is able to observe the time lapse between the experience and the review should be able to calculate the valence of reviews in a way that corrects for the non-response bias. That is, we suggest how to correct for the extremity bias by taking into account the latency of response data. To test our hypotheses, we use a new dataset from a large online travel portal. Overall, we have detailed information on 1.26 million bookings and 2.75 million reviews over the complete history of the firm (twelve years). Because we observe hotel bookings and review provision behavior at the individual customer level, we know for each customer the exact duration between her last travel day and the day that she provided the review. Based on our empirical results, we show how customer self-selection across time impacts her review behavior and suggest a method for controlling for this bias.

3 - Deal or No Deal? The Quality Implications of Online Daily Deals and Competition

Jorge Mejia, University of Maryland, Robert H. Smith School of Business, College Park, MD, United States of America, jmejia@rhsmith.umd.edu, Anand Gopal, Michael Trusov

Consumers use online reviews to inform purchasing decisions about many products / services. Moreover, online daily deals have become an important part of the marketing mix for merchants. The objective of this study is to understand the effect of daily deals on consumers' quality perceptions, expressed through online reviews and investigate potential moderators for this effect, such as merchant characteristics and competition. We combine online reviews for restaurants from Yelp with data from online deals in a major American metropolitan area. We find that online deals have a significant negative effect on online reviews. Additionally, this effect is moderated by certain merchant characteristics such as price point and restaurant age. We also find that the reviews of merchants who do not offer deals are affected by nearby deal competition. We replicate our empirical findings by conducting three lab studies using subjects from MTurk and find consistent results, thus showing robustness.

4 - Swayed by the Numbers: The Consequences of Displaying Review Counts in Purchase Decisions

Jared Watson, University of Maryland, College Park, MD, United States of America, jwatson@rhsmith.umd.edu, Michael Trusov, Anastasiya Pocheptsova

Online retailers often display customers' review to aid consumers' decision-making. While prior literature postulates that an increase in review counts leads to an increase in consumers' purchase intentions, the authors find an important corollary: holding purchase intentions constant, revealing a small review count systematically biases consumers' preferences between choice options. Further, withholding review count information increases purchase intention relative to a small review count. These findings are contrasted with current retailer practices of revealing small review count information.

■ TD53

53-Room 107B, CC

Inventory and Information Sharing

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Enno Siemsen, Associate Professor, University of Minnesota, 321 19th Ave S, Minneapolis, MN, 55455, United States of America, siems017@umn.edu

1 - Decision Dependent Bounded Rationality in Dual Sales Channel Management

Ozalp Ozer, The University of Texas at Dallas, 800 West Campbell Road, Richardson, TX, United States of America, ooz@utdallas.edu, Kay-Yut Chen

We experimentally study behaviors in a dual sales channel in which a manufacturer sells through his direct channel and an independent retailer. The channels compete on demand. The manufacturer sets the wholesale price for the retailer, and also delivery times for customers in his direct channel. The retailer decides on its inventory level. We show and discuss why bounded rationality differs, in the same subject pool, across three decisions and model the behavior as quantal response equilibrium.

2 - Behavioral Inventory Sharing

Enno Siemsen, Associate Professor, University of Minnesota, 321 19th Ave S, Minneapolis, MN, 55455, United States of America, siems017@umn.edu, Hui Zhao

The benefits of aggregating demand for reducing required safety stock investments in supply chains are well known. Yet if decision makers are decentralized and keep separate stockpiles of inventory, these benefits can only be reaped if they agree to transship their inventory to others. Using behavioral experiments, we explore the conditions under which decision makers share inventory, and the implication of inventory sharing on initial order quantities.

3 - Communication Strategies in Assembly Systems: An Experimental Investigation

Jud Kenney, McGill University, Bronfman Building, Montreal, Canada, jud.kenney@mail.mcgill.ca, Jim Engle-Warnick, Saibal Ray

This study investigates how supply chain partners in an assembly system react to three different strategies of communicating supply risk. Our behavioral experiment uses a minimum game to model suppliers deciding on the amount of capacity to build when facing certain end customer demand, but uncertain supply from their peers. We find effective communication strategies can significantly improve performance and such improvements are more significant under higher critical ratios.

4 - Is Non-linear Pricing Contract Always Better than Linear Pricing Contract?

Guangwen Kong, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55414, United States of America, gkong@umn.edu, Tony Haitao Cui

We study supply chain contracts with consideration of information sharing and bounded rationality. We examine a dyadic supply chain where a supplier with more accurate demand information sells products to a bounded rational retailer. The research suggests that the supplier can be better-off by using a linear pricing contract than adopting a buy-back contract. The supplier either shares information with the retailer or help improve the retailer's bounded rationality but not both in equilibrium.

■ TD54

54-Room 108A, CC

Meta-algorithms: From Algorithm Tuning and Configuration to Algorithm Portfolios

Cluster: Tutorials

Invited Session

Chair: Meinolf Sellmann, IBM, Yorktown Heights, NY, United States of America

1 - Meta-algorithms: from Algorithm Tuning and Configuration to Algorithm Portfolios

Meinolf Sellmann, IBM, Yorktown Heights, NY, United States of America

Efficiency and accuracy are of primary concern when developing analytics solutions in OR. Typically, there is more than one possible algorithmic approach and none dominates the others. Moreover, algorithms usually have implicit or explicit parameters that greatly affect performance. Meta-algorithms focuses on the development of effective automatic tools that tune algorithm parameters and, at runtime, choose the approach best suited for the given input. Here we summarize the lessons learned when devising such tools.

■ TD55

55-Room 108B, CC

Data Envelopment Analysis (DEA)

Contributed Session

Chair: Samir Srairi, Ministry of Higher Education and Scientific Research, 14 Avenue de Tunis, Arian, 2080, Tunisia, srairisamir3@gmail.com

1 - Combination of Hybrid Two Level DEA with SVM for Indicator Weighting in Financial Failure Prediction

Chao Huang, Southeast University, Xuan Wu District, Sipailou No.2, Nanjing, 210096, China, huangchao@seu.edu.cn

A new WPF two level DEA is proposed to identify the bankruptcy firms by constructing a worst-practice frontier. Combining traditional BPF two level DEA and WPF two level DEA, a hybrid model is put forward as a tool for cooperates financial failure prediction. To improve the accuracy, a new indicator weighting method based on SVM is also proposed. The empirical results show that the proposed hybrid method has excellent bankruptcy prediction ability.

2 - A Cross-Dynamic Evaluation of Warehouse Operations

Jose Humberto Ablanado Rosas, Associate Professor, University of Texas at El Paso, 500 W University Avenue, Marketing & Management Department, El Paso, TX, 79968, United States of America, jablanedorosas2@utep.edu, Faruk Arslan

We report a cross-dynamic comparison of distribution centers worldwide. This problem has been analyzed with the Malmquist productivity index; we introduce an approach based on cross-efficiency assessment which eliminates the drawbacks of traditional cross-efficiency methods. A comparison between both approaches is discussed and managerial recommendations for decision makers are derived.

3 - Performance Evaluation of Dynamic Supply Chain using Dea

Somayeh Mamizadeh-Chatghayeh, Asia Business Clusters & Networks Development (ABCD) Foundation Cooperation, Tehran, Tehran, Iran, somayeh_mamizadeh@yahoo.com, Abbas Ali Noura

One of the main researches in supply chain management is to improve the overall efficiency based on dynamic performance of supply chain. In this paper, by developing the basic dynamic model, different methods for evaluating the supply chain are studied. Dynamic Data Evolution Analysis as an efficient tool is new research focus in supply chain benchmarking. We develop DDEA models that can be evaluating the overall efficiency of supply chains and subsystems.

4 - On Integrating DEA and AHP for the Facility Layout Design in Manufacturing Systems

Toloo Mehdi, Technical University of Ostrava, Ostracew,
Czech Republic, mehdi.toloo@vsb.cz

Analytic hierarchy process (AHP) is a decomposition multiple-attribute decision making (MADM) method, which can represent human decision making process and help to achieve better judgments based on hierarchy, pair-wise comparisons, judgment scales, allocation of criteria weights and selection of the best alternative from a finite number of variants by calculation of their utility functions. Data envelopment analysis (DEA) is a well-known non-parametric method to evaluate the performance of a set of homogeneous decision making units (DMUs) with multiple inputs and multiple outputs.

5 - The Efficiency of Tunisian Universities: An Application of a Two-Stage Dea Approach

Samir Srairi, Ministry of Higher Education and Scientific
Research, 14 Avenue de Tunis, Arian, 2080, Tunisia,
srairisamir3@gmail.com

This paper examines the efficiency of eleven universities in Tunisia during the period 2009-2013. Regression analysis suggests that a higher share of professors, a higher number of women in academic staff and a better quality of student in secondary education improve the efficiency of the university.

■ TD56

56-Room 109A, CC

Project Selection, Evaluation and Collaboration

Cluster: New Product Development

Invited Session

Chair: Yaozhong Wu, National University of Singapore, NUS Business School, Singapore, Singapore, yaozhong.wu@nus.edu.sg

1 - An Experimental Study of Idea Selection Process

Zhijian Cui, Assistant Professor of Operations and Technology
Management, IE Business School, Calle de Maria de Molina 12,
Madrid, 28006, Spain, Zhijian.Cui@ie.edu, Shijith Payyadak,
Dilney Gonçalves

In this study, we design several online experiments to compare the efficacy of two commonly observed processes of idea selection: scoring vs. ranking. In scoring process, subjects are asked to evaluate the quality of each idea and give a score while in ranking process, subjects are asked to only rank the ideas according to their preferences. We find that the choice of idea selection process depends on some contextual factors.

2 - Overvaluation of Process Innovation Ideas

Fabian Sting, Erasmus University Rotterdam, Rotterdam,
Netherlands, fsting@rsm.nl, Christoph Fuchs, Maik Schlickel

Ideas by employees are a vital source for innovation. But are such ideas overvalued by their creators? If so, which ideas in particular? Drawing on a unique data set that comprises the generation, election, and implementation of process improvement ideas of an automotive supplier, we identify antecedents of overvalued ideas. Overvaluation is greater for ideas generated by higher-level employees, collaboratively versus individually, and by employees with previously lower ideation success.

3 - Project Evaluation and Selection via Risk-adjusted Net Present Value

Nicholas G. Hall, The Ohio State University, Fisher College of
Business, Columbus, OH, United States of America,
hall.33@osu.edu, Zhixin Liu, Wenhui Zhao

We consider a project with risk that declines over time as its tasks are completed, as reflected in a declining discount rate. The objective is to maximize the NPV of the project. This problem is highly nonlinear, since the discount rate at any point in time is a function of previous scheduling decisions. We solve this model and show that risk-adjusted NPV varies significantly from traditional NPV, and that the use of the risk-adjusted measure significantly improves project selection decisions.

4 - Resource Competitions for Research Projects

Pascale Crama, Singapore Management University, 50 Stamford
Road, Singapore, 178899, Singapore, pcrama@smu.edu.sg, Anand
Nandkumar, Reddi Kotha

Academic research is funded by governments, but is often seeded through grants from university administered research funds (UARF) and other charitable institutions. We compare the effectiveness of UARF and other sources of funds in obtaining subsequent federal funding and value creation. We build a parsimonious model that can explain the superior productivity of UARF funding and make recommendations on the ideal way to organize UARF funding.

■ TD57

57-Room 109B, CC

Modeling the Economics of Low-Carbon Power Systems

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Todd Levin, Energy Systems Engineer, Argonne National
Laboratory, 9700 S Cass Ave, Lemont, IL, 60439,
United States of America, tlevin@anl.gov

1 - Revenue Sufficiency and Resource Adequacy in Systems with Variable Generation Resources

Todd Levin, Energy Systems Engineer, Argonne National
Laboratory, 9700 S Cass Ave, Lemont, IL, 60439,
United States of America, tlevin@anl.gov, Audun Botterud

An efficient MIP framework is applied to analyze the impact of increasing wind power capacity on generator profitability. The model is executed with hourly time steps on a test case that approximates the ERCOT system for a range of wind capacity levels. We analyze three market policies that support resource adequacy and find that some additional market incentives may be required to ensure long term revenue sufficiency and resource adequacy in systems with significant variable energy resources.

2 - An Approximate Model for Scheduling Energy and Reserve in Renewable-Dominated Power Systems

Miguel Carrion, Universidad de Castilla - La Mancha,
Av. Carlos III, s/n, Toledo, Spain, miguel.carrion@uclm.es,
Rafael Zarate-miñano

Since most of renewable energies are non-dispatchable, an appropriate schedule of reserves in renewable-dominated power systems is crucial. We propose an alternative formulation that co-optimizes energy and reserve considering the uncertainty involved in demand and renewable production. This formulation requires a significantly smaller number of variables and constraints than the classical stochastic economic dispatch problem. The proposed formulation is tested in a realistic case study.

3 - Hydroelectric Bid Optimization under Uncertainty

Andy Philpott, University of Auckland, Engineering Science
Department, Private Bag 92019, Auckland, 1025, New Zealand,
a.philpott@auckland.ac.nz, Faisal Wahid, Frederic Bonnans,
Cedric Gouvernet

We consider the problem faced by the operator of a cascade of hydroelectric generating plants offering energy to a wholesale electricity pool market to maximize revenue. Both energy prices and uncontrolled inflows to the reservoirs of the cascade are assumed to be stochastic. We describe a stochastic dynamic programming model that generates an optimal offer for the next period given current observed prices. This is solved using SDDP when value functions are concave or MIDAS when they are not.

4 - Optimal Timing to Invest, Mothball, Reactivate, and Decommission a Coal Power Plant

Paul Rebeiz, Doctoral Candidate In Operations Management,
UCLA Anderson School of Management, 110 Westwood Plaza,
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paul.rebeiz.1@anderson.ucla.edu, Christian Blanco

Transitioning to a low-carbon economy will require most coal power plants to be replaced by other sources of generation such as wind and solar. We present a dynamic program to solve for the optimal price signals to invest, mothball, reactivate, and decommission a coal power plant. We find that our results are consistent with current industry trends. We conclude with some insights on the effect of renewable energy policy on mothballing and retiring a coal plant.

■ TD58

58-Room 110A, CC

New Insights on Electricity Markets with Uncertain Supply

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Juan M. Morales, Associate Professor, Technical University of Denmark, Matematiktorvet, Building 303b, 008, Kgs. Lyngby, 2800, Denmark, jmmgo@dtu.dk

1 - The Benefits of Sharing Reserves Between Countries: A Case Study of the European Electricity System

Kenneth Van Den Bergh, PhD Researcher, KU Leuven, Celestijnenlaan 300 Box 2421, Leuven, Belgium, kenneth.vandenbergh@kuleuven.be, Robin Broder Hytowitz, Benjamin Hobbs, William D'Haeseleer, Erik Delarue

Reserves are scheduled day-ahead in order to deal with forecast errors from wind and sun. This study examines reserve coordination in time and space for the Central European electricity system. Four scenarios involving various degrees of coordination for reserves are simulated. A large-scale unit commitment model is used to simulate the electricity markets. The study indicates savings in reserve allocation costs of up to 90% with increasing degree of coordination.

2 - Effect of Ramping Pricing Scheme in Systems with High Wind Energy Penetration

Yves Smeers, Professor Emeritus, Université Catholique de Louvain, Voie du Roman Pays, 34, Louvain-la-neuve, B-1384, Belgium, yves.smeers@uclouvain.be, Sebastian Martin

We consider the continuous version of a unit commitment problem with wind penetration, and subject to ramping constraints. The optimization problem assumes that ramping providers are priced at opportunity cost. We explore the impact of having different pricing schemes for ramping. We use a complementarity formulation in several versions that differ to reflect different policy proposals based on pricing schemes for ramping.

3 - A Stochastic Electricity Market Clearing Formulation with Consistent Pricing Properties

Victor M. Zavala, Computational Mathematician, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439, United States of America, vzavala@mcs.anl.gov

Deterministic clearing formulations introduce arbitrary distortions between day-ahead and real-time prices that bias economic incentives. We analyze a stochastic clearing formulation in which the social surplus function induces absolute value penalties between day-ahead and real-time quantities. We prove that the formulation yields price distortions that are bounded by the bid prices and we prove that day-ahead quantities and flows converge to the medians of real-time counterparts.

4 - On the Inefficiency of the Merit Order in Forward Electricity Markets with Uncertain Supply

Juan M. Morales, Associate Professor, Technical University of Denmark, Matematiktorvet, Building 303b, 008, Kgs. Lyngby, 2800, Denmark, jmmgo@dtu.dk, Salvador Pineda, Marco Zugno

We derive analytically the dispatch rule for a stylized power system with infinite transmission capacity under a stochastic market-clearing mechanism. We provide conditions for this clearing procedure to break the merit order and for virtual bidding to ensure maximum market efficiency under a classical merit-order dispatch. Finally, we provide a reinterpretation of these two market-clearing procedures as members of a broader family that allows for marked-up forward production costs.

■ TD59

59-Room 110B, CC

Optimal Design and Operation of Smart Electrical Grids

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Baosen Zhang, University of Washington, 185 Stevens Way, Seattle, WA, United States of America, zhangbao@uw.edu

1 - Design of Resilient Distribution Network Against Natural Disasters: A Robust Optimization Approach

Bo Zeng, Assistant Professor, University of South Florida, Tampa, 4202 E. Fowler Avenue, Tampa, FL, 33620, United States of America, bzeng@usf.edu, Wei Yuan, Feng Qiu, Chen Chen, Jianhui Wang

Natural disasters such as Hurricane Sandy have seriously disrupted the power grids. To increase the resilience of a distribution system under natural disaster attacks, we propose a resilient distribution network design model considering hardening and distributed generation unit placement to minimize the load shedding under worst-case natural disaster attacks.

2 - Electric Resource Optimization with High Penetration Renewables and Varying Reliability Measures

Cynthia Bothwell, Student, Johns Hopkins University, 117 Meridian Lane, Towson, MD, 21286, United States of America, cdbothwell@gmail.com, Calvin Wood

As intermittent wind and solar energy resources increase in use throughout the electricity sector, techniques to assess system reliability are evolving. The optimization of investment in new capacity resources changes as a result of the reliability criteria applied to the system. This work overviews for policy and decision makers the tradeoffs between reliability criteria and generation investment with high penetrations of intermittent renewables for capacity planning and market design.

3 - Scheduling Energy Storage Resources to Provide Multiple Services

Johanna Mathieu, Assistant Professor, University of Michigan, 1301 Beal Ave, Ann Arbor, MI, 48109, United States of America, jlmath@umich.edu, Goran Andersson, Olivier Megel

Most energy storage devices in power systems are only partially used most of time, and so they could also be used to help balance electricity supply and demand. The challenge is how to allocate their energy and power capacities to different services given uncertainty from multiple sources. We formulate the scheduling problem and apply both stochastic dynamic programming and stochastic dual dynamic programming to several case studies, and compare performance and computational complexity.

4 - Bidding Models for Price-responsive Loads in Electricity Markets

Javier Saez-gallego, PhD Candidate, Technical University of Denmark, Matematiktorvet Building 303B, 019, Kgs. Lyngby, 2800, Denmark, jsa@dtu.dk, Juan M. Morales, Marco Zugno

This paper presents a data-driven approach to estimate the parameters of the market bid that best represents the stochastic and dynamic behavior of a pool of price-responsive consumers. The proposed methodology is based on inverse optimization and is able to leverage exogenous information, besides the electricity price, to partly explain the parameters of the bid. We use data relative to the Olympic Peninsula project to assess the performance of the proposed method.

■ TD60

60-Room 111A, CC

Performance Measurement

Contributed Session

Chair: Huan Liu, PhD, Xi'an Jiaotong University, 28# Xianning West Road, Shaanxi Province, Xi'an, 710049, China, liuhuan-look@163.com

1 - Rapid Analysis of Attentional Processes While Looking at Print Advertisements Based on Eye Tracking

Hirota Aoki, Dr., Tokyo Institute of Technology, 2-12-1-W9-75, Oh-Okayama, Meguro-Ku, Tokyo, 152-8552, Japan, aoki.h.ad@m.titech.ac.jp

This paper develops an eye tracking-based analysis framework for attentional processes during viewing print advertisements. The framework consists of a scheme for classification of information in advertising and principles for data interpretation from attentional processes perspectives. Based on a case study in which 20 consumers' data during looking at insurance advertisements were collected, the potentials of our framework as well as implications for effective advertising design are discussed.

2 - Destructive Testing Gauge Capability Analysis

David Kim, Professor, Oregon State University, 204 Rogers, Corvallis, OR, 97331, United States of America, david.kim@orst.edu, Xinyu Luo

This research examines the current state-of-the-art in gauge capability analysis for destructive testing. Results are then presented that extend the specific destructive testing situations where gauge repeatability can be estimated.

3 - Project Timeliness or Project Effectiveness: Which One is Sacrificed?

Asghar Afshar Jahanshahi, Postdoc, Pontifical Catholic University, Av. Vicuña Mackenna 4860. Macul, Santiago, Chile, asghar@ing.puc.cl, Khaled Nawaser

There is a consensus among scholars that real options reasoning is crucial for project performance under conditions of high environmental uncertainty. However, few empirical studies have confirmed this claim. Our longitudinal analysis of 101 electronic commerce projects, drawn from new technology ventures, indicated the differential effects of real options reasoning on project performance under conditions of high environmental state, effect and response uncertainty.

4 - A New Framework for Sustainability Measurement

Anthony Afful-Dadzie, University of Ghana, P.O. Box LG 78,
Legon, Accra, Ghana, atosarsah@gmail.com

This presentation explores a new sustainability measurement and scoring system for assessing the efforts of organizations at meeting sustainability targets. Based on TOPSIS, the proposed measurement and scoring system incorporates all three sustainability dimensions and enables the establishment of a threshold below which an organization is considered to have failed a sustainability test. A time-independent threshold is also introduced to help compare performance over time.

5 - Government Intervention and Technovation Performance: An Empirical Study of Soes from Mainland China

Huan Liu, PhD, Xi'an Jiaotong University, 28# Xianning West
Road, Shaanxi Province, Xi'an, 710049, China,
liuhuan-look@163.com, Jiannan Wu

We use a comprehensive provincial-level panel data set of 30 provinces during 2005-2012. Our results show that project funding and tax break at the provincial level have no impact on new products sales. Project funding has a negative impact on invention patents, by contrast, tax break has a positive impact on invention patents. The interaction term of project funding and tax break has an invert U-shaped relationship with new products sales, but it has no impact on invention patent.

TD61

61-Room 111B, CC

Environmentally Responsible Operations Management

Sponsor: ENRE – Environment I – Environment and Sustainability
Sponsored Session

Chair: Arda Yenipazarli, Assistant Professor of Operations Management,
Georgia Southern University, COBA 2224, Statesboro, GA, 30460,
United States of America, ayenipazarli@georgiasouthern.edu

1 - Competitive Positioning and Pricing of Green Products with Multiple Environmental Attributes

Arda Yenipazarli, Assistant Professor of Operations Management,
Georgia Southern University, COBA 2224, Statesboro, GA, 30460,
United States of America, ayenipazarli@georgiasouthern.edu

To address consumers' sustainability-related product concerns, a thorough approach to improving the environmental profile of one's products is required. Using one dimension of green may hide possible trade-offs and overlook the fact that consumers' preferences exhibit different orders in different green attributes. We study a duopoly model that explicitly incorporates multiple environmental attributes into the green product positioning and pricing, along with the trade-offs among them.

2 - Product Line Design: The Impact of Consumers' Varied Perceptions of Recycled Content

Monire Jalili, University of Oregon, 1208 University of Oregon,
Eugene, OR, United States of America, mjalili@uoregon.edu,
Nagesh Murthy, Tolga Aydinliyim

We consider a monopolist selling ordinary and green product versions to consumers whose differential (dis)utility vary by consumer type, and is a function of the firm's quality decision (i.e., the amount of recycled content in the green version.) We discuss how the optimal quality and pricing decisions drive demand and profit and whether/when it is optimal for the firm to only offer the green version (go completely green).

3 - Replenishment Decisions of Perishable Products under Price and Emissions Sensitive Demand

Gokce Palak, Assistant Professor Of Operations Management,
Shenandoah University, Harry F. Byrd, Jr. School of Business,
Winchester, VA, 22601, United States of America, gpalak@su.edu

We extend economic lot sizing models for age dependent perishable products to maximize profit and minimize emissions. This model captures the tradeoffs between supplier and mode selection decisions, profits and emissions, and transportation lead time and remaining shelf life of products. We analyze impacts of price and emissions sensitive demand on the replenishment decisions.

4 - Maximizing Sustainability of Ecosystem Model through Socio-economic Policies

Urmila Diwekar, President, Vishwamitra Research Institute, 2714
Crystal Way, Crystal Lake, IL, 60012, United States of America,
urmila@vri-custom.org, Kirti Yenkie, Rohan Doshi,
Pahola Benevades, Heriberto Cabezas

Current practices in natural resources consumption are unsustainable and may eventually lead to ecosystem extinction. This paper uses a simple mathematical model of an integrated ecological and economic system representing our planet's sectors. The aim of the project is to maximize the sustainability of this system, using Fisher Information as a measure of sustainability, and derive socio-economic policies using multivariable optimal control techniques.

TD62

62-Room 112A, CC

Optimization on Power Grid Application

Cluster: Energy Systems: Design, Operation, Reliability
and Maintenance

Invited Session

Chair: Chaoyue Zhao, Oklahoma State University, 322G Engineering
North, Stillwater, OK, United States of America,
chaoyue.zhao@okstate.edu

1 - Risk-based Admissibility Assessment of Wind Generation Integrated into a Bulk Power System

Cheng Wang, Tsinghua University, 3-211, West Main Building,
Beijing, China, shlwangcheng2008@163.com, Feng Liu, Wei Wei,
Jianhui Wang, Shengwei Mei

In this talk, a risk-based admissibility assessment approach is proposed to quantitatively evaluate how much wind generation can be accommodated by the bulk power system under a given UC strategy. Firstly, the operational risk brought by wind generation is developed as an admissibility measure. Then a risk-minimization model is established to mathematically characterize the admissible region. Simulations demonstrate the effectiveness and efficiency of the proposed methodology.

2 - Strong Formulations for Unit Commitment Problem

Kai Pan, PhD Student, University of Florida, 411 Weil Hall,
Gainesville, FL, 32608, United States of America, kpan@ufl.edu,
Yongpei Guan

In this talk, we will present the strong formulations for unit commitment problem under different settings. Technical proofs are provided accordingly. Our computational experiments verify the effectiveness of proposed strong formulations.

3 - A Scalable Decomposition Method for the Two-Stage Stochastic Unit Commitment Problem

Farzad Yousefian, Postdoctoral Research Associate, Penn State,
333 Logan Ave., Apt. 307, State College, PA, 16801, United States
of America, szy5@psu.edu, Wendian Wan, Uday Shanbhag

We consider a two-stage stochastic unit commitment problem modeled as a large-scale mixed integer nonlinear optimization problem. The state-of-the-art commercial packages, e.g. CPLEX, do not scale with the number of the units and scenarios. Motivated by the structure of the KKT system and employing the ideas of Schur complements, we propose a multiphase primal-dual algorithm that scales with the size of the scenarios. Preliminary simulation results are presents.

TD63

63-Room 112B, CC

Operations Management II

Contributed Session

Chair: Xiaoyan Qian, PhD, The University of Auckland, 486 Parnell
Road, Auckland, New Zealand, x.qian@auckland.ac.nz

1 - Flexible Commitment Contract in the Presence of Goodwill-sensitive Customers

Xiaoya Han, University of Science and Technology of China,
No. 96, Jinchai Road, Hefei, China, xyhan@mail.ustc.edu.cn,
Yugang Yu

This paper focuses on a retailer's dynamic decision problem: how to determine a minimum commitment at the beginning of the planning horizon and periodically variable order quantities to maximize its profit when facing goodwill-sensitive customers. We obtain that the next-period goodwill decreases in the current-period one, and the goodwill monotonically converges to a constant steady-state one over time. Moreover, we find that the steady-state goodwill may decrease in minimum commitment.

2 - Flexible Capacity Management with Advanced Information

Julian Kurz, Chair of Logistics and Quantitative Methods in Business Administration, University of Wuerzburg, Stephanstrasse 1, Wuerzburg, 97070, Germany, julian.kurz1@uni-wuerzburg.de

We consider a maintenance service provider that overhauls technical equipment for customers in a central facility. A flexible capacity control policy is developed such that capacity costs and queue length-related holding costs are minimized. We investigate three operating modes, each taking into account a different amount of information (reactive/single-/multi-stage proactive modes). In the proactive modes, advanced information regarding future jobs is utilized.

3 - How to Take Advantage of Crowdsourcing to Collect New Ideas about Product Innovation?

Wanjiang Deng, Huazhong University of Science and Technology, School of Management, Luoyu Road 1037, Hongshan District, Wuhan, 430074, China, dengwj01@foxmail.com, Shihua Ma

Crowdsourcing is gaining more and more attention in both practice and research field. We stand on the position of the company who is going to propose a task about product innovation on one online crowdsourcing platform, and investigate its best strategies of both choice of platform and reward setting. We derive solutions of the base model and then extend it to some detail aspects. Finally, we discuss the managerial insights of our research.

4 - A Heuristic for Hospital Operating Theatre Scheduling under Uncertainty

Milad Zafar Nezhad, Wayne State University, Industrial and Systems Engineering Dep, Detroit, MI, 48202, United States of America, fq3963@wayne.edu, Hossein Badri, Kai Yang

Resource planning is one of the most important issues in healthcare operating management. In this research a heuristic solution algorithm based on the shifting bottleneck method is developed for hospital operating theatre scheduling when some parameters are not deterministic. The developed algorithm is applied on several instances to evaluate its applicability and performance.

5 - Contractual Coordination of Agricultural Cooperatives with Quality Specifications

Xiaoyan Qian, PhD, The University of Auckland, 486 Parnell Road, Auckland, New Zealand, x.qian@auckland.ac.nz

This talk examines how agricultural cooperatives can motivate farmers' effort when the market price depends on the quantity of high quality produce. We assume that a quality premium is offered to farmers and that their pay-outs are made progressively. We propose a two-stage stochastic model. The main findings are conditions for when the supply chain can be coordinated, that effort is motivated by the quality requirement, and that the progressive payment is needed for coordination.

TD64

64-Room 113A, CC

Optimization and Utility Theory

Sponsor: Decision Analysis

Sponsored Session

Chair: Hiba Baroud, Vanderbilt University, 400 24th Avenue South, Nashville, TN, 37205, United States of America, hiba.baroud@vanderbilt.edu

1 - A Multi-criteria Decision Analysis Approach for Importance Ranking of Network Components

Yasser Almoghathawi, PhD Candidate, University of Oklahoma, 202 W Boyd St., Norman, OK, 73019, United States of America, moghathawi@ou.edu, Kash Barker

Analyzing network vulnerability is a key element of network planning and preparing for a disruptive event that might impact the performance of the network. Many importance measures have been proposed to identify and rank the important components in a network to focus on preparedness efforts. We integrate a number of flow-based importance measures with a multi-criteria decision analysis technique, TOPSIS, highlighting how different weighting schemes can lead to different rankings.

2 - Modeling Uncertainty in Risk-preference Elicitation

Dharmashankar Subramanian, Research Staff Member, IBM Research, 1101 Kitchawan Rd, Rte 134, Yorktown Heights, NY, 10598, United States of America, dharmash@us.ibm.com, Debarun Bhattacharjya, Mengyang Gu

Utility functions are used to model a decision-maker's risk-preferences. However, interactive elicitation of a precise utility function is fraught with many practical challenges such as noise, inconsistency and bias in the responses to questions. In this work, we provide a flexible model along with Bayesian analysis to calibrate random utility functions and to quantify different sources of uncertainty. We present both theoretical and numerical results.

3 - Modeling Reference Dependence using One-switch Independence

David Vairo, Virginia Commonwealth University, 2415 Krossridge Road, N. Chesterfield, VA, 23236, United States of America, vairodl@vcu.edu, Jason Merrick

We present an application of multi-attribute one-switch independence to single attribute gambles by modeling chance as an attribute, which models reference dependence and shows it is equivalent to one-switch independence. The resulting form obeys stochastic dominance while incorporating probabilistic sensitivity, utility curvature, reference dependence, and loss aversion. The approach connects single-attribute behavioral and multi-attribute prescriptive decision analysis.

4 - Multiobjective Network Resilience Model with Parallel Component Recovery

Nazanin Morshedlou, PhD Student, University of Oklahoma, 202 W. Boyd St., Room 424, Norman, OK, 73071, United States of America, nazanin.morshedlou@ou.edu, Kash Barker

This work introduces a multiobjective formulation that trades off investments to enhance network resilience in the form of (i) strengthening link capacity following a disruptive event to decrease vulnerability, and (ii) introducing "parallel component at a time" recovery scheduling to improve recoverability. Given the uncertainty associated with critical infrastructures, robust interval optimization is used to solve the multiobjective formulation

TD65

65-Room 113B, CC

Near Miss and Threshold Events and Their Influence on Risk Perception and Behavior

Sponsor: Decision Analysis

Sponsored Session

Chair: Florian Federspiel, IE Business School, Maria de Molina 12, Bajo, Madrid, 28006, Spain, ffederspiel.phd2014@student.ie.edu

1 - Conceptualizing Perceptions of Near Misses

Richard John, Associate Professor, University of Southern California, 3620 McClintock Ave., Dept. of Psychology, MC-1061, Los Angeles, CA, 90266-1061, United States of America, richardj@usc.edu, Jinshu Cui, Heather Rosoff

I will present a dynamic probabilistic model for describing and defining near miss events. The model is useful for highlighting characteristics of a near miss that determine the extent to which the event is perceived as a near miss. Measurement of individual differences in perceptions of near misses will also be discussed.

2 - Small Near-Misses: Too Weak of a Warning Signal

Robin Dillon-Merrill, McDonough School of Business, Georgetown University, Washington, DC, 20057, United States of America, rld9@georgetown.edu

This research demonstrates that individuals too often evaluate near-misses as successful events even when it was fortunate chance that prevented the same event from resulting in a failed outcome. These weak signals of problems are then overlooked as the warnings they could potentially be. This problem is exacerbated as small near-misses accumulate over time, and decision makers increasing accept more risk.

3 - Learning from Threshold Events

Wenjie Tang, IE Business School, Calle de Maria de Molina 12, Piso 5, Madrid, MA, 28006, Spain, Wenjie.Tang@ie.edu, Steffen Keck, Matthias Seifert

Threshold events are events that are triggered when an observable underlying random variable passes a known threshold. We suggest that when individuals learn from past threshold events, their judgments depend strongly on whether the realization of the underlying variable triggers the threshold event; the extent to which the realization has been close to the threshold will be discounted. Results from a laboratory experiment support our main hypothesis.

4 - The Experience of Near Miss Events under Ambiguity

Florian Federspiel, IE Business School, Maria de Molina 12, Bajo, Madrid, 28006, Spain, ffederspiel.phd2014@student.ie.edu, Matthias Seifert

Near miss events are often clouded in ambiguity, allowing for hubris and misattribution of what caused success or prevented failure. We investigate the experience of near miss events, probabilistic events nearly resulting in loss outcomes that do not materialize due to chance circumstances, and related changes in risk perception and behavior under both ambiguity and unawareness. We find that the near miss effect (an increase in risk taking behavior) principally occurs under ambiguity.

■ TD66

66-Room 113C, CC

Air Cargo

Sponsor: Aviation Applications

Sponsored Session

Chair: Jose Quesada, Université Catholique de Louvain, Chaussée de Binche, 151, Mons, 7000, Belgium, jose.quesada@uclouvain-mons.be

1 - An Economic Analysis of the Air Cargo Problems in an Integrated Supply Chain

Kwon Gi Mun, PhD Candidate, Rutgers University, SCM, Rutgers Business School, 1 Washington Park, Newark, NJ, 07102, United States of America, kwongimun@gmail.com, Yoondong Jung, Yao Zhao, Endre Boros, Arim Park

In this model, we demonstrate an integrated forecasting approach to coordinate ground and air transportation for a Korean air cargo company. Therefore, we present expected benefits of this integrated approach compared to current practice.

2 - A Multi-Stage Air Service Network Design Problem for an Express Carrier

Yusuf Secerdin, University of Miami, 1251 Memorial Drive, Department of Industrial Engineering, Coral Gables, FL, 33146, United States of America, yusufsecerdin@miami.edu, Murat Erkoc

We study the air service network configuration problem for a global express carrier. We propose a multi-stage modeling framework for the company's Central and South America region by incorporating multiple service types in terms of time commitments for the air network. The proposed approach consists of three phases in which we formulate a hub location problem, generate feasible pick-up and delivery routes and formulate the service network design problem using the composite variable formulation.

3 - An Adaptive Search Network for the Pickup and Delivery Problem with Time Windows

Ferdinand Kiermaier, TU Munich, Arcisstr. 21, Munich, Germany, ferdi.kiermaier@googlemail.com, Jonathan Bard, Markus M. Frey

We present an innovative "out-of-the-box" algorithmic framework coupling existing heuristics with a learning-based network structure applicable to many variants of the Pick-Up and Delivery Problem with Time-Windows (PDPWTW) and, thus, for the Vehicle Routing Problem with Time-Windows. We show an application to a real-world airport baggage and cargo transportation problem and prove the effectiveness of our new approach by a comparison with state-of-the-art solution algorithms for the PDPWTW.

4 - Express Air Network Design with Multi-Hub Flexible Connections

Jose Quesada, Université Catholique de Louvain, Chaussée de Binche, 151, Mons, 7000, Belgium, jose.quesada@uclouvain-mons.be, Jean-sébastien Tancrez, Jean-charles Lange

We present a model for the Air Network Design for the next day delivery within an Express company. Most of the existing models rely on a pre-definition of connections for each commodity through a specific hub. We present a model in which we integrate the decision of connectivity simultaneously with the network design. When two hubs are so close from each other that they can serve (almost) the same nodes, the results show that savings can be obtained by taking both decisions at the same time.

■ TD67

67-Room 201A, CC

Topics in Transport I

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Zahra Mokhtari, Oregon State University, Corvallis, OR, United States of America, mokhtarz@onid.oregonstate.edu

1 - A Hybrid Heuristic Method for the Compressed Natural Gas Truck Routing Problem with Fueling Stations

Yihuan (Ethan) Shao, University of Southern California, Los Angeles, CA, United States of America, yihuansh@usc.edu, Maged Dessouky

We introduce the Compressed Natural Gas Truck Routing Problem with Fueling Stations to model decisions to be made with regards to the vehicle routes including the choice of fueling stations. A hybrid heuristic method is proposed, which combines an Adaptive Large Neighborhood Search (ALNS) with a mixed integer program. By solving a set of benchmark instances, we show the effectiveness of the method. We also conduct experiments based on the data from the Ports of Los Angeles and Long Beach.

2 - Designing a Biorefinery Supply Chain: a Real Case in Navarre (Spain)

Adrian Serrano, Public University of Navarra, Pamplona Spain, adrian.serrano@unavarra.es, Javier Beloso, Javier Faulin, Alejandro G. del Valle

New alternative energy sources are spreading around the world to reduce greenhouse gas emissions and oil dependence. Our paper proposes a procedure to manage a biorefinery supply chain in Navarre (Spain) which involves, among others, which farms are going to be harvested, when they are going to be collected, and the storage levels. Moreover, a Facility Location Problem is solved inside a MILP model. Promising results are obtained at both levels: strategic (location) and operational (SCM).

3 - Train Dispatching Problem under Exact Travel Time Estimation for a Double Track Rail System

Lance Fu, University of Southern California, Los Angeles, CA, United States of America, luncfu@usc.edu, Maged Dessouky

We consider the problem of dispatching trains through double track railway system, where track segments have different speed limits. We take the train's dynamics into consideration, which differentiates our model from the previous literature. The objective is to minimize the traveling time under no-deadlock and no-collision constraints. We give a mixed integer programming (MIP) formulation for the train dispatching problem. Also we provide certain conditions which can ensure that there exists an optimal integer solution to relaxation of the MIP. A local search based heuristic is also proposed to solve the problem. Simulation on the railway system in Los Angeles County is conducted to verify the efficiency of the proposed algorithms.

4 - A Stochastic Programming Approach for Truckload Relay Network Design under Demand Uncertainty

Zahra Mokhtari, Oregon State University, Corvallis, OR, United States of America, mokhtarz@onid.oregonstate.edu, Hector A. Vergara

This study addresses the problem of strategic relay network design for truckload transportation under demand uncertainty and proposes a stochastic programming model and solution algorithm. The solution methodology uses Sample Average Approximation (SAA) to address a very large number of scenarios of demand realization. The examined number of scenarios determines the trade-off between optimality of the solutions obtained for the stochastic programming model and its computational complexity. Numerical results on a set of instances of this problem are presented along with areas for future research.

■ TD68

68-Room 201B, CC

Resilience in Electricity Infrastructure Systems

Sponsor: Transportation, Science and Logistics

Sponsored Session

Chair: Yong Fu, Associate Professor, Mississippi State University, Starkville, MS, United States of America, fu@ece.msstate.edu

1 - Microgrids for Enhancing the Power System Resilience, Reliability, & Economics

Mohammad Shahidehpour, Professor, IIT, 10 West 35th Street, Suite 1600, Chicago, IL, 60616, United States of America, ms@iit.edu

Microgrids form the building blocks of perfect power systems which promote the use of real-time pricing and demand response for optimizing the distributed control of electric power systems. This presentation will highlight some of the key issues in the design and the operation of microgrids and discuss the role of recent innovations and, in particular, the significance of smart grid applications to power system operations and control.

2 - Mitigating Cascading Outages under Severe Weather using Simulation-based Optimization

Jianhui Wang, Argonne National Laboratory, 9700 South Cass Avenue, Building 221, Argonne, IL, 60439, United States of America, jianhui.wang@anl.gov, Feng Qiu, Jie Xu

In this work, we investigate cascading outage mitigation under severe weather conditions. Since the cost function, expected cascading outage costs, cannot be expressed as an explicit function of protection actions and system status, we develop a power system security simulator to estimate the cascading outage costs of given mitigation actions and use a simulation-based optimization approach.

3 - A Decentralized Decision Making System to Enable Resilient Microgrid Clusters

Yong Fu, Associate Professor, Mississippi State University,
Starkville, MS, United States of America, fu@ece.msstate.edu

Microgrid has been proposed to ensure resilience in power systems. The microgrid can treat connected neighboring microgrids as local energy buffers thus freely forming a cluster to share, exchange, and aggregate site-generated energy. This research proposes a decentralized decision making system to improve the microgrid clusters' resilience capability to power disturbances and extreme events, consequently minimizing down-time for both consumers and the grid.

TD69

69-Room 201C, CC

Connected and Autonomous Vehicles I

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Yong Hoon Kim, Purdue University, United States of America,
kim523@purdue.edu

1 - Multi-agent Based Formation Control of Connected Autonomous Vehicles

Yongfu Li, Chongqing University of Posts and
Telecommunications, Chongqing, China, laf1212@163.com,
Kezhi Li, Li Zhang, Srinivas Peeta, Xiaozheng He, Hong Zheng,
Taixiong Zheng

This study seeks to improve network throughput and reduce energy consumption under V2V communications environment through formation control. A multi-agent systems based formation control is proposed using consensus theory. We analyze the formation of autonomous vehicles in longitudinal and lateral gaps simultaneously. Numerical experiments illustrate the effectiveness of the proposed method in terms of position and velocity consensus.

2 - Macroscopic Modeling of the Spatial-temporal Information Flow Propagation Waves under Vehicle-to-Vehicle Communications

Yong Hoon Kim, Purdue University, West Lafayette, IN,
United States of America, kim523@purdue.edu, Srinivas Peeta,
Xiaozheng He

This study proposes an integrated model consisting of integro-differential equations to describe the information flow propagation process and a partial differential equation to describe the traffic flow dynamics. It incorporates the success rate of communication with distance and interference as a probability density function, and provide a closed-form solution for the speed of the information propagation wave. Numerical experiments are conducted to analyze the performance of the proposed model.

3 - Vehicle Trajectory Reconstruction under the Mixed Connected Vehicle Environment

Feng Zhu, Purdue University, West Lafayette, IN,
United States of America, zhu214@purdue.edu,
Satish V. Ukkusuri

This paper sets out to reconstruct the trajectory of non-connected vehicles based on the trajectory of connected vehicles only. The trajectory reconstruction problem is formulated in the linear state-space modeling (SSM) framework, where the state dynamics is captured by the simplified car following model. Next a modified EM (Expectation-Maximization) algorithm is developed to obtain the optimal estimation of the unknown trajectory and model parameters simultaneously. The performance of the EM algorithm is tested and validated through the simulation data.

4 - A Mathematical Model to Locate Optimal Lane Changing Zone at a Highway Off-ramp

Siyuan Gong, Illinois Institute of Technology, Chicago, IL,
United States of America, sgong1@hawk.iit.edu, Lili Du

This research seeks to locate an optimal temporal-spatial lane change zone around a highway off-ramp. This zone will grant enough opportunities for vehicles to proposed and validated by simulation experiments so that the resulted time delay can be minimized. A mathematical model combining traffic flow analysis is conduct smooth lane change maneuvers before an off ramp

TD70

70-Room 202A, CC

Tutorial: Railroad Predictive Analytics

Sponsor: Railway Applications

Sponsored Session

Chair: Aihong Wen, CSX, 500 Water St, Jacksonville, FL, 32202,
United States of America, aihong_wen@csx.com

1 - Railroad Data Mining Tutorial

Aihong Wen, CSX, 500 Water St, Jacksonville, FL, 32202,
United States of America, aihong_wen@csx.com, Jerry Kam

We will share the business use cases and modeling experiences in applying data mining and big data techniques to railroad.

TD71

71-Room 202B, CC

Transportation Planning II

Contributed Session

Chair: Hadi Farhangi, Research Assistant, Missouri University of
Science and Technology, 1870 Miner Cir, Rolla, MO, 65401,
United States of America, hfrhc@mst.edu

1 - NHTSA Cafe Compliance Cost Optimization

Yohan Shim, Sr. Analyst, AVL Scenaria Inc, 47603 Halyard Drive,
Plymouth, MI, 48170, United States of America,
yohan.shim@scenaria.com, Travis Tamez, Christopher Molloy,
Frederic Jacquelin

The United States National Highway Traffic Safety Administration (NHTSA) has issued in August 2012 final rules and regulations for Corporate Average Fuel Economy (CAFE) for model years 2017 and beyond. NHTSA sets national CAFE standards under the Energy Policy and Conservation Act to improve fuel economy for passenger cars and light trucks. We present a mathematical program model and efficient heuristics to support vehicle manufacturer's long-term strategic decisions on CAFE credit utilization.

2 - Highway Cost Allocation for Vehicle Classes with Variable Traffic Capacity Requirements

Saurav Kumar Dubey, PhD Student, Department Of Industrial
And Systems Engineering, University of Tennessee at Knoxville,
1615 Laurel Avenue, Knoxville, TN, 37916, United States of
America, skumardu@vols.utk.edu, Alberto Garcia-Diaz

A Highway Cost Allocation model with variable traffic capacity levels is developed to distribute costs among vehicle classes. The discrete Aumann-Shapley value is used to generate costs for all coalitions in the least core model. Rules for tie breaking to get a unique allocation known as the nucleolus are discussed.

3 - Competition and Regulation of the Taxi Market with Ride-sourcing Platforms

Liteng Zha, University of Florida, 365 Weil Hall, Gainesville, FL,
32611, United States of America, seuzha@gmail.com, Yafeng Yin

Ride-sourcing platforms such as Uber and Lyft are eroding the traditional taxi market. Despite of their attractiveness, controversies arise over the legality and reliability of their services as well as the fairness of the competition to regular taxis. This study offers a quantitative investigation of the taxi market with ride-sourcing platforms and investigates its regulation strategies.

4 - Biobjective Efficient Driving of Electric Vehicles on an Edge of a Network

Hadi Farhangi, Research Assistant, Missouri University of Science
and Technology, 1870 Miner Cir, Rolla, MO, 65401, United States
of America, hfrhc@mst.edu, Dincer Konur, Warren Vaz,
Umit Koylu

This study analyzes driving profile for an electric vehicle between two nodes, i.e., on an edge of a network. We consider acceleration, maximum speed, and deceleration as decision variables. The energy consumed and the travel time required are functions of these variables as well as the load carried and the distance traveled. We investigate the energy and time minimizing driving profiles through a bi-objective optimization approach.

■ TD72

72-Room 203A, CC

Design and Analysis of Data with Complex Structure

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Xinwei Deng, Assistant Professor, Department of Statistics, Virginia Tech, 211 Hutcheson Hall, Blacksburg, VA, United States of America, xdeng@vt.edu

Co-Chair: Ran Jin, Virginia Tech., Grado Department of Industrial and Systems Engineering, Blacksburg, VA, 24061, United States of America, jran5@vt.edu

1 - Markov Switching Autoregressive Models with Applications in Cell Biology

Ying Hung, Rutgers University, Piscataway, NJ, United States of America, yhung@stat.rutgers.edu

We will introduce a new framework based on Markov switching autoregressive models for the analysis of experiments in cell biology.

2 - Sparse Particle Filtering

Yun Chen, University of South Florida, 4202 E. Fowler Ave. ENB118, Tampa, FL, United States of America, yunchen@mail.usf.edu, Hui Yang

Wireless sensor network has emerged as a key technology for monitoring space-time dynamics of complex systems. Distributed sensing gives rise to spatially-temporally big data. Realizing the full potentials of distributed sensing calls upon the development of space-time modeling of measured signals in dynamically-evolving physical environment. This paper will present a new approach of sparse particle filtering to model spatiotemporal dynamics of big data in distributed sensor network.

3 - Graphical Modeling with Functional Variables

Ran Jin, Virginia Tech., Grado Department of Industrial and Systems Engineering, Blacksburg, VA, 24061, United States of America, jran5@vt.edu, Hongyue Sun, Shuai Huang

Graphical models are widely used to model variable relationship. Traditional graphical models are mainly used to model scalar variables. In this paper, a graphical model with functional variables is proposed. Functional regression models, combined with sparsity-inducing norms, are applied for the graphical modeling. A case study and simulation will be used to evaluate the proposed method.

4 - Optimal Design of Experiments for Generalized Linear Models

Abhyuday Mandal, University of Georgia, Department of Statistics, 101 Cedar Street, Athens, GA, 30602-7952, United States of America, amandal@stat.uga.edu, Liping Tong, Jie Yang, Dibyen Majumdar

Generalized linear models have been used widely for modeling the mean response both for discrete and continuous random variables with an emphasis on categorical response. Here we find efficient designs in the context of several optimality criteria, namely D-optimality, EW-optimality and Bayesian optimality. Regular fractional factorials with uniform replications are often used in practice. We show that these popular designs are often not optimal for binomial, Poisson and multinomial cases.

■ TD73

73-Room 203B, CC

Recent Advances in Analyzing Experiments

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Rong Pan, Associate Professor, Arizona State University, P.O. Box 878809, Tempe, AZ, United States of America, rong.pan@asu.edu

1 - Performance of Standard Mixture Designs in Modeling Ordinal Responses

Mickey Mancenido, Arizona State University, 699 S. Mill Ave., Tempe, AZ, United States of America, mmanceni@asu.edu, Douglas Montgomery, Rong Pan

Mixture designs for the proportional odds model — the widely used model for ordinal data — are lacking in literature. A viable surrogate are the standard mixture designs for linear models with normal errors. We are interested in the performance of the simplex-lattice with axial runs, simplex-centroid, computer-generated I-optimal, and the uniform space-filling designs when used in a mixture study with an ordinal response.

2 - Generating and Comparing Pareto Fronts of Experiment Designs to Account for Multiple Objectives

Byran Smucker, Assistant Professor, Miami University, 100 Bishop Circle, 311 Upham Hall, Oxford, OH, 45056, United States of America, smuckerb@miamiOH.edu, Yongtao Cao, Tim Robinson

In many design scenarios the experimenter entertains multiple, conflicting objectives. The Pareto approach to experiment design is to construct a set of designs while explicitly considering trade-offs between criteria. The true Pareto front is not known, which creates problems in assessing front quality, and existing algorithms are inefficient, ineffective, or both. Here, we introduce an improved measure of front assessment, and present a new algorithm to generate Pareto fronts of designs.

3 - Cost Constrained ALT with Exponentially Changing Stress Durations

David Han, University of Texas, One UTSA Circle, San Antonio, TX, United States of America, David.Han@utsa.edu

When designing ALT, several variables such as the allocation proportions and stress durations must be determined carefully because of constrained resources. This talk discusses the optimal decision variables based on the popular optimality criteria under the constraint that the total cost does not exceed a pre-specified budget. A general scale family of distributions is considered to accommodate different lifetime models for flexible modeling with exponentially decreasing stress durations.

4 - Integration of Computer and Physical Experiments for Improving Predictive Inference

Arda Vanli, Associate Professor, Florida State University, Tallahassee, FL, avanli@fsu.edu, Spandan Mishra

A Bayesian predictive approach is developed to combine data from designed experiments on physical process and computer predictions. Predictive distribution of a regression model is used for inference on the outcome variable and issues including predictive capability, model adequacy and sensitivity to prior specifications are discussed. Applications from structural loss prediction and quality control are presented for illustrations.

■ TD74

74-Room 204A, CC

Bayesian Applications in Industrial Statistics

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Refik Soyer, The George Washington University, 2201 G St NW, Washington, DC, United States of America, soyer@gwu.edu

1 - What do Coin Tosses, Vessel Traffic Risk Assessment and Return Time Uncertainty Have in Common?

Johan Rene Van Dorp, Professor, The George Washington University, 800 22nd Street NW, Suite 2800, Washington, DC, United States of America, dorpr@gwu.edu, Jason Merrick

Via a coin toss argument we will advocate decision making under uncertainty in vessel traffic risk assessment to be informed by relative risk comparisons by highlighting the analogy of an accident potentially occurring in a traffic situation with the toss of a biased coin. That same analogy is next used to demonstrate the large uncertainty bands that result for average return times of accidents in this context.

2 - Integrating Expert Judgement and Bayesian Analysis

Thomas A. Mazzuchi, Professor And Chairman, George Washington University, Washington DC, DC, 20052, United States of America, mazzu@gwu.edu

There is a growing need for marrying the fields of expert judgement and Bayesian Analysis that is, using the Expert Judgement approach to define prior distributions and for understanding the effects of the elicitation, codification and combination on the prior distribution and subsequent posterior analysis. This paper presents an investigation of the above for a simple model using the Classical Model for Expert Judgment by Cooke (2001).

3 - An Augmented Simulation Approach for Bayesian Design of Life Tests

Refik Soyer, The George Washington University, 2201 G St. NW, Washington, DC, United States of America, soyer@gwu.edu

In this talk we consider a Bayesian decision theoretic setup for optimal design of life tests. More specifically, we consider use of augmented probability simulation with a conjugate class of utility functions for design of life tests. We illustrate the implementation of the approach in one and two stage designs.

4 - Bayesian Updating of Dirichlet Process Prior via Kernel Estimate

Ehsan Soofi, University of Wisconsin, Lubar School of Business,
Milwaukee, WI, United States of America, esoofi@uwm.edu,
Neshat Beheshti, Jeffrey Racine

The standard nonparametric Bayesian approach uses multinomial proportions to update the Dirichlet Process Prior (DPP). We use kernel-smoothed CDF instead of the multinomial proportions for updating DPP. Applications include Bayesian measures and inferences for distributional fit and for dependence of random variables via the information measure of copula. The posterior mean of the quantized entropy provides a Bayes estimate of the dependence.

TD75

75-Room 204B, CC

IBM Research Best Student Paper Award IV

Sponsor: Service Science

Sponsored Session

Chair: Ming-Hui Huang, National Taiwan University, Taiwan - ROC,
huangmh@ntu.edu.tw

1 - Best Student Paper Competitive Presentation

Ming-Hui Huang, National Taiwan University, Taiwan - ROC,
huangmh@ntu.edu.tw

Finalists of the IBM Research Best Student Paper Award present their research findings in front of a panel of judges. The judging panel will decide the order of winners, which will be announced during the business meeting of the Service Science Section at the Annual Conference.

2 - Can Objective Early Warning Scores and Subjective Risk Assessments Predict Patient's Hospital Length of Stay and Mortality?

Nasibeh Azadeh-Fard, PhD Candidate, Virginia Tech,
544 Whittemore Hall, Virginia Tech, Blacksburg VA 24061,
United States of America, nasibeh@vt.edu, Jaime Camelio, Navid Ghaffarzadegan

This paper presents a dynamic simulation model of patient's health outcome and length of stay based on initial health risk and physician's assessment of risk. Simulation results are empirically supported by analyzing a detailed dataset of 1,031 patients admitted to a large southeastern hospital in US.

3 - Dynamic Personalized Monitoring and Treatment Control of Glaucoma

Pooyan Kazemian, PhD Candidate, University of Michigan-Ann Arbor, 1205 Beal Ave., Ann Arbor MI 48105, United States of America, pooyan@umich.edu, Jonathan Helm, Mariel Lavieri, Joshua Stein, Mark Van Oyen,

We develop an innovative modeling framework for chronic disease patients to help guide clinicians to quickly detect disease progression and adjust the treatment plan over time to limit disease progression. The model is able to (1) optimize the time interval between sequential monitoring tests; (2) specify the best set of tests to take during each patient's office visit; and (3) provide target values for the controllable disease risk factors. Glaucoma is discussed as a case study.

4 - Evaluating Consumer m-Health Services for Promoting Healthy Eating: A Randomized Field Experiment

Yi-Chin Lin, CMU, 5000 Forbes Avenue, Pittsburgh PA 15213,
United States of America, yichinl@cmu.edu, Vibanshu Abhishek,
Julie Downs, Rema Padman

Mobile apps have great potential to provide promising services to improve consumers' engagement and behaviors. Focusing on healthy eating, this study shows that an image-based professional support greatly improves consumer engagement and eating behaviors, while social media and a heuristic approach of self-management might have negative effects in some occasions.

5 - Dynamic Matching in a Two-Sided Market

Yun Zhou, University of Toronto, 105 St. George Street, Toronto,
ON, Canada, Yun.Zhou13@Rotman.Utoronto.ca, Ming Hu

A two-sided market often shares a common structure that engages three parties: the supply side, the demand side and an intermediate firm facing intertemporal uncertainty on both supply/demand sides. We propose a general framework of dynamically matching supply with demand of heterogeneous types (with horizontally or vertically differentiated types as special cases) by the intermediary firm and explore the optimal and heuristic matching policies.

TD76

76-Room 204C, CC

Rare Event Simulation and Network Applications

Sponsor: Simulation

Sponsored Session

Chair: John Shortle, George Mason University, 4400 University Dr.,
MSN 4A6, Fairfax, VA, United States of America, jshortle@gmu.edu

1 - Rare-event Simulation for Queues with Time-varying Arrivals

Ni Ma, Columbia University, 500 West 120th Street, Room 345,
New York, NY, 10027, United States of America,
nm2692@columbia.edu, Ward Whitt

We show that the exponential tilting approach for rare-event simulation in the GI/G/1 queue can also be applied to efficiently estimate the time-varying periodic-steady-state probability of large delays in a Mt/GI/1 single-server queue with periodic arrival rate function.

2 - Green Simulation Designs for Repeated Experiments

Mingbin Feng, PhD Candidate, Northwestern University, 2145
Sheridan Rd, Rm C210, Evanston, IL, 60208, United States of
America, benfeng@u.northwestern.edu, Jeremy Staum

In many applications of simulation, such as in financial risk management, experiments are usually repeated with similar inputs. In these cases simulation outputs should be viewed as useful resource that should be recycled and reused to improve the efficiency of subsequent experiments. We consider a periodic credit risk evaluation problem in the KMV model and the numerical results show improving accuracy over time, measured by mean squared error, as more and more outputs are recycled.

3 - A General Golf Course Simulation Tool: Keeping Delays Down and throughput Up

Moonsoo Choi, Columbia University, Department of Industrial
Engineering, New York, NY, 10027, United States of America,
mc3983@columbia.edu, Qi Fu, Ward Whitt

We describe a simulation tool for designing and managing golf courses. Group play is represented by eighteen queues with precedence constraints, in series, where the primitives are the random group playing times on each stage of a hole. We characterize balanced courses and show the advantages over unbalanced courses.

4 - Rare-event Simulation for Vulnerability Analysis of Power Grids

John Shortle, George Mason University, 4400 University Dr.,
MSN 4A6, Fairfax, VA, United States of America,
jshortle@gmu.edu, Jie Xu, Chun-hung Chen

Vulnerability of a power grid can be evaluated by systematically considering failures of individual elements and estimating the likelihood of a large-scale blackout following these initial failures. This talk presents a method for identifying vulnerable links by using a low-fidelity model of the power system to guide simulation of a higher-fidelity model. Numerical examples using real power systems are given.

TD77

77-Room 300, CC

Supply Chain Optimization

Contributed Session

Chair: Robert Russell, Professor of Operations Management,
Univ. of Tulsa, 800 S Tucker Drive, College of Business, Tulsa, OK,
74104, United States of America, rrussell@utulsa.edu

1 - A Practical Application of Large-Scale Capacitated Facility Location

Uday Rao, Professor, OBAIS Department, College of Business,
University of Cincinnati, Cincinnati, OH, 45221, United States of
America, uday.rao@uc.edu, Amit Raturi, Maria Caridi

We study a large-scale capacitated facility location problem motivated by interaction with a company in the US Midwest. The problem has 1000 locations with demand seasonality, several facility types differing in capacity, fixed installation and variable operating costs, and transportation costs depending on transportation speed / mode selected. We present solution approaches using mathematical programming, clustering and quick heuristics. We test sensitivity to problem parameters.

2 - A Branch-and-Price Algorithm for Switchgrass Logistic Supply Chain Design

Maichel M. Aguayo Bustos, Virginia Tech, 250 Durham Hall, 1145 Perry Street, MC 0118, Blacksburg, VA, 24061, United States of America, maiguay@vt.edu, Subhash C. Sarin, John S. Cundiff

Given the locations of a bio-energy plant and storage facilities for a switchgrass-based bio-ethanol supply chain, we introduce a multi-period mixed integer programming model to determine both strategic and tactical decisions. A novel branch-and-price approach is used to obtain near-optimal solutions for large-sized problem instances. Results of its implementation to a case study are also presented.

3 - A Newsvendor Problem with Multiple, Capacitated Suppliers and Marginal Quantity Discounts

Roshanak Mohammadivojdan, PhD Student, University of Florida, 303 Weil Hall, P.O. Box 116595, Gainesville, FL, 32611, United States of America, rmohammadivojdan@ufl.edu, Joseph Geunes

We consider a newsvendor who may order stock from multiple, capacitated suppliers, each of which offers a marginal quantity discount pricing structure. The newsvendor seeks to minimize its total procurement plus expected overstock and understock costs, resulting in an objective function consisting of a sum of convex and concave terms. We provide an algorithmic approach that permits solving this non-convex problem in pseudopolynomial time by solving a set of 0-1 knapsack subproblems.

4 - An Integrated Model for Supplier Selection and Optimal Order Allocation Considering Uncertainty

Majid Hooshmandi Maher, Allameh Tabatabaie University, Faculty of Management & Accounting, Hemmat Exp, Tehran, Iran, majidhooshmand@gmail.com

This paper first presents an approach for supplier evaluation based on integrated multiple criteria decision making model and then proposes a mathematical model to optimize the order allocation in a supply chain considering uncertainty in different parameters. An Iranian automobile company is utilized as a case study. The mathematical model is solved by genetic algorithm and the performance of the model is verified using other optimization approaches.

5 - The Production Routing Problem with Vehicle Costs

Robert Russell, Professor of Operations Management, Univ. of Tulsa, 800 S Tucker Drive, College of Business, Tulsa, OK, 74104, United States of America, russell@utulsa.edu

This paper addresses the integration of production, inventory, distribution, and vehicle costs for supplying retail demand locations from a production facility. A mixed integer model is used to determine an approximate solution to the production routing problem with vehicle costs and a vehicle routing metaheuristic is used to sequence routes for each time period. Computational results are reported and compared to results from the traditional production routing problem.

■ TD78

78-Room 301, CC

Electricity Markets and Utilities

Contributed Session

Chair: Chung-Hsiao Wang, LG&E and KU, 102 Spruce Ln, Louisville, KY, United States of America, chunghsiao@hotmail.com

1 - Analysis of Consumer Behavior Towards Dynamic Residential Electricity Pricing

Prajwal Khadgi, PhD Candidate, University of Louisville, Speed School of Engineering, Louisville, KY, 40219, United States of America, p0khad01@louisville.edu, Lihui Bai

Variable electricity pricing for the control of residential load has attracted much interest in the field of demand response, and static variable pricing such as time of use rates has had successful applications in the US as an optional service. However, dynamic variable pricing remains an open question, due to lack of understanding on consumer behavior. We study consumer behavior against two dynamic rates, i.e., demand charge and load-following rates, using utility functions and simulation.

2 - A Dynamic Garch Model for Energy Portfolio Allocation in Electricity Markets

Reinaldo Garcia, Associate Professor, University of Brasilia - UnB, Faculty of Technology, Industrial Engineering Department, Brasilia, 70904-970, Brazil, rcgarcia@unb.br, Javier Contreras, Virginia González, Janiele E. S. C. Custodio

In the deregulated electricity markets, a Generation Company (Genco) has to optimally allocate their energy portfolio. Modern Portfolio Theory (MPT) allows a Genco to maximize their profit and decrease their associated risk. This paper proposes a model where MPT is combined with a Generalized Autoregressive Conditional Heteroskedastic (GARCH) prediction model for a Genco to optimally diversify their energy portfolio. The model is applied to the PJM electricity market showing its capabilities.

3 - Intraday Electricity Load Forecasting using Rule-based Model

Myung Suk Kim, Professor, Sogang University, #1 Shinsu-Dong, Mapo-Gu, Seoul, Korea, Republic of, myungkim@sogang.ac.kr

A rule-based model selection methodology incorporating a multiplicative seasonal autoregressive with exogenous variables (ARX) model and a support vector machine (SVM) is provided and applied to Korean hourly electricity load data. We set up a rule that determines which of the SVM and ARX models should be applied to forecasting a specific hour within a day. The proposed rule-based model selection methodology outperforms its benchmarks.

4 - Modeling Grid Operations in China's Partially-Restructured Electricity Market

Michael Davidson, Massachusetts Institute of Technology, 400 Main Street, E19-411, Cambridge, MA, 02139, United States of America, michd@mit.edu, Valerie Karplus, Ignacio Perez Arriaga

Long transitions of restructuring vertically-integrated electric utilities can affect interim market operations and assumptions underlying tools for policy assessment. We develop a mixed integer unit commitment model of China's northeast region with several legacy central planning mechanisms modeled as regulatory constraints and penalties. We analyze their influence on system operation, test tractability of formulations and validate with actual operational outcomes.

5 - Fuel Hedging Strategy for Electric Power Utilities

Chung-Hsiao Wang, LG&E and KU, 102 Spruce Ln, Louisville, KY, United States of America, chunghsiao@hotmail.com, Kyung Jo Min

In recent years, natural gas combined cycle power plants have started to replace aging and less efficient coal power plants. Because fuel costs represent the majority of total costs for an electric power utility, how to manage volume and price risks for coal and natural gas fuel is critically important. In this paper, we develop mathematical models for structured and analytical guidelines on fuel hedging strategies for a utility owning both types of generation units.

■ TD79

79-Room 302, CC

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - SAS - Building and Solving Optimization Models with SAS

Ed Hughes, Principal Product Manager, SAS, Rob Pratt, David Kraay

SAS provides a broad spectrum of data and analytic capabilities, including statistics, data and text mining, econometrics and forecasting, and operations research-optimization, simulation, and scheduling. OPTMODEL from SAS provides a powerful and intuitive algebraic optimization modeling language and unified support for building and solving LP, MILP, QP, NLP, CLP, and network-oriented models. We'll demonstrate OPTMODEL for basic and advanced problems, highlighting its newer capabilities and its support for both standard and customized solution approaches.

2 - Responsive Learning Technologies - Online Games to Teach Operations and Supply Chain Management

Sam Wood, President, Responsive Learning Technologies

Learn about online competitive exercises that are used in Operations Management courses and Supply Chain Management courses to teach topics like capacity management, lead time management, inventory control, supply chain design and logistics. These games are typically used as graded assignments

Wednesday, 8:00am - 9:30am

■ WA01

01-Room 301, Marriott

Acquisition and Logistics

Sponsor: Military Applications

Sponsored Session

Chair: Aaron Burciaga, Analytics Executive, INFORMS Analytics

Maturity Model, 4305 Majestic Ln, Fairfax, VA, 22033,

United States of America, adburiaga@gmail.com

1 - Planning Naval Aircraft Procurement, Enhancements, and Retirements Over 30 Years

Robert Dell, Professor And Chairman Of Operations Research,
Naval Postgraduate School, Code OR/De, Monterey, Ca, 93943,
United States of America, dell@nps.edu, Holly Zabinski,
Gerald Brown

This talk describes an integer linear program (ILP) developed to plan annual procurement of new United States Navy and Marine Corps aircraft, enhancements to aircraft, and retirement of aircraft over a 30-year horizon. ILP prescriptions must adhere to numerous annual and cumulative budget constraints, age requirements, and mission requirements. We present computational experience for realistic planning scenarios.

2 - An Optimization Approach to Integrated Requirements Development for Acquisition Programs

Alexander Dessanti, Sandia National Laboratories, P.O. Box 5800,
Albuquerque, NM, 87185-1188, United States of America,
adessan@sandia.gov

Requirements for defense acquisition programs have traditionally been developed in isolation with little regard for their interactive effects. Too often this results in program cancellation and billions of dollars wasted. This research seeks to improve defense acquisition processes by enabling a deep understanding of the interactions and potential conflicts between system requirements during their inception and suggesting defensible, mutually compatible goals that satisfy multiple stakeholders.

3 - Certification of Logistics Officers in the USAF

Kenneth Schultz, Associate Professor, AFIT, 2950 Hobson Way,
WPAFB, OH, 45433, United States of America,
Kenneth.Schultz@afit.edu

We study the costs and benefits for supporting Logistics Officer certification for Logistics Officers in the USAF. We compare civilian certification programs with a self developed program.

■ WA02

02-Room 302, Marriott

Scheduling I

Contributed Session

Chair: Qiong Zhu, Shanghai Jiao Tong University, Mechanical Engineering Building 715, Shanghai, 200240, China, 7384702@qq.com

1 - Scheduling Operations of Pumping Units in Onshore Oilfields under Electric-power Constraints

Eduardo Camponogara, Professor, Federal University of Santa Catarina, Depart. Automation and Systems Eng., Florianopolis, SC, 88040900, Brazil, eduardo.camponogara@ufsc.br

In onshore oilfields, rod pumps are powered by electric motors to lift oil from the bottom of production wells. The pumps operate according to cyclic control policies that alternate between on and off pumping periods designed to drive maximum production. This cyclic behavior gives rise to the problem of scheduling pumpoff operations to minimize the system power peak. This work presents MILP formulations for the coordination of control policies and their reconfiguration during operations.

2 - Operational Scheduling of Storage in Decentralized Energy Management

Johann Hurink, University of Twente, P.O. Box 217,
Enschede, 7500 AE, Netherlands, j.l.hurink@utwente.nl,
Thijs Van Der Klauw, Marco Gerards

Within decentralized energy management an important task is to steer a local micro grid towards a pre-specified energy profile over a given period. To reach this goal, storage is one of the crucial ingredients. In this talk we present concepts and algorithms to use storage devices to influence the energy profile of a micro grid. The objective takes into account the cost of the energy and the deviation from the desired profile.

3 - Assembly Flowshop Scheduling to Minimize Maximum Tardiness

Harun Aydilek, GUST University, Mishref, Mishref, Kuwait,
aydilek.h@gust.edu.kw, Asiye Aydilek, Ali Allahverdi

Two-stage assembly flowshop scheduling problem with the objective of minimizing maximum tardiness is addressed where setup times are separate. A hybrid simulated annealing algorithm is proposed. Results show that the algorithm not only performs well for separate setup times case but also for zero setup times case.

4 - Multi-agent Based Production Scheduling Service for Cloud Manufacturing

Qiong Zhu, Shanghai Jiao Tong University, Mechanical Engineering Building 715, Shanghai, 200240, China,
7384702@qq.com, Jie Zhang

This paper applies the multi-agent system and cloud computing technologies to establish production scheduling service for cloud manufacturing paradigm. Each Multi-Agent system is packed with an intelligent algorithm solution for different types of workshop. The self adaptive parameter setting mechanism is designed for the algorithm based on the workshop parameter.

5 - Genetic Algorithm Based Approach for the Airline Crew Pairing Problem

Muhammet Deveci, Yildiz Technical University, Yildiz Campus A block 34349, Besiktas/Istanbul, Istanbul, Turkey,
muhammetdeveci@gmail.com, Nihan «etin Demirel

The aim of the airline crew-pairing problem (CPP) is to generate a set of minimal cost crew pairings covering all flight legs. The model has been formulated as set covering problem. The proposed approach is based on a hybrid genetic algorithm (GA). In fact, some heuristics are developed in the GA's process. Also a branch-and-bound algorithm is applied to test the airline CPP. Our results clearly demonstrate the success of our solution approaches on real-world instances

■ WA03

03-Room 303, Marriott

Logistics and Inventory Management

Contributed Session

Chair: Olga Rusyaeva, Kuehne Logistics University, Grofler Grasbrook 17, Hamburg, Germany, olga.rusyaeva@the-klu.org

1 - Managing Inventory of Perishable Products in Multiple Locations

Fang Liu, Assistant Professor, Nanyang Business School, Nanyang Technological University, 50 Nanyang Avenue, South Spine S3-B2A-13, Singapore, 639798, Singapore, liu_fang@ntu.edu.sg,
Yun Fong Lim

Consider a retailer selling multiple products with random demands over a single season. Upon receiving the products, the retailer stores them to multiple warehouses, each with a limited storage capacity. Because the costs to store and retrieve a unit of product vary with the warehouses, the retailer needs to properly assign the products and choose from which warehouses to retrieve these products after demand realizes. We study the retailer's optimal decisions in these two stages.

2 - Responsiveness Improvements in Inventory Management Systems with Imperfect Information

Sayed Shahab Mofidi, Rensselaer Polytechnic Institute, 110 8th St, CII 5007, Troy, NY, 12180, United States of America,
mofids@rpi.edu, Jennifer Pazour

In inventory management systems, discrepancies between recorded and physical stock in warehouses cause undesirable response times. To our knowledge, most of the existing research highlights the attained benefits of eliminating errors. In contrast, this research incorporates existing errors and associated costs of inappropriate response times in order-fulfillment decisions. We develop mathematical models that recommend policies to improve responsiveness in existing situations.

3 - Travel-time Models for 3D Compact Automated Storage and Retrieval Systems

Xiaozen Zhao, Huazhong University of Science and Technology, No.1037, Luoyu Road, Hongshan District, Wuhan, HB, 430074, China, zxzhu@163.com, Xianhao Xu

In the 3D compact automated storage and retrieval systems, the stacker cranes are used to store or retrieve loads into/from the storage location. And the conveyors can move loads in the orthogonal direction. In this paper, we make the expected travel time model of the S/R machine, considering different I/O points and the dwell strategies of the S/R machine.

4 - An Inventory Control Model for Modal Split in Transportation: A Tailored Base-Surge Approach

Chuanwen Dong, Kuehne Logistics University,
Grosser Grassbrook 17, Hamburg, Germany,
chuanwen.dong@the-klu.org, Sandra Transchel, Kai Hoberg

We study an inventory control problem where a firm ships products from a plant to a distribution center via two transportation modes, a slow and cheap mode (e.g., rail) and fast but expensive mode (e.g., truck). In the slow mode, products are shipped with a constant volume, whereas fast-mode ordering follows a base-stock policy every period. We extend the tailored base-surge (TBS) policy to less frequent slow-mode shipments and present an approximated analytical solution approach.

5 - Optimal Time to Reposition Inventories in Multi-location Centralized Networks

Olga Rusyaeva, Kuehne Logistics University,
Grosser Grassbrook 17, Hamburg, Germany,
olga.rusyaeva@the-klu.org, Joern Meissner

Repositioning of inventories between locations aims to decrease the impact of inventory imbalance caused by e.g. imperfect demand information or delayed delivery. In practice, it is often done via lateral transshipments. Our dynamic transshipment policy answers questions – when within the order cycle, how much, and from which location to transship to maximize the revenue of the network. A myopic policy and a near-optimal policy based on approximation are suggested for real-size problems.

■ WA04

04-Room 304, Marriott

Economics II

Contributed

Chair: Maryam Razeghian, Doctoral Student, EPFL, CDM-ODY 4.16,
Station 5, Lausanne, VD, 1015, Switzerland,
maryam.razeghian@epfl.ch

1 - Discrete Choice Modeling Approach to Decide The Digital Divide Policy Issue

Subhabrata Bapi Sen, Adjunct Faculty, Sillberman College of
Business, 32 Rolling Hill Dr, Chatham, NJ, 07928,
United States of America, bapi45@fd.edu

Discrete choice framework to address the digital divide issue as reported in NY Times story “F.C.C. Chief Seeks Broadband Plan To Aid The Poor” Bridging Digital Divide. To focus on the main issue - we need to access to Broadband demand using a conditional logit formulation. The service attributes/demographics will be explanatory variables. June 6, 2015 in The Wall Street Journal article “Is the U.S. Ready to pay for ‘Quad Play’?” is analyzed here.

2 - On the Relevance of Probability Distortions in the Extended Warranties Market

Mike Abito, Assistant Professor, University of Pennsylvania
(Wharton), 3620 Locust Walk, SHDH 1407, Philadelphia, PA,
19104, United States of America, abito@wharton.upenn.edu

We study the reasons for high profits in the extended warranties market. Using data from a big US consumer electronics retailer, we find that overweighting of failure probabilities is a relevant factor in determining economic outcomes: without probability overweighting, profits drop by 90% and consumer surplus more than doubles. We also find that overweighting is affected by the environment and is reduced with learning.

3 - To Share or Not to Share: Adjustment Dynamics in Sharing Markets

Maryam Razeghian, Doctoral Student, EPFL, CDM-ODY 4.16,
Station 5, Lausanne, VD, 1015, Switzerland,
maryam.razeghian@epfl.ch, Thomas Weber

To describe and further predict the growth of sharing markets, we construct a model for the dynamic sharing decisions of heterogeneous suppliers in a market with frictions, allowing for a mismatch between supply and demand. In each time period, an agent can enter or leave the sharing market, subject to an adjustment cost. We provide a closed-form expression for the nonlinear evolution of the rational-expectations equilibrium in this economy, typically resulting in an S-shaped diffusion pattern.

■ WA05

05-Room 305, Marriott

Identifying Sentiment Change and Geographic Location in Social Media

Cluster: Social Media Analytics

Invited Session

Chair: Chris Smith, TRAC-MTRY, 28 Lupin Lane, Carmel Valley, 93924,
United States of America, cmsmith1@nps.edu

1 - Identifying Changes in Twitter Sentiment

Sam Buttrey, Assoc. Prof., Naval Postgraduate School,
Code OR/Sb, Monterey, CA, 93943, United States of America,
buttrey@nps.edu, Jon Alt

This ongoing research demonstrates the application of statistics and machine learning to identify spatio-temporal changes in population sentiment using 10 TB of recent Twitter data. It also seeks to compare Twitter sentiment to results of surveys taken in the same places and times. This comparison may inform uses of sentiment analysis as an alternative to the use of structured surveys in areas where surveying is infeasible. Practical difficulties in analyzing big data of this sort are discussed.

2 - Changes in Network Topography to Predict Social Unrest using Social Media

Rob Schroeder, Naval Postgraduate School, 526 Union St.,
Monterey, CA, 93940, United States of America,
rscshroe@nps.edu

In recent years, social media has become a common communication medium for social movements. These social movements are able to interact with members, sympathizers, and the general public using social media. This research analyzes how the overall structure of their interactions via Twitter change over time and compares the changes to planned events by the social movement.

3 - Better Defining Location and Attribute Data in Twitter by Utilizing Wikipedia Localization Text

Patrick Dudas, Contractor, NPS, 1215 Wisconsin Ave, Pittsburgh,
PA, 15216, United States of America, dudasp@gmail.com

Within Twitter understanding users' geolocation is subject to either the user geotagging their tweets or a high-level profile location. Working with Wikipedia and Twitter, we better define locations and their localized names and attributes by means of Wikipedia's rich datasets. Parsing Wikipedia, we can produce location objects and their localized translation of the location around the world, producing a better means of understandings both the user's location and voice on Twitter.

4 - Non-linear Dynamics of Human Emotions: Analysis of Twitter Data and its Implications

Les Servi, The MITRE Corporation, 202 Burlington Road,
Bedford, MA, United States of America, lservi@mitre.org,
Waldemar Karwowski, Dylan Schmorow, Nabin Sapkota

Exploration of the extent that human emotions, expressed in Twitter data, have chaotic and non-linear dynamics has profound implications in its use for forecasting a population's mood. This study examines such dynamics through the analysis of hundreds of thousands of Twitter messages.

■ WA06

06-Room 306, Marriott

Modeling and Computations in Financial Engineering

Sponsor: Financial Services

Sponsored Session

Chair: Lingfei Li, Assistant Professor, The Chinese University of Hong Kong, 608 William M.W.Mong Engineering BLD, Shatin, Hong Kong - PRC, lli@se.cuhk.edu.hk

1 - Long Term Risk: A Martingale Approach

Likuan Qin, Northwestern University, 2145 Sheridan Rd, Tech
C210, Evanston, IL, 60208, United States of America,
LikuanQin2012@u.northwestern.edu, Vadim Linetsky

We extend long-term factorization of the pricing kernel to general semimartingale environments, without assuming the Markov property. We explicitly construct long-term factorization in HJM models and affine models and decompose the market price of Brownian risk into the volatility of the long bond plus an additional risk premium defining the permanent martingale component in the long-term factorization.

2 - From Bermudan to American

Liming Feng, Associate Professor, University of Illinois at Urbana-Champaign, 104 S Mathews Ave, Urbana, IL, 61801, United States of America, fenglm@illinois.edu

The price of an American option could be approximated by that of a Bermudan option when the number of monitoring times is large enough. This talk presents results on convergence of the Bermudan option price and the early exercise boundary. Examples illustrate the effectiveness of pricing American contracts through the Bermudan approach.

3 - A Primal-dual Iterative Method for Stochastic Dynamic Programming

Nan Chen, Prof, Chinese University of Hong Kong, 709A William Mong Engineering Building, Hong Kong, Hong Kong - PRC, nchen@se.cuhk.edu.hk, Xiang Ma

We use the information relaxation technique to develop a value-and-policy iterative method to solve stochastic control problems. A sequence of upper and lower bound estimations on the true value functions and suboptimal policies are generated. We prove that the sequence converge to the optimal value and policy in a finite number of iterations.

4 - Modelling Time Dependence in Finance: A Time Change Approach

Lingfei Li, Assistant Professor, The Chinese University of Hong Kong, 608 William M.W. Mong Engineering BLD, Shatin, Hong Kong - PRC, lli@se.cuhk.edu.hk

We propose a time change method named as additive subordination for constructing time-inhomogeneous Markov processes with tractability for financial modelling. As an application, we develop an analytically tractable model for pricing VIX options that is able to achieve excellent fit to the volatility surface.

WA07

07-Room 307, Marriott

Risk Management Approaches in Engineering Applications

Cluster: Risk Management

Invited Session

Chair: Stan Uryasev, University of Florida, 303 Weil Hall, Gainesville, FL, United States of America, uryasev@ufl.edu

1 - Multidimensional Buffered Probability of Exceedance: Risk Averse Tail Probability Approximations

Alexander Mafusalov, University of Florida, P.O. Box 116595, 303 Weil Hall, Gainesville, FL, 32611-6595, United States of America, mafusalov@ufl.edu

Probability of exceedance (POE) is widely used but has major drawbacks. Buffered probability of exceedance (bPOE) is a conservative approximation of POE and eliminates some of its drawbacks. We suggest a new multidimensional generalization of bPOE (M-bPOE). M-bPOE is used to control exceedances for several random variables simultaneously. Calculation formulas and optimization formulations for M-bPOE are provided. Mathematical properties and possible applications for M-bPOE are studied.

2 - Soft Margin Support Vector Classification as Buffered Probability Minimization

Matthew Norton, University of Florida, 2449 NW 93rd St, Gainesville, FL, 32606, United States of America, mdnorton@ufl.edu, Alexander Mafusalov

We discuss a new concept called Buffered Probability of Exceedance (bPOE) and show that soft margin support vector classification is equivalent to bPOE minimization. This allows us to provide new insights into SVM's. We provide a new SVM formulation, called the EC-SVM, based upon these insights. We also provide a general framework connecting soft margin support vector classification and superquantile concepts.

3 - Support Vector Machines Based on Convex Risk Functionals and General Norms

Stan Uryasev, University of Florida, 303 Weil Hall, Gainesville, FL, United States of America, uryasev@ufl.edu, Jun-ya Gotoh

We study unified formulations of support vector machines (SVMs) for binary classification, minimizing a combination of an arbitrary convex risk functional and an arbitrary norm-based regularizer. Especially, we investigate a condition under which nontrivial formulations can be obtained and what properties of risk functionals play roles in attaining interpretable dual formulations and/or tractable robust counterparts for robust optimization modelings.

4 - Energy Commodities: A Tool for Hedging and Investments

Rita D'Ecclesia, Birkbeck, University of London, Department of Economics, Mathematics and Statistics, rita.decclesia@uniroma1.it

Energy commodity prices in US and in Europe have shown increasing volatility, change in the relationship with other commodity prices and the traditional financial assets is also observed. Given the non stationarity of their returns we aim to measure the relationship existing between them and traditional financial assets using time varying volatility and correlation estimators. A portfolio diversification framework is also set using stochastic optimization modelling.

WA09

09-Room 309, Marriott

Innovation and Technology Management

Contributed Session

Chair: Zhongyuan Xu, Harbin Engineering University, 61th Building, 3046 Room, Harbin, China, xuruby0624@163.com

1 - Exploring Creative Collaboration in Maker Communities

Yi-tzu Chang, Department of Public Relations and Advertising, Shih-Hsin University, No.1, Ln. 17, Sec. 1, Muzha Rd., Wenshan, Taipei, Taiwan - ROC, silverzal315@gmail.com, Cheng-chieh Hsiao

The maker movement has drawn more and more attention from both management research and practice regarding information, technology, and innovation. Makers are creators who use digital technologies (e.g., 3D printing) to design and fabricate products collaboratively in DIY communities like FabLabs and makerspaces. This study interviews with 3D printing makers and develops a motivation-ability-opportunity framework to delineate creative collaboration in maker communities.

2 - How Much do Firms Earn in a Cooperative Innovation? From the Perspective of Relational Rent

Si Zhang, University of Chinese Academy of Sciences, 1-1-23A Zhong Hai Fu Yuan, Zengguang Rd 37, Haidian District, Beijing, China, zhangsi@ucas.ac.cn, Jizhen Li, Na Li

The paper first constructs an evaluation system that allows quantitative estimation and categorization of the relational rent generated by partners in collaborative innovation. Three types of rent are discovered, i.e. the individual, interactive and serendipitous rent. We then examine how the interdependence/relationship of focal paired firms affects the generation of rent. Valuable implications are provided to enterprises in the gaining and maximizing of benefits in innovative collaborations.

3 - Equity Split and Performance of High-technology Ventures: Whose Hands to Put the Company in?

Yueheng Wang, Tsinghua University, Room 729B, Zijing Apartment No.14, Tsinghua University, Beijing, 100084, China, wangyh.08@gmail.com, Yanbo Wang, Jizhen Li

The impact of equity split on firm performance is a crucial yet controversial topic regarding high-technology ventures in which shareholders play comparatively significant roles. With data of 626 Chinese high-technology ventures, we founded a curvilinear relationship between share concentration and firm performance, together with opposite moderating effects of board's functional diversity and firm age, which reveal significant implications for shaping shareholder compositions within those firms.

4 - Innovation Networks and Innovation Performance: The Intermediary Role of Knowledge Management Capability

Zhongyuan Xu, Harbin Engineering University, 61th Building, 3046 Room, Harbin, China, xuruby0624@163.com

This study extends the relationships between different innovation networks and innovation performance from a new perspective of knowledge management capability. Based on a survey to 239 Chinese knowledge intensive firms, this study empirically demonstrates how knowledge management capability plays an intermediary role from different innovation networks to innovation performance.

5 - Corporate Venture Capitalist Dependability and Their Inclusion in Venture Capital Syndicates

Joseph Cabral, PhD Student, Rensselaer Polytechnic Institute, 124 Ferry Street, Apt. 213, Troy, NY, 12180, United States of America, cabraj2@rpi.edu

Given that the venture capital industry involves great uncertainty, mutual dependency and staged investment, the reliability of partners is critical to the decision to co-invest. Using logic consistent with transaction cost economics Corporate Venture Capitalists are argued to be less predictable than traditional venture capitals and as a result are excluded from earlier rounds of investment where the greatest uncertainty and need for flexibility exists.

■ WA11

11-Franklin 1, Marriott

Optimization Large Scale II

Contributed Session

Chair: Lukas Bach, SINTEF, Forskningsveien 1, Oslo, 0373, Norway, lukas.bach@sintef.no

1 - Assortment Planning for Configurable Products with Consideration for Substitution

Ying Tang, Graduate Research Assistant, Wayne State University, 4815 Fourth Street, Detroit, MI, 48202, United States of America, ei3512@wayne.edu, Ratna Babu Chinnam, Alper Murat, Joshua Lyon

We develop assortment planning models for vehicle programs of a large automaker to support its strategic product planning efforts. We emphasize two objectives: 1) Utilizing both non-parametric and parametric approaches for characterizing demand. 2) Scalability of the models to support real-world programs. We will also present results representative of a North American vehicle program.

2 - Natural Gas System Operations and Expansion Planning for Reliability

Conrado Borraz-sanchez, Associate Postdoctoral Researcher, Los Alamos National Laboratory, 1927 22nd Street Apt. D, Los Alamos, NM, 87544, United States of America, conrado.borraz@gmail.com, Pascal Van Hentenryck, Scott Backhaus, Russell Bent, Hassan Hijazi

We present a MINLP formulation to tackle natural gas network expansion planning problems. Our model captures physical, operational, directionality and on/off constraints. However, given its non-convexity, we propose a second-order cone relaxation that proves to be highly effective on large-scale cases that include existing Belgian and German networks. Comparisons against a piecewise linearization approach also show the advantages of our approximation in terms of its robustness and scalability.

3 - Adaptive Large Neighborhood Search using the Graphics Processing Unit

Lukas Bach, SINTEF, Forskningsveien 1, Oslo, 0373, Norway, lukas.bach@sintef.no, Geir Hasle, Christian Schulz

We investigate the efficiency of Adaptive Large Neighborhood Search on the Graphics Processing Unit (GPU). We do this by implementing the algorithm for the Distance-constrained Capacitated Vehicle Routing Problem (DCVRP), which we benchmark towards a state of the art CPU implementation. The computational power of the GPU in ordinary computers has increased significantly in recent years. Therefore it is interesting to utilize this computing power. We perform tests on well-known DCVRP instances.

■ WA12

12-Franklin 2, Marriott

Optimization Stochastic I

Contributed Session

Chair: Sebastian Maier, Imperial College London, South Kensington Campus, London, SW7 2AZ, United Kingdom, s.maier13@imperial.ac.uk

1 - A Hierarchical Markov Decision Process for Finding the Best Replacement Policy of Fattening Pigs

Reza Pourmoayed, PhD Student, Aarhus University, Department of Economics and Business, Fuglesangs Allé, Aarhus, 8210, Denmark, rpourmoayed@econ.au.dk, Lars Relund Nielsen

We use a hierarchical Markov decision process to model the sequential decision problem of replacing fattening pigs for slaughter. State of the system includes the weight and the price information acquired by two statistical models based on a Bayesian updating approach. Transition probabilities and rewards are calculated using the statistical models and a simulation method, respectively. Numerical examples are given to show the functionality of the proposed model.

2 - Quantile Optimization for Heavy-tailed Distributions using Asymmetric Signum Functions

Ricardo Collado, Stevens Institute of Technology, Howe School of Technology Management, Hoboken, NJ, United States of America, rcollado@stevens.edu, Jae Ho Kim, Warren Powell

We present an algorithm for computing the quantile of a continuous random variable that does not require the existence of expectation or storing all of the sample realizations. We use this to optimize the quantile of a random function satisfying some strict monotonicity and differentiability properties. We apply this to the problem of electricity trading in the presence of storage, where electricity prices are known to be heavy-tailed with infinite variance.

3 - A Dynamic Size Sample Average Approximation for Stochastic Optimization

Adindu Emelogu, Mississippi State University, 260 McCain Building, Mississippi State, MS, 39762, United States of America, emeloguadindu@yahoo.com, Linkan Bian, Mohammad Marufuzzaman

The Sample Average Approximation (SAA) is a method of solving stochastic optimization problems by replacing the objective function with an approximation. The size of the sample affects the convergence of the solution of the approximation and the computation time. We propose an algorithm that dynamically updates the sample size in SAA and ensures both convergence and reasonable computation time. We apply our algorithm to a supply chain problem in health care, and compare it with other algorithms.

4 - Risk-averse Stochastic Path Interdiction

Stephan Meisel, University of Muenster, Department of Information Systems, Muenster, Germany, stephan.meisel@uni-muenster.de, Laura Priekule, Ricardo Collado

We propose a new risk-averse approach to allocating security resources in a network. Resources are allocated for blocking with high probability an attacker that selects a path for traversing the network. The attacker is characterized by an unknown probability distribution and resources are allocated based on beliefs about the distribution. We formulate the problem as a linear program and use coherent risk measures for getting solutions that are risk-averse with respect to errors in the beliefs.

5 - Appraising Interdependent Physical and Digital Infrastructure Investments: An Option Games Approach

Sebastian Maier, Imperial College London, South Kensington Campus, London, SW7 2AZ, United Kingdom, s.maier13@imperial.ac.uk, David Gann, John Polak

We present a new option games-based appraisal framework for selecting a portfolio of interdependent physical and digital infrastructure investments. We have used this framework to formulate a multistage stochastic optimisation model that combines the Least Squares Monte Carlo algorithm with the modelling of infrastructure interdependencies. We investigate the sensitivity of the optimised portfolio value and option exercise strategies to changes in competitor's decisions and strategic behaviour.

■ WA13

13-Franklin 3, Marriott

Stochastic Integer Programming Methods and Applications

Sponsor: Optimization/Optimization Under Uncertainty
Sponsored Session

Chair: Lewis Ntamo, Associate Professor, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, ntamo@tamu.edu

Co-Chair: Saravanan Venkatachalam, Texas A&M University, saravanan@tamu.edu

1 - Scaling Scenario Decomposition Methods for 0-1 Stochastic Programming

Kevin Ryan, Georgia Institute of Technology, kryan31@gatech.edu, Deepak Rajan, Shabbir Ahmed

A recently proposed scenario decomposition algorithm for stochastic 0-1 programs finds an optimal solution by evaluating and removing individual solutions discovered by solving scenario subproblems. We develop techniques for applying a parallel implementation of this algorithm to difficult problems with many first stage variables and a moderate number of scenarios. Challenges include problem symmetry and effective parallelization. Computational results from large scale problems are presented.

2 - Robust Multicriteria Risk-averse Stochastic Programming

Simge Kucukyavuz, Associate Professor, The Ohio State University, 210 Baker Systems Building 1971 Neil Ave, Columbus, OH, United States of America, kucukyavuz.2@osu.edu, Xiao Liu, Nilay Noyan

We study risk-averse models for multicriteria optimization problems under uncertainty. We use a weighted sum-based scalarization and consider a set of scalarization vectors to address the ambiguity and inconsistency in the relative weights of each criterion. We introduce a model that optimizes the worst-case multivariate CVaR and develop a finitely convergent algorithm for finite effectivity spaces. Our computational study illustrates the effectiveness of the proposed methods.

3 - Decomposition Algorithm for Two-stage Stochastic Integer Programs with Deviation Risk Measures

Saravanan Venkatachalam, Texas A&M University,
3131 TAMU, College Station TX 77843, saravanan@tamu.edu,
Lewis Ntamo, Bernardo Pagnoncelli

In this talk, we present a decomposition algorithm for two-stage stochastic integer programs (SIP) with absolute semi-deviation (ASD) risk measures. These types of problems are hard to decompose due to the lack of amenable problem structure. We propose a methodology that uses the information from expected excess risk measure to solve SIPs with ASD risk measures. Preliminary computational results will be presented.

■ WA14

14-Franklin 4, Marriott

Advances in Information Modeling

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Eugene Perevalov, Lehigh University, 200 W Packer Ave, Bethlehem, PA, United States of America, eup2@lehigh.edu

1 - Information Sources' Knowledge Structure, Question/Answer Depth and Information Relevance

Eugene Perevalov, Lehigh University, 200 W Packer Ave, Bethlehem, PA, United States of America, eup2@lehigh.edu,
Xing Wang

To optimize the process of information acquisition, a problem solving agent analyzes both the available information and the information relevant to the given problem, and, based on such analysis, selects the information source(s) that can help obtain the largest improvement of the solution quality. Currently, this is done on a largely ad hoc case-by-case basis. Our goal is to develop a general theory providing a regular way of performing such a selection.

2 - Towards the Full Information Theory: Knowledge Structure of Information Sources

Xing Wang, Lehigh University, 200 W Packer Ave, Bethlehem, PA, United States of America, xiw313@lehigh.edu,
Eugene Perevalov

The classical Information Theory was able to properly describe the sheer quantity of information which allowed for optimization of information transmission leaving the process of information acquisition still in the "pre-theoretical" state relying on ad-hoc approaches. We initiate the study of the latter which makes it necessary to describe the ability of information sources to change the agent's information state depending on the specific information requested.

3 - Using Network Diversity in Analytics and Visualization

Seifu Chonde, Student, The Pennsylvania State University,
311 Leonhard Building, University Park, PA, 16802,
United States of America, sjc294@psu.edu, Soundar Kumara

In 2007, the Rao-Stirling diversity framework was introduced to capture changes in the variety, balance, and disparity among nodes in networks. We extended this diversity measure to include coherence, which captures network density. We show how our diversity measure improves approaches in clustering, link prediction, and tracking evolutionary networks. We use a case study in drug design with hundreds of thousands of journal articles to motivate the study of diversity.

■ WA15

15-Franklin 5, Marriott

Monitoring and Prevention of Hospital Acquired Infections

Sponsor: Optimization in Healthcare

Sponsored Session

Chair: Eduardo Pérez, Assistant Professor, Texas State University,
601 University Drive Ingram School of Eng, San Marcos, TX, 78666,
United States of America, eduardopr@txstate.edu

1 - Network Effects on Hand-hygiene Behavior

Reidar Hagtvedt, University of Alberta, Edmonton, AB, Canada,
hagtvedt@ualberta.ca, Brian Whiteside,
Bruce Wright, Sarah Forgie

Hand-hygiene in healthcare settings is a phenomenon that has been studied a great deal, both on the individual and on the group level, but to our knowledge detail on the group working as a network in this context has not been studied. We use sociometric badges to gather data from a large teaching hospital and estimate network statistics. We then model the relationship between the network

and individual behaviors.

2 - Agent-Based Mediation Modeling of a Controlled Trial to Reduce Transmission of Resistant Organisms

Sean Barnes, University of Maryland, 4352 Van Munching Hall,
University of Maryland, College Park, MD, 20742, United States
of America, sbarnes@rhsmith.umd.edu, Daniel Morgan,
Lisa Pineles, Anthony Harris

In 2012-2013, the University of Maryland School of Medicine led a 20-site trial to assess the benefits of universal gloves and gowns in reducing the transmission of multidrug-resistant organisms in acute-care hospitals. We develop an agent-based model to simulate transmission in an ICU, and calibrate this model to best match the outcomes from the 20 sites. Then, we validate the model against the study's analysis, and perform a factorial design to quantify the direct benefit of this intervention.

3 - A Systems Approach to Reducing Central Line Associated Blood Stream Infections

Eva Lee, Georgia Institute of Technology, eva.lee@gatech.edu

The study aims to reduce central line associated bloodstream infections (CLABSI) at Grady Hospital by 20% from current levels. A systems model is designed that comprises the entire process of central line insertion and maintenance. Hospital data is analyzed to identify potential increased risk of CLABSI-related deaths. A second objective includes predicting death among CLABSI-infected patients while minimizing Type II errors; enabling providers to intervene early to reduce unnecessary deaths.

4 - Assessing CAUTI Prevention Interventions in Intensive Care Units

Eduardo Pérez, Assistant Professor, Texas State University, 601
University Drive Ingram School of En, San Marcos, TX, 78666,
United States of America, eduardopr@txstate.edu

This research extend the current methods for addressing CAUTIs to a new level beyond the current state of practice by introducing a new simulation model for system assessment and determination of the clinical efficacy and effectiveness of CAUTI preventive interventions. The simulation model provide a platform where specific interventions can be computed and analyzed, giving an idea on possible expectations of the intervention before clinical research is conducted.

■ WA16

16-Franklin 6, Marriott

Game Theory II

Contributed Session

Chair: Chuangyin Dang, Professor, City University of Hong Kong,
Dept. of SEEM, 83 Tat Chee Avenue, Kowloon, Hong Kong - PRC,
mecdang@cityu.edu.hk

1 - Royalty Licensing Mechanisms in a Leadership Structure

Masashi Umezawa, Professor, Tokyo Univesity of Science, School
of Management, 500 Shimokiyoku, Kuki, Saitama, 346-8512,
Japan, m.omezawa@gmail.com

This paper studies a patent licensing of a cost-reducing innovation which is developed by an internal patentee, one of the firms of the industry. Royalty licensing is mainly focused. Most patent licensing contracts observed empirically include either per-unit or ad valorem royalties. We consider that in a Stackelberg duopoly which types of royalty the patentee prefers. Moreover, we examine the effect of royalty licensing from the point of consumers and social welfare.

2 - Horizontal Product Differentiation in the Presence of Core Products

Hiroki Kishihara, Keio University, Hiyoshi 3-14-1 Kohoku-ku,
Yokohama, Japan, kishihara@z5.keio.jp, Nobuo Matsubayashi

We study horizontal product differentiation between two firms by a game-theoretic approach. We suppose that to introduce their new products, firms must incur "repositioning cost" which increases with the position difference from their core products exogenously given in a product space. We show that the presence of repositioning costs can have a significant impact on the equilibrium outcomes, which also depends on their cost structures.

3 - A General Method for Checking the Core Emptiness of Traveling Salesman Games

Lei Sun, Development Specialist, Praxair Inc., 175 E. Park Dr.,
Tonawanda, NY, 14150, United States of America,
Lei_Sun@Praxair.com, Mark Karwan

We study the core of traveling salesman games from an optimization perspective and propose a new variant of the traveling salesman problem building a link between the two problems. An exact formula is found to measure the gap between the best achievable cost allocation and the core. With network optimization models and algorithms, we develop an implementable method to check whether an empty core exists in general for both symmetric and asymmetric traveling salesman games.

4 - An Effective Approach to the Determination of Proper Equilibrium

Chuangyin Dang, Professor, City University of Hong Kong, Dept. of SEEM, 83 Tat Chee Avenue, Kowloon, Hong Kong - PRC, mecdang@cityu.edu.hk, Yin Chen

As a powerful refinement of Nash equilibrium, proper equilibrium plays an important role in the development of game theory. This paper aims to develop an effective smooth path-following method for computing proper equilibria. By appropriately incorporating barrier terms into payoff functions, we construct a smooth path to a proper equilibrium through closely approximating some Nash equilibrium of a perturbed game. Extensive numerical results further confirm the effectiveness of the method.

■ WA17

17-Franklin 7, Marriott

Network Analysis II

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Bahar Cavdar, Middle East Technical University, Ankara, Turkey, bcavdar@metu.edu.tr

1 - A Network-Based Approach to Bushfire Fuel Management

Dmytro Matsypura, The University of Sydney,
Rm 478 Merewether Building H04, Sydney, Australia,
dmytro.matsypura@sydney.edu.au, Oleg Prokopyev

Bushfires represent a real and continuing problem that can have a major impact on people, wildlife and the environment. One way to reduce the severity of their effect is through fuel management. We propose a general methodology to address the problem of optimal resource allocation for bushfire fuel management subject to landscape connectivity and stochastic fuel regeneration.

2 - Empty Repositioning under Demand Uncertainty in Large-scale Transportation Networks

Ilke Bakir, PhD Student, Georgia Institute of Technology, H. Milton Stewart School, 765 Ferst Dr NW, Atlanta, GA, 30332-0205, United States of America, ilkebakir@gatech.edu, Alan Erera, Martin Savelsbergh

We consider a transportation network where loaded demand quantities are uncertain, and only estimates are known. We introduce different methods of solving the repositioning problem on relatively sparse networks to satisfy as much demand as possible, using loaded demand estimates. We first experiment with various sharing group policies (hub/spoke structures for empty repositioning), and then introduce a robust optimization approach to further improve demand satisfaction.

3 - A Robust Framework for Event Prediction in Partially Unobserved Networks

Aaron Schecter, Northwestern University, 2240 Campus Drive, 1-459, Evanston, IL, 60208, United States of America, aaronschecter2016@u.northwestern.edu, Noshir Contractor

Longitudinal social network analysis is typically framed as a series of decisions by rational actors. However, individuals only have access to partial information about the whole network. As a result, behaviors are functions of both observed local ties as well as perceived second order relationships. We propose a statistical model for the prediction of dyadic link events under this assumption of network uncertainty; our technique draws from robust optimization and simulation principles.

4 - A Tabu Search with Time-based Preprocessing for Vehicle Routing Problem with Time Windows

Bahar Cavdar, Middle East Technical University, Ankara, Turkey, bcavdar@metu.edu.tr, Joel Sokol

Recent applications of Vehicle Routing Problem (VRP) such as online grocery shopping require finding solutions in a short time with little knowledge of the instance in advance. Current solution methods put more emphasis on the solution quality rather than the computation time. In this talk, we present a new heuristic for VRP with time windows. We combine a tabu search approach with a preprocessing of the instance using arc-based waiting time information to speed up the computation.

■ WA18

18-Franklin 8, Marriott

Optimization Combinatorial I

Contributed Session

Chair: Burcin Cakir Erdener, Dr., Baskent University, Eskisehir Yolu 20 km. Baglica Kampusu, Muhendislik Fak. Etimesgut, Ankara, 06800, Turkey, burcincakir55@gmail.com

1 - Dynamic-programming-based Inequalities for the Multi-dimensional Unbounded Knapsack Problem

Xueqi He, University of Florida, 3800 SW 34th St. Apt. P138, Gainesville, FL, 32608, United States of America, xueqihe@gmail.com

We present a new branch-and-cut approach for solving the multi-dimensional unbounded knapsack problem, where valid inequalities are generated for an integer programming formulation based on intermediate solutions of an equivalent dynamic programming formulation. These inequalities tighten the initial LP relaxation, and therefore improve the computational efficiency.

2 - An Exact Algorithm for Biobjective Mixed Integer Linear Programming Problems

Gazi Bilal Yildiz, Res. Assist., Erciyes University, Engineering Faculty, Industrial Engineering, Kayseri, 38039, Turkey, bilalyildiz@erciyes.edu.tr, Banu Soylu

In this study, we develop an algorithm to generate all Pareto line segments of BOMILPs. Our algorithm starts with the solution of an individual objective function and then sequentially generates all line segments of the Pareto frontier. At each iteration of the algorithm, one line segment of the Pareto frontier is detected. If there is no new Pareto line segment available, the algorithm ends. We provide a numerical example and present the performance of the algorithm over several test problems.

3 - Virtual Mixed Integer Nonlinear Programming Model for Integrated Electricity Distribution System

Burcin Cakir Erdener, Dr., Baskent University, Eskisehir Yolu 20 km. Baglica Kampusu, Muhendislik Fak. Etimesgut, Ankara, 06800, Turkey, burcincakir55@gmail.com, Berna Dengiz, Zulal Gungor, Imdat Kara

An electricity network design problem with distributed generation, which is called the Integrated Electricity Distribution System (IEDS) design problem is considered. The design procedure aims at the minimization of total system design cost while ensuring the optimum location and routing decisions for several system elements. To solve IEDS, a mixed-integer nonlinear-programming model is proposed. A new network transformation approach called virtual node duplicating is introduced within the model.

■ WA19

19-Franklin 9, Marriott

Computational Optimization for Applied Problems II

Sponsor: Computing Society

Sponsored Session

Chair: Hans Mittelmann, Arizona State University, Box 871804, Tempe, United States of America, mittelmann@asu.edu

1 - Scip-jack - A Solver for the Steiner Tree Problem and Variants with Parallelization Extensions

Stephen Maher, Zuse Institute Berlin, Takustr. 7, Berlin, BE, 14195, Germany, maher@zib.de, Gerald Gamrath, Thorsten Koch, Daniel Rehfeldt, Yuji Shinano

The Steiner tree problem in graphs (STP) arises in practical applications as one of many variants. A relationship exists between the different STP variants, suggesting the potential for a generic solver. However, problem specific solutions approaches are commonly observed. SCIP-Jack is a general purpose solver to solve both the STP and many of its variants. Transformations are employed that permit STPs to be solved using a MIP-framework. The result is a massively parallel general STP solver.

2 - Compact MIP Formulation of the Selective Delivery and Pickup Problem

Yuan Yuan Dong, Southern Methodist University, 3101 Dyer Street, Dallas, TX, 75205, United States of America, ydong@smu.edu, Eli Olinick

We present a compact MIP for the selective delivery and pickup problem with the objective of maximizing profit by accepting unscheduled deliveries during the time-limited trip. The MIP is inspired by a novel formulation of multicommodity flow that significantly reduces the size of the constraint matrix and the LP upper bound compared to a model based on the classical approach. This in turn leads to faster solution times when using commercial MIP codes, as we demonstrate in an empirical study.

3 - Solving A Real-world Snow Plow Optimization Problem: An Integrated Solution Approach

Joris Kinable, Post-doctoral Researcher, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, jkinable@cs.cmu.edu, Stephen F. Smith, Willem-Jan Van Hoeve

Each year, many northern cities are faced with significant expenditures pertaining winter road maintenance. Snow plowing constitutes a significant part of these costs. This work presents an integrated, adaptive solution approach for a real-world snow plow optimization problem. The large number of routing and scheduling constraints render this problem particularly hard to solve. The performance of our solution approach is demonstrated on data from the city of Pittsburgh (USA).

4 - On Solving Quadratic Assignment Problems in Wireless Communications

Hans Mittelmann, Arizona State University, Box 871804, Tempe, AZ, United States of America, mittelmann@asu.edu

In digital wireless communications optimal index assignment leads to difficult quadratic assignment problems. Those are standard QAPs for single transmissions or for sequential multiple transmissions. They become higher dimensional QmAPs when simultaneously optimizing over several retransmissions. We report on the exact and approximate solution of such problems that arise in practice.

■ WA21

21-Franklin 11, Marriott

Health Care Operations

Sponsor: Health Applications

Sponsored Session

Chair: Qiushi Chen, chenqiushi0812@gatech.edu

1 - Can an Early Warning Score Predict Patients' Hospital Length of Stay and Mortality?

Nasibeh Azadeh-fard, PhD Candidate, Virginia Tech, 544 Whittemore Hall, Virginia Tech, Blacksburg, VA, 24061, United States of America, nasibeh@vt.edu, Jaime Camelio, Navid Ghaffarzadegan

The Modified Early Warning Score (MEWS) is used in hospitals to quickly predict and prevent catastrophic events such as death. The prediction power of MEWS, however, is an empirical question. We analyze effectiveness of MEWS in a major hospital in the US over six months for a sample of 1021 patients. We find that MEWS modestly predicts hospital length of stay and death, while physicians' specific characteristics and their subjective assessments are much better predictors of health outcomes.

2 - Routing Patients to Community Health Services to Maintain Patient Access after Facility Merger

Aaron Ratcliffe, Assistant Professor, University of North Carolina at Greensboro, 438 Bryan Building, P.O. Box 26170, Greensboro, NC, 27402, United States of America, aaron.ratcliffe@uncg.edu

Merging the facilities dedicated to a health service may allow for cost savings in terms of economies of scale and other efficiency improvements at the expense of poorer access to services for patients. We develop a queueing network model to examine how a social planner should route heterogeneous patient classes to community health resources to improve patient access in the absence of a previously dedicated facility.

3 - Integrated Staff and Room Scheduling for Surgeries: Methodology and Application

Sandeep Rath, PhD Candidate, UCLA Anderson, B501 Gold Hall, UCLA Anderson, Los Angeles, CA, 90024, United States of America, Sandeep.Rath.1@anderson.ucla.edu, Kumar Rajaram

We consider the problem of minimizing resource usage and overtime costs across multiple parallel resources such as anesthesiologists and operating rooms at a large multi-specialty hospital. We develop a two stage optimization program with recourse. We develop a data driven robust optimization method that solves large-scale real-sized versions of this model close to optimality. We validate and implement this model as a decision support system at the UCLA Ronald Reagan Medical Center.

4 - Arbovirus Risk Maps in Texas

Xi Chen, University of Texas at Austin, Austin, TX 78712, Austin, TX, United States of America, carol.chen@utexas.edu, Nediako Dimitrov

Dengue fever and Chikungunya virus two key mosquito-borne diseases in Texas. To focus state resources, public health officials need to identify the geographic risk areas for these diseases. We consider thousands of possible risk models, based on maximum entropy methods, combined with data on the transmission vectors, environmental, and socio-economic factors. We select the best model empirically, using historical Texas Dengue data. The final model is in use by Texas health officials.

■ WA23

23-Franklin 13, Marriott

Stochastic Modeling and Analysis with Applications

Sponsor: Applied Probability

Sponsored Session

Chair: Jing Dong, Northwestern University, 2145 Sheridan Road, Tech C210, Evanston, United States of America, jing.dong@northwestern.edu

Co-Chair: Jose Blanchet, Associate Professor, Columbia University, 500 W 120th St., Mudd Building, IEOR, 3rd Floor., New York, NY, 10027, United States of America, jose.blanchet@columbia.edu

1 - Stationarity and Interchange of Limits in Heavy Traffic Analysis

Hengqing Ye, Associate Professor, Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong - PRC, lgyehq@polyu.edu.hk, David D. Yao

We develop a streamlined approach for justifying the heavy traffic stationary approximation of stochastic processing networks. First, we demonstrate that the stability of a deterministic dynamic complementarity problem is sufficient for both the diffusion limit and pre-limit networks to have stationary distributions. Then, given an additional mild condition, we show the convergence of stationary distributions of pre-limit networks to that of the diffusion limit.

2 - Resource Allocation in Bike Sharing using Coupling and Linear Programming

Shane Henderson, Professor, Cornell University, Rhodes Hall, Ithaca, NY, 14853, United States of America, sgh9@cornell.edu, David Shmoys, Eoin O'mahony

We propose an optimization problem that allocates bike racks and bikes to stations across a city. The objective is a transient performance measure from a continuous-time Markov chain. We show that the objective possesses a (joint) discrete convexity property that allows for efficient solution via linear programming. The proof uses a combination of geometrical arguments and coupling theory. The results are illustrated using Citibike data in NYC.

3 - Tail Analysis Without Tail Information: A Worst-case Perspective

Henry Lam, Assistant Professor, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, khlam@umich.edu, Clementine Mottet

One common bottleneck in tail modeling is that, due to their very nature, tail data are often very limited. Rather than using conventional parametric fitting, we will describe a robust alternative that is based on a worst-case analysis under the geometric premise of tail convexity. We demonstrate that the worst-case convex tail behavior is either extremely light-tailed or extremely heavy-tailed, and construct numerical schemes to distinguish between the two cases and find the worst-case tail.

4 - On the Stability of Matching Queues

Pascal Moyal, Université de Technologie de Compiègne, Rue du Dr Schweitzer, Compiègne, 6023, France, pascal.moyal@utc.fr, Ohad Perry

Consider a model in which, to each node of a graph G is associated an arrival process, and any entering item associated to node k either leaves the system if it finds in line, another item corresponding to a neighbor of k , or is stored in queue. Using fluid analysis, we investigate the stability of such matching models, which are of increasing practical importance. We show that, aside for a specific class of graphs, they can always be unstable even under a natural necessary stability condition.

■ WA24

24-Room 401, Marriott

Robustness and Approximation in Markov Decision Processes

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Marek Petrik, IBM, 1101 Kitchawan Rd., Yorktown Heights, NY, 10598, United States of America, mpetrik@us.ibm.com

1 - Algorithms for Risk-sensitive Optimization in MDPS

Mohammad Ghavamzadeh, Senior Analytics Researcher, Adobe Research, 321 Park Ave., E7412, San Jose, CA, 95126, United States of America, mohammad.ghavamzadeh@inria.fr

In many sequential decision-making problems we may want to manage risk by minimizing some measure of variability in costs in addition to minimizing a standard criterion. We consider variance-related and percentile-based risk-sensitive criteria. For each criterion, we devise algorithms for estimating its gradient and updating the policy parameters in the descent direction. We establish the convergence of our algorithms and demonstrate their usefulness in a variety of control problems.

2 - Ambiguous Joint Chance Constraints with Conic Dispersion Measures

Grani A. Hanasusanto, École Polytechnique Fédérale de Lausanne, EPFL-CDM-MTEI-RAO, Station 5, Lausanne, 1015, Switzerland, grani.hanasusanto@epfl.ch, Daniel Kuhn, Wolfram Wiesemann, Vladimir Roitch

We analyse the complexity of a class of ambiguous joint chance constrained programs where the uncertain parameters are described through their mean values and through upper bounds on general dispersion measures. We derive explicit conic reformulations for tractable problem classes and suggest efficiently computable conservative approximations for intractable ones. We illustrate the effectiveness of our reformulation in numerical experiments in project management and image denoising problems.

3 - Learning the Uncertainty in Robust Markov Decision Processes

Xu Huan, Assistant Professor, National University of Singapore, 9 Engineering Drive 1, Singapore, Singapore, mpexuh@nus.edu.sg, Shie Mannor, Shiao Hong Lim

Robust MDP models the parameter uncertainty as arbitrary element of uncertainty sets, and seeks the minimax policy. A crucial problem of robust MDP is how to find appropriate uncertainty. We address this using an online learning approach: we devise an algorithm that, without knowing the true uncertainty model, is able to adapt its level of protection to uncertainty, and in the long run performs as good as the minimax policy knowing the uncertainty model.

4 - Robust Approximate Dynamic Programming

Marek Petrik, IBM, 1101 Kitchawan Rd., Yorktown Heights, NY, 10598, United States of America, mpetrik@us.ibm.com

I describe how robust MDPs can be used to improve solution quality of both on-policy and policy approximate dynamic programming methods. The robustness addresses both model and sampling error. Finally, I show the utility of robust optimization when computing implementable policies in MDPs.

■ WA25

25-Room 402, Marriott

Managing Sustained Participation in Online Communities

Sponsor: Information Systems

Sponsored Session

Chair: Pratyush Nidhi Sharma, Assistant Professor, University of Delaware, 010 Purnell Hall, University of Delaware, Newark, DE, 19716, United States of America, pnsharma@udel.edu

1 - The Impact of Person-organization Fit and Psychological Ownership on Turnover in Open Source Software Projects

Tingting Rachel Chung, Chatham University, 106 Woodland Road, Pittsburgh, PA, United States of America, Rchung@chatham.edu, Pratyush Nidhi Sharma, Sherae Daniel

Open source software projects represent an alternate form of software production by relying on voluntary contributions. Most projects fail to sustain their development due to high turnover. Using 574 survey responses from GitHub, we examined the impact of Person-Organization fit and psychological ownership on developers' turnover intentions. Results show value and demands-abilities fit negatively impact turnover intentions and that psychological ownership moderates these effects.

2 - Coordinating Co-opetition: Insights from Open-source Cloud Software Development

Yash Raj Shrestha, ETH Zurich, Weinbergstrasse 56/58, Zurich, Switzerland, yshrestha@ethz.ch, Shiko Ben-Menahem, Georg Von Krogh

Using longitudinal data from OpenStack, an open-source cloud computing software development platform, this study explores why some participating firms exhibit greater success than others in their ability to coordinate activities in a co-opetitive ecosystem. Focusing on patterns of strategic task allocation and completion by firms facing strong competition for highly skilled developers, our study advances understanding on co-opetition and coordination in new organizational forms.

3 - The Movement of Open Source Communities

Georg J.P. Link, University of Nebraska Omaha, 6001 Dodge St, Omaha, NE, 68182, United States of America, glink@unomaha.edu, Matt Germonprez

In 2010, Oracle acquired OpenOffice during its acquisition of Sun Microsystems. At that time, community members formed the LibreOffice fork under The Document Foundation. And in the following year, Oracle transferred ownership of OpenOffice to the Apache Foundation. We explore thresholds for communal movement and how the transfer of open source projects affects the community. We find that understanding communities as movable reveals their nature as commoditized and consolidated objects of value.

■ WA26

26-Room 403, Marriott

Production and Scheduling II

Contributed Session

Chair: Katariina Kemppainen, School of Business, Aalto University, Runeberginkatu 22-24, Helsinki, 00076 Aalto, Finland, katariina.kemppainen@aalto.fi

1 - A Capacitated Multi-Item Lot-Sizing Problem with Stochastic Setup Times

Raf Jans, Professor, HEC Montreal, 3000 Chemin de la Cote-St-Catherine, Montreal, QC, H3T 2A7, Canada, raf.jans@hec.ca, Michel Gendreau, Duygu Tas, Ola Jabali

We introduce uncertainty with respect to the setup times in the standard capacitated lot sizing problem. The company fixes a production plan (i.e. timing and level of the production quantities). The company can use overtime if the given capacity is not sufficient due to the specific realizations of the setup times. We develop an efficient procedure to evaluate the expected overtime assuming a specific probability distribution. We also present several MIP-based heuristics to solve this problem.

2 - Issues in Batch Flowshop and Lot Streaming Problems

Ramakrishna Govindu, Instructor, University of South Florida, 8350 N Tamiami Tr, SMC-C263, Sarasota, FL, 34243, United States of America, rgovindu@sar.usf.edu, Anurag Agarwal

The lot streaming problem attempts to find sublots to reduce the makespan. We treat this problem as a multiobjective problem that attempts to strike a balance between makespan and cost of handling the sublots. We propose some heuristics and properties of the problem.

3 - Routing and Spectrum Assignment in Rings

Sahar Talebi, North Carolina State University, Operations Research and Computer Science, Raleigh, NC 27695, United States of America, stalebi@ncsu.edu

We present a theoretical study of the routing and spectrum assignment (RSA) problem in ring networks. We show that the RSA problem with fixed-alternate routing in general topology networks is a special case of a multiprocessor scheduling problem. We then investigate two problems: the spectrum assignment problem under the shortest path assumption and the general RSA whereby a routing decision must be made jointly with spectrum allocation. We then develop a suit of heuristic algorithms.

4 - Cutting Stock with Sequence Dependent Set-up Times: An Application to a Large Scale Industry Problem

David Wuttke, EBS University, EBS University, ISCM, Burgstr. 5, Oestrich-Winkel, 65375, Germany, david.wuttke@ebs.edu, Sebastian Heese, Florian Gojny

We consider a two-dimensional cutting stock problem with sequence dependent set-up times and tolerances as witnessed in textile and fiber-composite industries. To solve real-life instances we provide a decomposition heuristic that first identifies optimal cutting patterns and then optimizes their sequence by minimizing the number of knife relocations.

5 - Open Priority Scheduling Protocol for Sourcing and Supply Management

Katariina Kemppainen, School of Business, Aalto University,
Runeberginkatu 22-24, Helsinki, 00076 Aalt, Finland,
katariina.kemppainen@aalto.fi, Ari Vepsäläinen

Are you happy with the first-come-first-served priority rule when ordering goods online? The extensive scheduling literature has few answers from real-life applications, whereas in procurement case studies abound but theoretical analyses are few. We propose an open protocol for manufacturing and procurement which beats consistently not only FCFS but any other rule. It offers a sophisticated solution for one universal rule. Our protocol is backed up with simulation results and real-life cases.

■ WA27

27-Room 404, Marriott

Multi-objective Optimization and Applications

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Matthias Ehrgott, Professor, Department: Management Science, Lancaster University, The Management School, Lancaster, 00, LA1 4YX, United Kingdom, m.ehrgott@lancaster.ac.uk

1 - Ultra-high-dimensional Optimization for Trade Space Exploration: Challenges and Lessons Learned

Matthew Hoffman, Sandia National Laboratories, P.O. Box 5800
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America, mjhoffm@sandia.gov, Alexander Dessanti,
Stephen Henry, Jack Gauthier

In projects with many conflicting stakeholder objectives, negotiating compromise requires understanding tradeoffs. Existing multiobjective approaches build “coalitions” of objectives to reduce dimensionality – either explicitly via aggregation, or implicitly – which favors solutions that compromise across many objectives, but can severely obfuscate or distort the tradeoffs between them. We discuss our progress thus far in true ultra-high-dimensional optimization for trade space exploration.

2 - Special Constraint Treatment for Multi-objective Optimization

Sijie Liu, Graduate Student, University of Alabama, 714 1/2 12th
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sliu28@crimson.ua.edu

Several methods have been developed for finding pareto set and pareto front for multi-linear objective optimization problem subjective to one additional special constraint (such as bi-linear constraint or N-linear constraint) over a bounded interval domain subjective to linear equality constraint. These methods provide us fast approaches to plot the entire pareto frontier. Algorithms have been proved and numerical results demonstrate the effectiveness of these methods.

3 - A Nonparametric Approach to the Multi-Objective Sequential Decision Problem

Young H. Chun, Professor, Louisiana State University,
E. J. Ourso College of Business, Baton Rouge, LA, 70820,
United States of America, prof@drchun.net

Many choices are presented one at a time. You must decide whether to choose the current choice and stop the search process or to reject it and move to the next stage. The decision is irrevocable and each choice is evaluated based on multiple objectives. We propose a rank-based optimal decision strategy that minimizes the weighted rank of the selected choice. It can be shown that many sequential decision problems are special cases of the generalized multi-objective sequential decision problem.

4 - Deliverable Radiotherapy using Multiobjective Optimisation and Column Generation

Matthias Ehrgott, Professor, Department: Management Science,
Lancaster University, The Management School, Lancaster, 00,
LA1 4YX, United Kingdom, m.ehrgott@lancaster.ac.uk,
Kuan-min Lin

We propose a column generation based approach to compute deliverable radiotherapy treatment plans based on a multi-objective optimisation problem. We compute a representative set of non-dominated treatment plans using the revised normal boundary intersection method. The generation of each non-dominated treatment plan uses column generation to generate apertures that directly deliverable, obviating the need for a separate segmentation step that deteriorates plan quality.

■ WA28

28-Room 405, Marriott

Bidding Mechanisms

Cluster: Auctions

Invited Session

Chair: Bernardo Quiroga, Assistant Professor, Business and Behavioral Science, Clemson University, 100 Sirrine Hall, Clemson, SC, 29634, United States of America, bfquirog@gmail.com

1 - One-dimensional Strategyproof Facility Location

Itai Feigenbaum, Columbia University, New York, NY,
United States of America, itai@ieor.columbia.edu, Chun Ye,
Jay Sethuraman

Consider a set of agents on an interval, where a planner wishes to locate a facility so as to maximize some social benefit function. The agents have linear preferences over the location of the facility, and their locations are unknown to the planner. Thus, the planner wishes to locate the facility in a strategyproof manner while approximating social benefit. We discuss mechanisms, lower bounds, and characterizations for various versions of this model.

2 - Greening Multi-tenant Data Center Demand Response with Supply Function Bidding

Niangjun Chen, California Institute of Technology, Pasadena, CA,
United States of America, ncchen@caltech.edu, Adam Wierman,
Shaolei Ren, Xiaoqi Ren

Data centers have become critical resources for emergency demand response (EDR). In this talk, we focus on “greening” demand response in multi-tenant data centers by incentivizing tenants’ load reduction and reducing on-site diesel generation. Our proposed mechanism, ColoEDR, which is based on parameterized supply function mechanism, provides provably near-optimal efficiency guarantees, both when tenants are price-taking and when they are price-anticipating.

3 - Optimal Bidding for Bundles in Sequential Auctions

Karti Puranam, Assistant Professor, La Salle University, 1900 W
Olney Ave, Philadelphia, PA, 19141, United States of America,
puranam@lasalle.edu, Michael Katehakis

We study the problem of optimal bidding for a firm that in each period procures items to meet a random demand by participating in a finite sequence of auctions where in each auction involves bids for bundles of items. We develop a new model for a firm where its item valuation derives from the sale of the acquired. We establish monotonicity properties for the value function and the optimal dynamic bid strategy and we present computations.

4 - Complexity and Transparency in Sealed-bid Procurement Auctions with Multi-dimensional Bids

Bernardo Quiroga, Assistant Professor, Business and Behavioral Science, Clemson University, 100 Sirrine Hall, Clemson, SC,
29634, United States of America, bfquirog@gmail.com,
Brent Moritz, V. Daniel R. Guide, Jr.

We experimentally analyze A+B (price-and-quality) bidding behavior in two closely related sealed-bid scenarios: One where the rule to assign the contract is transparently communicated to bidders before they submit their offers, and another where the assignment rule is only known to the buyer and not to the bidders. Our results show substantial losses in terms of social welfare and buyer surplus as a direct effect of transparency loss in this procurement system.

■ WA29

29-Room 406, Marriott

Applied Analytics

Sponsor: Analytics

Sponsored Session

Chair: Jon Alt, Assistant Professor, Naval Postgraduate School, Department of Operations Research, Naval Postgraduate School, Monterey, CA, 93943, United States of America, jkalt@nps.edu

1 - Improved U.S. Army Reserve Stationing using Recruitable Market Demographics

Nathan Parker, U.S. Army, 4120 Crest Rd, Pebble Beach, CA,
93953, United States of America, nparker@nps.edu

The objective of this work is to develop a model to predict a U.S. Army Reserve (USAR) unit's manning level based on the demographics of the unit's reserve center recruitable market (RCRM). This study first develops an allocation method to determine the RCRM available to each reserve center. Classification and regression models are then developed to determine the ability of the RCRM to support the reserve center's manning requirements.

2 - Comprehensive Analysis of the U.S. Army's Global Assessment Tool

Cardy Moten, Maj, TRADOC Analysis Center-Monterey, 700 Dyer Road, Room 183, Monterey, CA, 93943, United States of America, cmoten@nps.edu

The focus of this research is to investigate new interpretations of the Global Assessment Tool in order to provide more informed feedback to the Soldier and improve prediction of Soldier outcomes. We used factor analysis, cluster analysis, and data visualization techniques to evaluate similarities and differences between the services and provide a more comprehensive picture of the component data that is more readily understood by Soldiers.

■ WA30

30-Room 407, Marriott

Information Systems for E-Business/Commerce

Contributed Session

Chair: Anwesha Bhattacharjee, Student, University of Texas, Dallas, 2200 Waterview Pkwy, #1836, Richardson, TX, 75080, United States of America, axb094820@utdallas.edu

1 - Investigating the Effect of Social Connections on Usefulness of Online Reviews

Pouya Khansaryan, University of Connecticut, 101 South Eagleville, Apt. 18B, Storrs, CT, 06268, United States of America, seyedamirpouya.khansaryan@business.uconn.edu

Online reviews are a form of eWOM which are nowadays available to prospective customers. In this study, we try to answer the question: "what are the key factors that contribute to the consumer's perception of the usefulness of online reviews?". The data from Yelp in different time spots show that star ratings, total votes, review length, average writer's star rating, number of fans and elapsed time are the most significant measures for the perceived usefulness.

2 - Online Activities in Virtual World and Money Spending in Real World

Gwangjae Jung, Korea Information Society Development Institute, 18, Jeongtong-ro, Deoksan-myeon, Jincheon, Korea, Republic of, indioblu@gmail.com, Youngsoo Kim

We examine the relationship between online activities virtual world and money spending in real world. We collected users' log data in an online game from Feb. to Aug. 2010. Our analyses show that virtual money spending complements real money spending in playing an online game. Another finding is that group play in an online game facilitates real money spending on avatar decorations, but not on gaming efficiency. Real money spending also decreases as users advance to the latter stage of game.

3 - Differences in Hedonic and Utilitarian Apps through Consumer Addiction, Frustration and Evaluation

Bidyut Hazarika, University of Colorado Denver, 1475 Lawrence St, Denver, CO, 80202, United States of America, bidyut.hazarika@ucdenver.edu, Madhavan Parthasarathy, Jahangir Karimi, Jiban Khuntia

Hedonic and utilitarian apps differ in addiction, frustration and subsequent evaluation scores. This study analyzes scores on these factors for more than 18136 apps data to establish this differentiation values using interaction models and econometric analyses.

4 - How Could We Cope with Malicious Rater? A New Detection Method for Trustworthy Reputation Systems

Yuanfeng Cai, CUNY—Baruch College, 55 Lexington Ave, New York, NY, United States of America, Yuanfeng.Cai@baruch.cuny.edu, Dan Zhu

Reputation systems are vulnerable to rating fraud. To address it, we use data from TripAdvisor, Expedia and Amazon to empirically exploit the rating time series features of malicious rater. Then we propose the two-phase method for detection. First, it examines the rating series associated with each entity and filters out those under attack. Second, the clustering method is applied to discriminate malicious raters. Experimental studies have demonstrated the effectiveness of the proposed method.

5 - Searching the Global Distribution System: A Double-edged Sabre

Anwesha Bhattacharjee, Student, University of Texas, Dallas, 2200 Waterview Pkwy, #1836, Richardson, TX, 75080, United States of America, axb094820@utdallas.edu, Vijay Mookerjee, Mehmet Ayyaci, Radha Mookerjee

As the demand for travel grows, so does the need for travel agencies. Travel agencies, in turn, use a global distribution system to find the appropriate service for their clients. In this paper, we look at one such travel service market segment: hotel shopping. We identify search behaviors among agencies and we identify the tradeoff for the global distribution system itself which invest millions on setting up the search want to increase the number of bookings with the minimum number of searches.

■ WA31

31-Room 408, Marriott

Data Mining for Environmental and Natural Hazard Applications

Sponsor: Data Mining

Sponsored Session

Chair: Seth Guikema, Associate Professor, Johns Hopkins University, 3400 N Charles Street, Ames Hall 313, Baltimore, MD, 21218, United States of America, sguikem1@jhu.edu

1 - Data Mining Approaches to Characterize Non-uniform Wind Farm Power Production

Andrea Staid, PhD Candidate, Johns Hopkins University, 3400 N. Charles St., 313 Ames Hall, Baltimore, MD, 21218, United States of America, astaid@gmail.com, Claire Verhulst, Seth Guikema

Power production of wind farms with non-uniform layouts is more difficult to analyze using traditional wake-decay models. We present some of the discrepancies that arise when modeling these types of farms and highlight the sources of error. We then present new methods to characterize farm production based on data mining instead of wake modeling, and we show the benefits of using these methods in conjunction with more traditional means.

2 - Analysis of Low Probability Streamflow Outcomes in the Mid-atlantic Region

Gina Tonn, PhD Candidate, Johns Hopkins University, 115 Broadbent Road, Wilmington, DE, 19810, United States of America, gtonn2@jhu.edu, Seth Guikema

Standard flood frequency analysis methods are widely used, but involve much uncertainty and low probability outcomes can occur. In this study, statistical analysis is used to identify watershed characteristics that are correlated with low probability streamflow outcomes. Methods include a Random Forest model and clustering analysis.

3 - Data Mining for Understanding Tsunami Death Rates in Japan

Seth Guikema, Associate Professor, Johns Hopkins University, 3400 N Charles Street, Ames Hall 313, Baltimore, MD, 21218, United States of America, sguikem1@jhu.edu, Roshanak Nateghi

Then 2011 Tsunami in Japan caused widespread destruction and led to a large number of deaths. It was the most recent in a strong of tsunamis in the Tohoku region of Japan. We use data from the 1896, 1933, 1960, and 2011 tsunamis together with modern data mining methods to better understand the factors affecting death rates during these events.

4 - Prediction of Mean Harvest Weight of Royal Gala Apples

Tom Logan, PhD Student, University of Michigan, 3700 N Charles Street, Baltimore, MD, 21218, United States of America, tom.logan@jhu.edu, Seth Guikema, Stella Mcleod

Early prediction of the mean harvest size of apples is useful for decision makers in the apple and horticultural industry. Decisions including logistics and marketing are made prior to harvest and are generally based on estimates of the crop. A random forest model was developed using data for the apple variety Royal Gala from orchards within the Hawkes Bay Region of New Zealand. For the eight years of data available it has been shown to have a mean predictive error of 2.4%.

■ WA32

32-Room 409, Marriott

Data Mining with Marketing Applications

Contributed Session

Chair: Elham Khabiri, IBM, 1101 Kitchawan Rd, Yorktown Heights, NY, United States of America, ekhabiri@us.ibm.com

1 - Evaluating Database Marketing Models: More than Meets the Eye

Sam Koslowsky, Senior Analytic Consultant Modeling Solutions and Delivery, Harte Hanks, 2118 Avenue T, Brooklyn, NY, 11229, United States of America, sam.koslowsky@hartehanks.com

Managers are most pleased with using the gains table to assess their predictive models. Identifying more 'HIVES' at the top, and fewer on the bottom is most desirable. But, more needs to be examined. Some use standard statistical criteria. This may be fine. But, some common sense features are frequently ignored as it relates to model evaluation and the gains table. These include variations in lift, unevenness in decile performance, the stability of predictions and the interpretations of results.

2 - Marketing-driven Content Management in Large Organizations

Roman Vaculin, IBM, 1101 Kitchawan Rd, Yorktown Heights, NY, United States of America, vaculin@us.ibm.com, Yi-min Chee, Ashish Jagmohan, Elham Khabiri, Richard Segal, Noi Sukaviriya

Content management in large organizations is a complex process involving range of approaches such as text analysis or classification with taxonomies. We focus on facilitating management of legacy and creation of new content to improve marketing content effectiveness. We discuss techniques for (1) content characterization based on semantic concept models, (2) mapping textual content to legacy taxonomies, and (3) taxonomy enhancement for data-driven taxonomy rationalization, extension and mapping.

3 - Product Recommendations with Discovered Hidden Topics in Online Reviews

Julie Zhang, Assistant Professor, University of Massachusetts Lowell, One University Ave., Lowell, MA, 01854, United States of America, juheng_zhang@uml.edu

We use LDA (latent Dirichlet Allocation) to discover hidden information embedded in online product reviews for consumers to make informed purchase decisions. The discovered topics are used to make product recommendations to offer consumers better utility.

4 - Towards Automatic Identification of B2B Marketing Prospects

Elham Khabiri, IBM, 1101 Kitchawan RD, Yorktown Heights, NY, United States of America, ekhabiri@us.ibm.com, Roman Vaculin, Richard Hull, Matthew D. Riemer

In B2B marketing, it is critical to identify marketing leads effectively. We investigate into what extent the B2B leads identification process can be automated using online and historical data, and if algorithmic leads mining can achieve better performance than leads identified by human experts. We present a solution that combines deep learning to identify look-a-like companies with respect to historical leads, and mining of online data for identification of signals indicating potential leads.

■ WA33

33-Room 410, Marriott

Data-driven Healthcare Operations

Sponsor: Health Applications

Sponsored Session

Chair: Muge Capan, Value Institute, Christiana Care Health System, 4755 Ogletown-Stanton Road, John H. Ammon Medical Education Center, Newark, DE, 19718, United States of America, Muge.Capan@ChristianaCare.org

1 - Determining an Optimal Schedule for Pre-mixing Chemotherapy Drugs

Donald Richardson, University of Michigan, Ann Arbor, MI, donalric@umich.edu, Amy Cohn

In collaboration with the University of Michigan Comprehensive Cancer Center, we have developed a data-driven, optimization-based approach to improving the timeliness of drug preparation for chemotherapy infusion patients while reducing staff workload and improving resource utilization. We compare the results from both static and dynamic decision policies to determine the optimal schedule for pre-mixing chemotherapy drugs at the cancer center.

2 - Using Text Analytics to Identify Labor and Delivery Sentiment from the Internet and Social Media

Karen Hicklin, PhD Student, North Carolina State University, 111 Lampe Drive, Campus Box 7906, Raleigh, NC, 27695, United States of America, kthickli@ncsu.edu, Julie Ivy, Fay Cobb Payton, Evan Myers, Meera Viswanathan, Michael Wallis, Vidyadhar Kulkarni

Pregnant women often seek counsel online from doctors, midwives, experienced and other expectant mothers to understand if their experience lines up with that of others and to seek opinions, suggestions and recommendations. We use text analytics to identify key attributes and preferences for women from internet data to identify important attributes that influence patient perceptions in regards to the birth experience that can be used as input parameters to inform delivery mode decision models.

3 - Data-driven and Analytical Approaches to Falls Injury Prediction and Rescue Resources Allocation

Tze Chiam, Associate Director, Research Informatics, Christiana Care Health Systems, 4755 Ogletown-Stanton Road, Newark, DE, 19718, United States of America, Tze.C.Chiam@ChristianaCare.org, Kristen Miller, Bailey Ingraham Lopresto

As an effort to improve patient safety, Christiana Care Health Systems embarked on work to evaluate current rescue strategies for patient fall events. This study investigates the use of age, bone density, coagulation, surgery and fall type to

identify patients at high risk for injury due to falls and the appropriate responses based on these criteria. A discrete-event simulation is used to evaluate rescue strategies that yield fastest response time while minimizing interruptions to the system.

4 - Nurse Scheduling Optimization in the Neonatal Intensive Care Unit

Muge Capan, Value Institute, Christiana Care Health System, 4755 Ogletown-Stanton Road, John H. Ammon Medical Education Center, Newark, DE, 19718, United States of America, Muge.Capan@ChristianaCare.org, Eric V. Jackson, Robert Locke

Nurse scheduling is the process of assigning nurses to work shifts. A suboptimal schedule can impact the staffing ratios, nurses' well-being, job satisfaction, and quality of care. Nurse scheduling in the Neonatal Intensive Care Unit is particularly challenging due to the complexity of care environment and required nursing skillset. We present a multi-objective optimization approach to allocate nurses to shifts while considering institutional requirements, workload fairness and nurses' health.

■ WA34

34-Room 411, Marriott

Real World Problems, Innovative Approaches and Implementations at Geisinger Health System

Sponsor: Health Applications

Sponsored Session

Chair: Christopher Stromblad, Senior Modeler - Operations Research, Geisinger Health System, 100 N. Academy Ave, Danville, PA, 17822, United States of America, ctstromblad@geisinger.edu

1 - Implementing Predictive Models in Five Operating Suites Improved Surgical Case Duration Accuracy

Ronald Dravenstott, Geisinger Center for Healthcare Systems Engineering, 100 N Academy Ave, Danville, PA, 17822, United States of America, rwdravenstott@geisinger.edu, Eric Reich, Cheng-bang Chen, Priyantha Devapriya

The length of a surgical procedure is generally predicted using a moving average of previous procedures performed by a given surgeon, a method which is often inaccurate and complicates Operating Room scheduling. This research developed and implemented predictive models for high-volume surgeries to seamlessly improve surgical scheduling by leveraging patient and provider data. The models now in place overcame real-time data inconsistencies and have improved scheduling.

2 - Anticipating Provider Orders in Outpatient Clinics

Yi-shan Sung, Research Assistant, Penn State, 425 Waupelani Dr., Apt. 509, State College, PA, 16801, United States of America, yqs5097@psu.edu, Ronald Dravenstott, Priyantha Devapriya, Soundar Kumara

Understanding provider ordering patterns for patients can enhance resource utilization in hospitals. By using patient and provider retrospective data, this research aims to develop statistical and network-based techniques to predict orders for upcoming appointments. These predictions can lead to a recommendation system supporting providers to increase order effectiveness and ease order documentation. The models will be validated with outpatient data from pulmonary clinics.

3 - RTLS Data Applications in Healthcare Analytics and Modeling

Seth Hostetler, Lead Process Engineer, Geisinger Health System, 100 N Academy Ave, Danville, PA, 17822-2550, United States of America, sthostetler@geisinger.edu

Often, when developing models in healthcare, the lack of accurate and complete data is cited as a limitation. A real-time location system is able provide additional information concerning patient, staff, and asset locations and flows. This presentation will present results from applications in three application areas (ambulatory, inpatient, and emergency department) where RTLS data has been utilized to provide additional insight via analytic methods and improved modeling capabilities.

4 - Outpatient Clinic Provider Scheduling under Uncertainty

Deepak Agrawal, PhD Candidate, Pennsylvania State University, 801 Southgate Drive, A4, State College, PA, 16801, United States of America, dual43@psu.edu, Christopher Stromblad, Soundar Kumara, Mort Webster

Current clinic provider scheduling systems are inefficient, because scheduling is done manually and months in advance, most of the demand, capacity, and other constraints and their uncertainties are not considered. There is no objective way to evaluate the quality of a schedule; until after the fact. Therefore, the original schedule becomes suboptimal at the time of realization. A stochastic program to provider scheduling is proposed considering demand and capacity uncertainties using real data.

■ WA36

36-Room 413, Marriott

Joint Session PPSN/TSL: Network Infrastructure Recovery and Resilience

Sponsor: Public Sector OR and TSL

Sponsored Session

Chair: Ozlem Ergun, Assoc. Prof, Northeastern University, 360 Huntington Avenue, Boston, ma, 02115, United States of America, o.ergun@neu.edu

1 - Restoration of Network Connectivity in Large-scale Disaster Response Problems

Aybike Ulsan, PhD Student, Northeastern University, 360 Huntington Avenue, Boston, MA, 02115, United States of America, ulsan.a@husky.neu.edu, Ozlem Ergun

The goal of this study is to establish the connectivity of a disrupted road network in a timely manner by determining a schedule for recovering/repairing damaged edges. Due to the complex nature of the problem, we propose a heuristic that prioritizes the edges based on their head and tail nodes' centrality measures. By capturing the particular features of the network topology with these measures, we are able to acquire near-optimal solutions in a rapid fashion.

2 - On the Value of Information-sharing in Interdependent Infrastructure Restoration

Thomas Sharkey, Rensselaer Polytechnic Institute, 110 8th Street, Troy, NY, 12180, United States of America, sharkey@rpi.edu, Huy Nguyen, John Mitchell, William Wallace

We consider the problem of restoring multiple disrupted infrastructure networks after an extreme event. This work analyzes the loss in restoration effectiveness resulting from decentralized planning across these networks in forming their restoration plans. We then examine different levels of information-sharing schemes and their impact in reducing this loss. Computational results based on realistic damage scenarios to networks are presented.

3 - An Integrated Network Design and Scheduling Problem for Network Restoration

Suzan Afacan, Graduate Student, University of Wisconsin Madison, 1415 Engineering Dr, Madison, WI, 53706, United States of America, iloglu@wisc.edu, Laura McIay

Infrastructure recovery is important for delivering time-sensitive services and commodities after a disaster. To examine this issue, we present an extension of the p-median problem that allows for network components to be installed by repair crews with a goal of minimizing the cumulative weighted distance. The model is illustrated with a computational example.

■ WA38

38-Room 415, Marriott

Bayesian Approach I

Contributed Session

Chair: Babak Zafari, The George Washington University School of Business, 2201 G Street NW, Funger Hall, Suite 415, Washington, DC, United States of America, zafari@gwu.edu

1 - Bayesian Inference for Deadline Reactivity

Ji-eun Kim, PhD Student, The Pennsylvania State University, Department of Industrial Engineering, 310 Leonhard Building, University Park, PA, 16802, United States of America, jxk594@psu.edu, David A. Nembhard

In time management phenomenon, human generally exhibit the rush before a deadline. This means relatively little time is devoted to tasks at the beginning, and most of the work is performed in close time proximity to the deadline. A Bayesian inference is applied to course website data to obtain reliable individual differences in pacing styles. We observe large reductions in error on data sets, which suggests that Bayesian estimation is a useful tool for learning deadline reactivity.

2 - Bayesian Estimation of Time of the First Bid in Retail Secondary Market Online Auctions

Babak Zafari, The George Washington University School of Business, 2201 G Street NW, Funger Hall, Suite 415, Washington, DC, United States of America, zafari@gwu.edu

In this work, we propose to develop a model to estimate the distribution of the time of the first bid in retail secondary market online auctions. The proposed estimation is based on a Bayesian mixture model of finite beta distributions. Our main interest is to study this distribution from auctions heterogeneity point of view. We also discuss managerial implications and suggest how auctioneers can benefit from this study.

3 - A Framework for Pediatrics Clinic No-show Prediction using Elastic Net and Bayesian Belief Network

Kazim Topuz, Wichita State University, 3737 N. Rushwood St. Apt. 1205, Wichita, KS, 67226, United States of America, mktopuz@gmail.com

This study predicts the no-show probability of the patient with using demographic, social and appointment as well as appointment attendance information. We develop a hybrid probabilistic prediction framework based on statistics and Bayesian network. We utilized Elastic Net for selection of the variables and state of art structural learning algorithm for building the Bayesian Belief Network.

■ WA39

39-Room 100, CC

Supply Chain Management with Marketing Considerations

Cluster: Operations/Marketing Interface

Invited Session

Chair: Yusen Xia, Georgia State University, 35 Broad St., Atlanta, GA, United States of America, yxia@gsu.edu

1 - Product Quality Strategy in the Presence of Consumer Heterogeneity of Technology Platform

Xiuli He, University of North Carolina Charlotte, 9201 University City Blvd, Charlotte, NC, United States of America, xhe8@uncc.edu, Yong Zha

This paper investigates quality strategy of the technology product which is attached to the platform when consumers convey a transaction utility on platform. We show that seller will choose different product quality strategies when consumers are homogeneous or heterogeneous on platform and seller has different platform cost strategies.

2 - Modeling Risk and Ambiguity-on-Nature in Normal-Form Games

Jian Yang, Associate Professor, Rutgers University, 1 Washington Park RM1084, Newark, NJ, 07102, United States of America, jyang@business.rutgers.edu

We propose multi-player frameworks that mitigate decision-theoretical difficulties with the traditional normal-form game. We react to Allais's (1953) paradox by concerning players with potentially nonlinear functionals of the payoff distributions they encounter. To deal with Ellsberg's (1961) paradox, we let players optimize on vectors of payoff distributions in which every component corresponds to one nature action. Equilibria are linked to nonlinear programs.

3 - Supply Chain Excellence and Firm Values

Min Shi, Associate Professor, California State University, Los Angeles, 5151 University Drive, Los Angeles, CA, 90032, United States of America, mshi2@exchange.calstatela.edu, Wei Yu

We empirically investigate the impacts of supply chain excellence, measured by AMR Research's Supply Chain Top 25 list, on firms' financial market performance under different macroeconomic scenarios from 2004-2014. In addition, this paper examines how the characteristics of SCM excellence influence the leading SCM firms on the financial market.

4 - Price or Quality-based Competition and Channel Structure with Consumers Loyalty

Sujan Wang, Institute of Management and Decision, Shanxi University, NO. 92 Wucheng Road, Xiaodian District, Taiyuan, 030006, China, tt_kkcn@sxu.edu.cn, Qiying Hu

In the practices of Chinese household appliance industry, we introduce a model for two manufacturers with different customer loyalty who may sell products through a decentralized channel or an integrated channel to consumers and face deterministic demand depending on quality, retail price and customer loyalty. We show that channel choices are closely related to market types and find decentralized channel structures is more likely.

■ **WA40**

40- Room 101, CC

Marketing III

Contributed Session

Chair: Fouad El Ouardighi, ESSEC Business School, BP 105, Cergy Pontoise, 95021, France, elouardighi@essec.fr

1 - Segment's Competitive Environment and Dynamics of Segment Entry and Segment Exit

Setiadi Umar, PhD Candidate, Rutgers Business School, 1 Washington Park, Newark, NJ, 07102, United States of America, setiadi.umar@rutgers.edu, Sengun Yenyurt

This study examines how segment's competitive conditions influence firms' patterns of segment selection: which segment to enter to and which segment to exit from in the context of business ecosystems. The study showed that high concentration and low density segment attract potential entrants to enter the segment and inhibit incumbents in the segment to exit. However, competitors' competitive moves might counter this condition.

2 - Optimal Promotion Strategies

Krista Foster, PhD Candidate, University of Pittsburgh, Katz Graduate School of Business, 241 Mervis Hall, Pittsburgh, PA, 15260, United States of America, kmf88@pitt.edu, Jennifer Shang

Given a portfolio of three products and a fixed pool of consumers, which form of promotion will maximize a seller's profits? We consider a number of promotional strategies to determine if and when each is optimal.

3 - The Marketing Dilemma: To Market or Not to Market During a Competitor's Product Harm Crises

Amirhossein Alamdar Yazdi, PhD Student, 121 Presidents Drive, 24 Rolling Green Drive, Amherst, MA, 01003, United States of America, aalamdaryazd@som.umass.edu, Adams Steven

What is the impact of advertising on a firm's performance during unfavorable news coverage of a close competitor? Positive? Likely. Negative? Possible. This study investigates the effect of advertising intensity on a firm's marketing and financial performance and the moderating influence of a competitor's product recalls.

4 - Advertising and Quality-Dependent Word-of-Mouth in a Contagion Sales Model

Fouad El Ouardighi, ESSEC Business School, BP 105, Cergy Pontoise, 95021, France, elouardighi@essec.fr, Dieter Grass, Richard Hartl, Peter Kort, Gustav Feichtinger

The omission of negative evaluations by current customers in contagion sales models and, more importantly, of the originating factors of such negative evaluations, may lead to prescribing of improper communication policy and therefore poor brand building strategy. This paper bridges the gap by suggesting a sales model where both positive and negative word-of-mouth affect the attraction rate of new customers, along with advertising.

■ **WA41**

41-Room 102A, CC

Healthcare Operations Management

Sponsor: Manufacturing & Service Oper Mgmt/Healthcare Operations

Sponsored Session

Chair: Andrew Trapp, Assistant Professor, Worcester Polytechnic Institute, 100 Institute Rd., Worcester, MA, 01609, United States of America, atrapp@wpi.edu

1 - Impact of Breast Density on Designing Mammography Screening Policies

Mucahit Cevik, University of Wisconsin - Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, cevik2@wisc.edu, Burhaneddin Sandikci

Mammography screening is the golden standard for breast cancer screening, but it is also known to be less accurate for women with dense breasts. Therefore, some patients are often referred to receive supplemental screenings. We incorporate the breast density information to the breast cancer screening decisions and use a discrete-time partially observable Markov decision process model to assess the effectiveness of the supplemental screening tests.

2 - A Simulation Model for the Heart Allocation Process

Farhad Hasankhani Kohneh Sh, PhD Graduate Assistant, Clemson University, #4, 129 Freeman Hall, Clemson University, Clemson, SC, 29631, United States of America, fhasank@g.clemson.edu, Amin Khademi

Heart failure occurs when a heart loses its ability to properly circulate blood in the body. Over 5.8 million people in the US are suffering from heart failure. Heart transplantation is a life-saving treatment for such patients. The Number of donors, the only source of hearts, is limited, and demand far exceeds supply. In this study we create a simulation model to investigate the impacts of a variety of allocation policies on several outcomes such as expected life-years of the population.

3 - Scheduling with Stochastic Processing Times in a Medical Clinic

David Phillips, dphillip@usna.edu, Marcus Colyer, Marisa Molkenbuhr

We consider the problem of scheduling patients in a medical clinic. Patients must see one of the clinic's doctors and some must also receive a scan prior to seeing the doctor. Complications of the problem include stochastic processing times and model selection based on the decision problem of interest. We present models as well as computational results based on both integer programming and approximation algorithms approaches.

4 - Optimal Adjusted Panel Size for Balancing Patient and Physician Risk

Zelda Zabinsky, Professor, University of Washington, Industrial and Systems Engineering, Box 352650, Seattle, WA, 98195, United States of America, zelda@u.washington.edu, David Linz, Hao Huang, Paul Fishman, Joseph Heim

An issue in healthcare is sizing physician adjusted panels. Patient concerns (wait time, disruption of care, inequitable care) as well as physician concerns (inequitable workload, panel size preference) need to be balanced in any fair strategy for adjusted panel size. This paper proposes a multi-objective optimization model for minimizing the risk of patient and physician concerns that accounts for acute instances of inequality and risk. We provide an efficient frontier for administrative use.

■ **WA43**

43-Room 103A, CC

Choice Modeling Applications in Revenue Management

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Adam Elmachtoub, Assistant Professor, Columbia IEOR, 500 West 120th St, New York, NY, United States of America, adam@ieor.columbia.edu

1 - Revenue Management under the Markov Chain Choice Model

Huseyin Topaloglu, Professor, Cornell University, 223 Rhodes Hall, Ithaca, NY, 14853, United States of America, ht88@cornell.edu, Jacob Feldman

We consider static assortment, network revenue management and single-leg revenue management problems under the Markov chain choice model. For static assortment problem, we give structural properties of the optimal assortment. For network revenue management, we give a tractable linear programming formulation. For single-leg revenue management, we characterize the optimal policy as a protection level policy.

2 - A Multi-attempt Approximation of Choice Model

Hakjin Chung, Stephen M. Ross School of Business, University of Michigan, Ann Arbor, MI, United States of America, hakjin@umich.edu, Boying Liu, Hyun-soo Ahn, Stefanus Jasin

We consider the problem of approximating an arbitrary mixture of logits with a series expansion. The degree of the expansion can be interpreted as the number of attempts that a customer is willing to make before leaving the system because his preferred product is not available. There are at least two benefits of using this approximation: the optimization problem becomes tractable and its parameters can be estimated using linear regression. We derive some bounds.

3 - Managing Product Transitions via Strategic Customer Selection

Roger Lederman, IBM, T. J. Watson Research Center, Yorktown Heights, NY, United States of America, rldederm@us.ibm.com, Adam Elmachtoub

The talk will discuss tools for shaping demand to better match supply capabilities, with a specific focus on product transitions. We describe a framework for managing transitions, including the role that sales targeting can have in shaping customer decisions. We then formulate as a customer selection problem in which a seller with limited inventories must prioritize sales effort across a set of heterogeneous customers with differing historical patterns of adoption.

4 - A Dynamic Learning Approach for Personalized Promotion Recommendations

Adam Elmachtoub, Assistant Professor, Columbia IEOR, 500 West 120th St, New York, NY, United States of America, adam@ieor.columbia.edu, Markus Ettl, Sechan Oh, Marek Petrik

Many companies are aiming to offer real-time personalized promotions to online shoppers with the goal of increasing conversion rates and revenue. In this work, we provide a dynamic learning model and algorithm that simultaneously maximizes revenue while learning how customers choose based on their attributes and the promotions they receive. We provide theoretical bounds on the regret as well as new analytical tools to determine feature importance in the context of promotion recommendations.

■ WA44

44-Room 103B, CC

Dynamic Pricing

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Candace Yano, University of California, Berkeley, IEOR Dept. and Haas School of Business, Berkeley, CA, 94720, United States of America, yano@haas.berkeley.edu

1 - Optimal Dynamic Pricing for Trade-in Programs

Mohammad Ghuloum, Doctoral Student, Indiana University, 1309 E 10th St, Bloomington, IN, 47405, United States of America, mghuloum@indiana.edu, Goker Aydin, Gilvan (Gil) Souza

Trade-in managers continuously monitor their inventory of used products, and adjust the acquisition and selling prices accordingly. Considering such a firm, we study a novel dynamic pricing problem, where not only the demand of the product is random and sensitive to the selling price, but also its supply is random and sensitive to the acquisition price.

2 - Pricing in Crowdfunding

Ming Hu, Associate Professor, University of Toronto, 105 St. George Street, Toronto, Canada, Ming.Hu@Rotman.Utoronto.Ca, Mengze Shi, Xi Li, Longyuan Du

We study the pricing decisions under an all-or-nothing crowdfunding scheme. First, menu or intertemporal pricing is more likely than a single price to be optimal. Second, dynamic pricing (contingent on the pledge amount) can help the creator to stay over the funding tipping point over time, increasing success rate and profitability.

3 - Dynamic Competition under Market Size Dynamics:

Balancing the Exploitation-induction Trade-off

Nan Yang, Assistant Professor, University of Washington at St. Louis, St. Louis, MO, 63130, United States of America, yangn@wustl.edu, Renyu Zhang

We study a dynamic competition model, in which retail firms periodically compete on promotional effort, sales price, and service level over a finite planning horizon. The key feature of our model is that the current decisions influence the future market sizes through the service effect and the network effect. Using the linear separability approach, we characterize the pure strategy Markov perfect equilibrium in both the simultaneous competition and the promotion-first competition.

4 - Optimizing Pre-season Order Quantities in the Presence of Planned Promotions

Dimin Xu, UC Berkeley, Haas School of Business, Berkeley, CA, United States of America, dimin_xu@haas.berkeley.edu, Candace Yano

Most retailers plan major promotions well before a product's selling season, possibly to coincide with storewide sales events. We optimize the pre-season order quantity for a product considering planned promotions (and consequent time-varying prices), when demand is price- and time-sensitive and stochastic. Our approach accounts for both systematic fluctuations and uncertainty in the implied salvage value over the season. We present structural results and managerial insights.

■ WA45

45-Room 103C, CC

Topics in Revenue Management

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Florin Ciocan, INSEAD, Boulevard de Constance 77305, Fontainebleu, France, florin.ciocan@insead.edu

1 - When Fixed Pricing Meets Priority Auctions: Service Systems with Dual Modes

Jiayang Gao, PhD Candidate, Cornell University, 507 Hasbrouck Apts, Ithaca, NY, 14850, United States of America, jg838@cornell.edu, Huseyin Topaloglu, Krishnamurthy Iyer

Suppose a firm offers two modes of service: a fixed price, FIFO queue, and a priority queue. Customers choose a mode to participate, as well as their bids if they join the priority queue. We prove that in the unique symmetric equilibrium, customer behavior has a threshold structure, in which customers with very high and very low patience levels join the priority queue, whereas those with intermediate patience levels join the FIFO queue. We then discuss the firm's server allocation problem.

2 - Product Support Forum: Customers as Partners in Service Delivery

Konstantinos Stouras, PhD Candidate, INSEAD, Bd. de Constance, Fontainebleau, 77305, France, Konstantinos.Stouras@insead.edu, Serguei Netessine, Karan Girotra

Online product support forums where customers can post complaints and questions, or report issues about a product or service abound. More and more companies crowdsource their product and service support back to their customers, employing a few dedicated service operators. Through an analytical model, we characterize the equilibrium behavior of such a service system and compare it with a call center model.

3 - Econometrics for Learning Agents

Vasilis Syrgkanis, Microsoft Research, 641 Avenue of the Americas, New York, United States of America, vasy@microsoft.com, Eva Tardos, Denis Nekipelov

The goal of this paper is to develop a theory of inference of player valuations from observed data in the generalized second price auction without relying on the Nash equilibrium assumption. Existing work assumes that each player's strategies are best responses to the observed play of others. We show how to perform inference relying on the weaker assumption that players use some form of no-regret learning. We apply our techniques to a dataset from Microsoft's sponsored search auction system.

4 - Adwords Equilibria with Budgeted Bidders

Florin Ciocan, INSEAD, Boulevard de Constance 77305, Fontainebleu, France, florin.ciocan@insead.edu, Krishnamurthy Iyer

We examine a model of the AdWords market where bidders strategically choose their budgets and bids, while the network can throttle bidders to optimize its own revenues. We show the equilibria in this market take a simple form and that for these equilibria the network's optimal throttling policy is greedy.

■ WA46

46-Room 104A, CC

Empirical Studies in Public Services: Health Care and Education

Sponsor: Manufacturing & Service Oper

Mgmt/Service Operations

Sponsored Session

Chair: Jun Li, Assistant Professor, Ross School of Business, University of Michigan, 701 Tappan St, Ann Arbor, 48103, United States of America, junwli@umich.edu

1 - A Multiple Case Study of Resource Flow in Education Systems

Samantha Meyer, Research Fellow, University of Michigan, Ross School of Business, R5340, Ann Arbor, MI, 48109, United States of America, srmeyer@umich.edu, Karen Smilowitz

The US spends more to educate its children than nearly every other developed nation, but scores near the bottom on international tests. Yet, how the US could better use its resources is hard to know. Social scientists focus on the way resources influence power, trust, and competition, whereas operations scholars focus on technical problems of resource distribution and use. The reality is that both matter. In this study we examine the way social and technical issues interact in education systems.

2 - Motivating Process Compliance through Electronic Monitoring

Bradley Staats, Associate Professor, UNC-Chapel Hill, United States of America, Bradley_Staats@kenan-flagler.unc.edu,
Hengchen Dai, David Hofmann, Katy Milkman

We investigate the deployment of electronic monitoring as a way to drive process compliance. We do so using a unique, RFID-based system implemented in 72 hospital units at 42 hospitals. We found that the implementation of electronic monitoring resulted in a large, positive effect on compliance although compliance rates initially increased before they began a gradual decline. Additionally, where monitoring was removed we found that compliance rates declined to below pre-intervention levels.

3 - Social Engagement and Learning in Massive Open Online Courses: Evidence from Field Experiments

Dennis Zhang, Kellogg School of Management, Northwestern University, 2001 Sheridan Road, Evanston, IL, 60201, United States of America, j-zhang@kellogg.northwestern.edu, Gad Allon, Jan Van Mieghem

We study the impact of students' social engagement levels on their learning outcomes in Massive Open Online Courses (MOOCs) with several field experiments.

4 - Patient Perception and Hospital Choice in Mitral Valve Surgery

Guihua Wang, Ross School of Business, University of Michigan, 701 Tappan Avenue, Ann Arbor, MI, 48109, United States of America, guihuaw@umich.edu, Jun Li, Wallace Hopp

Using a patient-level dataset across 35 New York hospitals, we document wide quality gap among hospitals. We then use a discrete choice model to estimate what influences patient perception of hospital quality and quantify the level of sub-optimality of their choices of hospitals.

■ WA47

47-Room 104B, CC

Promoting and Developing Markets for Recycling & Reuse

Sponsor: Manufacturing & Service Oper Mgmt/Sustainable Operations

Sponsored Session

Chair: Suvrat Dhanorkar, Assistant Professor, Penn State University, University Park, State College, PA, United States of America, ghanorkarsuvrat@gmail.com

1 - Coopeting for Sustainability

Karthik Murali, University of Illinois, Urbana-Champaign, IL, United States of America, kmurali4@illinois.edu, Anupam Agrawal

Motivated by the observation of a spate of collaborative alliances between competing firms to source and sell more sustainable products, we study vertical and horizontal environmental R&D collaboration within and across competing supply chains and the ensuing environmental, social, and economic implications.

2 - The Value of Product Returns: Intertemporal Product Management with Strategic Consumers

Narendra Singh, Narendra.Singh@scheller.gatech.edu, Karthik Ramachandran, Ravi Subramanian

Consumer product returns are a significant and growing concern in many industries, and firms typically deem returns to be undesirable. We study the impact of returns on the intertemporal product strategy of a firm facing strategic consumers. Importantly, we show that returns may act as a device for the firm to mitigate the well-known time inconsistency problem, and firm profit could increase with the return rate.

3 - Contracting for Reuse under Condition Uncertainty

Aditya Vedantam, Assistant Professor, State University of New York, Buffalo, State University of New York, Buffalo, Buffalo, NY, United States of America, avedanta@purdue.edu, Ananth Iyer

Managing the operations of traditional end-of-life disposition of used electronics involving reuse and recycling is complicated by the varying condition of incoming units. We show how uncertainty in the reverse supply chain can be managed by sharing the resale value between the product recovery facility and the customer. Data from a large IT Asset retirement company is presented to support our findings.

4 - Relationship Between Appointments of Sustainability Officers and Performance

Priyank Arora, Georgia Institute of Technology, 800 W Peachtree St. NW, Atlanta, GA, 30308, United States of America, priyank.arora@scheller.gatech.edu, Ravi Subramanian, Manpreet Hora

In recent years, firms have been creating and staffing senior-level environmental and sustainability positions. We investigate the association between announcements pertaining to appointments of senior-level environmental or sustainability officers and firm performance.

■ WA48

48-Room 105A, CC

Supply Chain Risk Management

Sponsor: Manufacturing & Service Oper Mgmt/iFORM

Sponsored Session

Chair: Nikolaos Trichakis, HBS, ntrichakis@hbs.edu

1 - Learning from Precursors to Disasters: The Role of Incentives

Heikki Peura, London Business School, Regent's Park, London, United Kingdom, hpeura@london.edu, Nitin Bakshi

Disaster investigations often reveal that the accident was preceded by near misses – precursor events that could have led to a disaster but did not – that went unreported or unheeded. To avoid disasters, a firm has to rely on employees for mitigation effort; to learn about disaster risk through precursors, it may be dependent on their reports. We examine the role of incentives in mediating the resulting three-way tradeoff between learning, mitigation and reporting.

2 - Inventory Decisions and Signals of Demand Management Capability to Investors

Guoming Lai, Univ. of Texas Austin, 2110 Speedway Stop B6500, Austin, TX, United States of America, Guoming.Lai@mcombs.utexas.edu, Wenqiang Xiao

We study the effects of asymmetric information of demand volatility on the inventory decision of a public firm who cares about not only its operational profits but also its market value. We find that the firm, when it faces a high demand volatility (less efficient), overstocks if the profit margin is low and understocks if the profit margin is high, while the firm with a low demand volatility (more efficient) may either overstock or understock in both cases.

3 - Operationalizing Financial Covenants

Gerry Tsoukalas, Assistant Professor, Wharton, 3730 Walnut Street, Philadelphia, PA, 19104, United States of America, gtouk@wharton.upenn.edu

We analyze the effectiveness of debt covenants in mitigating "operationally-driven" agency costs. It is shown that a leveraged firm's inherent operating flexibility can lead to significant agency distortions when optimal interest-only debt contracts are chosen, potentially wiping out as much as half the firm's value. Conversely, we show that the inclusion of simple financial covenants (widely used in practice) can eliminate these agency distortions and fully restore firm value.

■ WA49

49-Room 105B, CC

Inventory Problems in Online Retail

Sponsor: Manufacturing & Service Oper Mgmt/Supply Chain

Sponsored Session

Chair: Annie I. Chen, Massachusetts Institute of Technology, P.O. Box 426068, Cambridge, MA, 02139, United States of America, anniecia@mit.edu

1 - Sparsity-constrained Inventory Placement for Online Retail

Annie I. Chen, Massachusetts Institute of Technology, P.O. Box 426068, Cambridge, MA, 02139, United States of America, anniecia@mit.edu, Stephen Graves

We study the problem of placing online retail inventory in the presence of sparsity constraints, which limit the number of fulfillment centers holding an item. The large-scale and combinatorial nature of the problem makes it challenging to obtain the exact optimal solution in a computationally efficient manner. We propose a technique that combines column generation and item aggregation to compute near-optimal solutions efficiently.

2 - Affinity-guided Assortment Selection for Inventory Deployment

Zhiwei (tony) Qin, Staff Data Scientist, Walmart Labs, 850 Cherry Ave, San Bruno, CA, 94066, United States of America, TQin@walmartlabs.com, Jagtej Bewli, Arash Asadi

We consider assortment selection problems arising from online retailing inventory deployment, e.g. forward deployment, cross-channel migration. Typically, reducing fulfillment costs due to order splits is an important factor in the selection decision. We describe an optimization framework based on product affinity network and mathematical programming, which is able to adapt to different cost drivers. We also present fulfillment simulation results on real orders data.

3 - Localized Assortment Selection

Graham Poliner, Vice President Merchandise And Supply Chain Analytics, Macy's Inc., 1440 Broadway, New York, NY, 10018, United States of America, graham.poliner@macys.com, Bhagyesh Phanse, Mark Posner

We consider the assortment selection problem for omnichannel selling locations to support multiple fulfillment alternatives (e.g. direct to consumer, walk in store customers, and buy online pick up in store). The total assortment breadth offered is much larger than the capacity of a single store or fulfillment center. We describe how cross-channel demand information and product affinities can be used to inform localized assortment decisions, and we present the results of pilot implementations.

4 - Optimal Inventory Placement under Warehouse Capacity Constraints

Salal Humair, Principal Research Scientist, Amazon.com, Inc., 500 Westlake Ave N, Seattle, WA, 98109, United States of America, salal@amazon.com, Onur Ozkok, Erdem Eskigun

We consider how to place initial stocks for multiple products in multiple warehouses that serve multiple regions, when demand from a region can be fulfilled by more than one warehouse. We obtain the optimal initial stocks using a constructive algorithm with reasonable complexity. We use numerical experiments to understand how the algorithm distributes products across warehouses. We use these insights to decompose the problem of how much to buy vs. how to distribute it across the warehouses.

■ WA50

50-Room 106A, CC

New Models and Algorithms for Exploration and Exploitation Tradeoff Optimization

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Retsef Levi, J. Spencer Standish (1945) Professor of Operations Management, Sloan School of Management, MIT, 100 Main Street, BDG E62-562, Cambridge, MA, 02142, United States of America, retsef@mit.edu

1 - Approximate Gittins Indices for The Multi-armed Bandits

Eli Gutin, Mr, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, gutin@mit.edu, Vivek Farias

Multi-armed bandits is a fundamental problem that deals with the tradeoff between exploration and exploitation. While theoretical regret bounds have been proved for many solution methods, only in special cases have these bounds been shown to be optimal. By using Gittins' theorem, that applies to the discounted infinite horizon MAB problem, we propose an efficient, asymptotically optimal algorithm, AGI, that is competitive with IDS, UCB and Thompson Sampling methods for Bernoulli rewards.

2 - Stochastic Selection Problems with Testing

Chen Attias, Weizmann Institute of Science, 234 Herzl Street, Rehovot, 7610001, Israel, attiasc@mit.edu, Retsef Levi, Thomas Magnanti, Yaron Shaposhnik, Robert Krauthgamer

We study a new class of stochastic selection problems, where the goal is to choose the minimal cost option among alternatives with a-priori stochastic costs, by introducing a testing option that has fixed cost but reveals the realization of the random cost of the option being tested. For several interesting cases of this model, we obtain the optimal testing order and show that local decision rules that only consider the value of the currently tested option are optimal.

3 - When and How to Test in Scheduling Nonhomogeneous Job Classes

Yaron Shaposhnik, MIT, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA, 02139, United States of America, shap@mit.edu, Retsef Levi, Thomas Magnanti

We study a fundamental tradeoff that arises in many operational settings of performing work under uncertainty (exploitation) and investing capacity to reduce the underlying uncertainty (exploration). Sample domains include emergency departments, maintenance, scheduling, and project management. Our work leverages innovative analysis based on stochastic orders to obtain crisp descriptions of computationally efficient optimal exploration-exploitation policies, and provides managerial insights.

■ WA51

51-Room 106B, CC

Analyzing and Managing Incentives

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Tinglong Dai, Assistant Professor, Johns Hopkins University, 100 International Dr, Baltimore, MD, 21202, United States of America, dai@jhu.edu

Co-Chair: Fuqiang Zhang, Olin Business School, Washington University, St. Louis, MO, United States of America, fzhang22@wustl.edu

1 - Incorporating Customer Response in an Online-to-offline Fulfillment Strategy

Elnaz Jalilipour Alishah, PhD Candidate, University of Washington, Seattle, Foster School of Business, Mackenzie Hall 358, Seattle, Wa, 98195-3200, United States of America, jalilipo@uw.edu, Yong-Pin Zhou

We study an omni-channel retailer who fulfills online customer orders using inventory from offline retail stores. We examine the practice of fulfilling from the nearest location, and suggest other strategies in response to customer price and leadtime preferences.

2 - Signalling by Testing

Tinglong Dai, Assistant Professor, Johns Hopkins University, 100 International Dr, Baltimore, MD, 21202, United States of America, dai@jhu.edu, Shubhranshu Singh

Diagnostic experts, such as medical specialists, often only imperfectly observe customers' true conditions, and may resort to advanced testing procedures. We model a diagnostic expert's diagnostic decision tree problem when the expert's level of competence is unknown to customers. We characterize perfect Bayesian equilibria, and prove the existence and uniqueness of a separating equilibrium. Our results offer insights into diagnostic experts' testing behavior driven by their signaling efforts.

3 - Information Sharing in Competing Supply Chains with Production Cost Reduction

Shilu Tong, Chinese University of Hong Kong, Shenzhen, 2001, Longxiang Blvd, Longgang District, Shenzhen, China, tongshilu@cuhk.edu.cn, Albert Ha, Quan Tian

We consider the problem of sharing demand information in two competing supply chains, each consisting of one manufacturer and one retailer. A supply chain that engages in information sharing triggers a reaction from the rival chain. Such a reaction may benefit or hurt the first supply chain, depending on whether the retailers compete on quantity or price, and whether the manufacturers are efficient in cost reduction or not.

4 - Push vs. Pull: How to Best Allocate Supply Risk in Random Yield Supply Chains

Guang Xiao, Olin Business School, Washington University in St. Louis, St. Louis, United States of America, xiaoguang@wustl.edu, Panos Kouvelis

We consider a bilateral supply chain with supply random yield and propose three variants of wholesale price contracts, which induce different risk allocations between the supply chain parties. We completely characterize the Pareto set of any contract type combination to fully explore the price negotiation possibilities and profit improvement opportunities within the supply chain.

■ WA52

52-Room 107A, CC

Retail Management I

Contributed Session

Chair: Anurag Agarwal, Professor, University of South Florida, 8350 N Tamiami Tr, Sarasota, FL, 34243, United States of America, agarwala@sar.usf.edu

1 - Shrinking Shrinkage: An Empirical Investigation into Antecedents and Countermeasures

Shivom Aggarwal, IE Business School, Instituto de Empresa, S.L., CIF: B823343, C/ Maria de Molina, 12 Bajo, Madrid, 28006, Spain, dr.shivom@gmail.com, Daniel Corsten

Vendor-side fraud has been overlooked in literature due to intractability, but poses to be significant antecedent of shrinkage. Using multi-store longitudinal data from a US retailer, we investigate holistic antecedents of shrinkage and how they affect store performance. The unified framework will contribute to extant literature on efficient retail operations.

2 - Inventory Allocation in Omni-channel Retailing

Alexander Huebner, Associate Professor, Catholic University
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Germany, alexander.huebner@ku.de, Heinrich Kuhn,
Andreas Holzapfel

Omni-channel retailers need to allocate inventories to their stores and the warehouse for online fulfillment. The objective is to reduce for all channels operational replenishment costs, stock-out costs and margin losses for overaged inventory. We develop a decision model for inventory allocation and setting the end-season discounts. The problem is solved with stochastic dynamic programming. We show insights from a case study with a German fashion retailer, where the model is applied.

3 - Vendor Influence on Inventory Adjustments

Daniel Corsten, IE Business School, Calle Maria de Molina 12
Bajo, Madrid, 28006, Spain, daniel.corsten@ie.edu,
Shivom Aggarwal

Vendor-side factors have been overlooked in the literature on shrinkage due to intractability. Using multi-store longitudinal data from a US retailer we investigate antecedents of shrinkage and how they affect store performance. Our holistic framework will contribute to extant literature on retail operations.

4 - Efficient Algorithm for Assortment Planning with Limited Shelf Space

Chun-miin Chen, Assistant Professor, Bucknell University,
313 Taylor Hall, 701 Moore Ave., Lewisburg, PA, 17837,
United States of America, cmc052@bucknell.edu, Zhaolin Li

We study the impact of limited shelf space on assortment planning in a single-period model. As the shelf-space constraint makes the optimization problem NP-complete, we investigate a comprehensive measure which enables efficient identification of the variants to be added into the assortment and efficient allocation of the available shelf space.

5 - An Analytics Framework for the Retail Shelf Space Management

Anurag Agarwal, Professor, University of South Florida, 8350 N
Tamiami Tr, Sarasota, FL, 34243, United States of America,
agarwala@sar.usf.edu, Ramakrishna Govindu, James Curran

Due to advancements in information technology, retailers are collecting a lot of data and trying to optimize their limited shelf space. In this presentation, we propose an analytics framework that integrates predictive and prescriptive analytics for optimizing the retail shelf space.

■ WA54

54-Room 108A, CC

Behavioral Models in Operations Management

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Xuanming Su, The Wharton School, University of Pennsylvania,
Philadelphia, United States of America, xuanming@wharton.upenn.edu

1 - The Impact of Decision Rights and Long Term Relationships on Innovation Sharing

Ruth Beer, Kelley School of Business, Indiana University, 1275 E
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ruthbeer@indiana.edu, Stephen Leider

We study a supplier's incentives to share an innovation with a buyer when sharing the innovation increases efficiency but makes the supplier vulnerable to the buyer sharing it with other suppliers. We show, both theoretically and experimentally, that the supplier's optimal decision depends on the length of the relationship and in particular, on how the buyer allocates decision rights among its employees.

2 - Linking Customer Behavior and Delay Announcements using a Probability Model

Qiuping Yu, Assistant Professor, Indiana University, 1309 E. 10th
Street, Bloomington, IN, 47405, United States of America,
qiupyu@indiana.edu, Eric Webb, Kurt Bretthauer

Service systems often offer announcements to customers about their anticipated delay. We empirically examine how announcements affect queue abandonment behavior using a duration model accounting for potential behavioral factors. Our results show announcements induce the reference effect and customers exhibit loss aversion. We also find evidence indicative of the sunk cost fallacy. We then provide insights for staffing and delay announcement policy accounting for observed behavioral factors.

3 - Trust, Social Networks, and Information Sharing Among Executives

Karen Zheng, MIT, 77 Massachusetts Avenue, Cambridge, MA,
02139, United States of America, yanchong@mit.edu, Emily Choi,
Ozalp Ozer

We experimentally study how trust and social networks influence forecast information sharing behavior among executives with an average 17 years of professional experience. We demonstrate an intricate interaction among trust preconditioned by prior experiences, trust measured from social network, and trust in supply chain information exchange. We show when trust from social network significantly impacts trust in the supply chain and the resulting information sharing efficiency.

4 - Behavioral Impact of Irrelevant Market Information on Buying Decisions

Kay-Yut Chen, Professor, University of Texas Arlington,
701 West Street, Arlington, TX, United States of America,
kychen@uta.edu, Diana Wu

We study how market information such as past sales, current stock levels and stock-out probability influences purchase behavior. Experiments are conducted in which buyers, who are exposed to different information, evaluate trade-offs between the likelihood of out-of-stock and future price discounts. We found that individuals can be swayed by information that is non-informative and irrelevant. We develop a behavioral model that captures such behavioral reactions to explain the lab findings.

■ WA54

54-Room 108A, CC

Resource Allocation

Contributed Session

Chair: Marc Jansen, PhD Candidate, Judge Business School,
University of Cambridge, Trumpington Street, Cambridge,
United Kingdom, mcj32@cam.ac.uk

1 - Optimal Allocation of Conference Rooms to Meeting Requests

Pawan Chowdhary, Software Research, IBM Research,
650 Harry Road, San Jose, CA, 95120, United States of America,
chowdhar@us.ibm.com, Robert Moore, Susanne Glissmann,
Sunhwan Lee, Ray Strong, Anca Chandra, Jeanette Blomberg

We present an analytics driven solution that dynamically allocates the conference rooms based on time and other constraints. The approach initially assigns a conference room using greedy heuristic and later reassigns or reaffirms the room as responses from attendees arrive. We will show the results of both traditional and optimal approach along with algorithm. We will also discuss how we can leverage mobile to further enhance the solution and analytics to further improve the outcomes.

2 - Optimizing Campsites Accommodation and Prices

Dasong Cao, Principal Scientist, Wyndham Exchange and Rental,
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dasong.cao@rci.com

European vacation rental company offers package camping holidays, the accommodation includes mobile homes, lodges and tents. Each year, they put together a contracting plan, to decide which sites to choose to place accommodation units on and how many units of each type to offer on each site, and then a process to set the prices. We first built a mathematical model to pick optimal site location and unit mix, and then built an Yield Management System to set the prices dynamically.

3 - Managing Escalation: Support System Failure and Response Capacity Allocation

Marc Jansen, PhD Candidate, Judge Business School, University
of Cambridge, Trumpington Street, Cambridge, United Kingdom,
mcj32@cam.ac.uk, Nektarios Oraopoulos, Daniel Ralph

Recent high profile IT system disruptions highlight the dependency of large client pools on continuous availability of equipment provided and maintained by a single vendor. At the onset of disruption, the scale of the disruption is typically unknown. This paper examines how contracting decisions between an IT vendor and multiple clients can enable efficient allocation of response capacity under imperfect information on the true nature of the disruption.

■ WA55

55-Room 108B, CC

Forecasting

Contributed Session

Chair: Arnd Huchzermeier, WHU-Otto Beisheim School of Management, Production Management, Burgplatz 2, Vallendar, 56179, Germany, ah@whu.edu

1 - Modeling Effects of Price Changes on Sales for Improved Forecasting and Promotion Planning

Shubhankar Ray, Walmart Labs, 850 Cherry Ave., San Bruno, CA, 94066, United States of America, sr02@walmartlabs.com, Brian Seaman, Ashin Mukherjee

In online retail, the high sales variability & missing samples makes item-level estimation of price elasticities unreliable. We use a mixed-effects framework to fit autoregressive distributed lag models on item groups to get reliable population-level estimates of short/long-run elasticities while pooling information across items. This model can be layered with any forecasting model to generate price sensitive forecasts & can help steer the sales in a desired direction during promotion planning.

2 - A Better Accuracy Measure than Mean Absolute Percentage Error

Chris Tofallis, Professor of Decision Science, Hertfordshire Business School, College Lane, Hatfield, AL10 9AB, United Kingdom, c.tofallis@herts.ac.uk

Although Mean Absolute Percentage Error is widely used, it suffers from bias: its use in selecting a forecasting method favours methods whose predictions are too low. We explain why this happens and present an alternative relative accuracy measure which is unbiased. This measure can be used to estimate prediction models. Minimum MAPE models do not predict a known statistic. By contrast, when the proposed metric is used, the resulting least squares regression model predicts the geometric mean.

3 - Information Sharing in Supply Chains Facing Autoregressive Demand.

Vladimir Kovtun, Syms School of Business, 215 Lexington Avenue, New York, NY, 10016, United States of America, vladimir.kovtun@yu.edu, Avi Giloni, Clifford Hurvich

We introduce a general class of potentially valuable sharing arrangements in a multi-stage supply chain in which the retailer observes stationary ARMA demand with respect to Gaussian white noise (shocks). We demonstrate how a typical supply chain player can create an incentive-compatible sequence of partial-information shocks (PIS) based on its available information and share these with an adjacent upstream player, potentially reducing the upstream players lead-time demand forecast error.

4 - Judgemental Demand Forecasts for Online Sales of a Premium Bike Manufacturer

Arnd Huchzermeier, WHU-Otto Beisheim School of Management, Production Management, Burgplatz 2, Vallendar, 56179, Germany, ah@whu.edu, Christoph Diermann

We present a judgmental demand forecast model for a premium bike manufacturer selling each season a new collection of products online. Forecast accuracy could be improved by using a team approach, by de-biasing the expert forecasts and by selecting the appropriate segmentation of bike types. Forecast accuracy could be improved by 26% and profit increased by more than 40%.

■ WA56

56-Room 109A, CC

Operations Management VII

Contributed Session

Chair: Xueyuan Cai, Huazhong University of Science and Technology, 1037 Luoyu road, Wuhan, China, comeon1644@163.com

1 - Configurations of Distribution Strategies

Jing Tang, Em-Lyon Business School, 23 Avenue Guy de Collongueresear, Ecully, 69134, France, tangacade@gmail.com, Yeming Gong

Based on 124 quantitative samples with both first-hand and second hand data, as well as 56 qualitative samples, this paper examines the strategic fit of distribution strategies from the perspective of configuration theory. We find that the fit between operational decisions including infrastructural and structural decisions, and operational competencies including cost and flexibility, has an important effect on business performance.

2 - Exchange-old-for-new Program: An Incentive to Induce Early Purchases with Product Rollover

Yongbo Xiao, Associate Professor, Tsinghua University, School of Economics and Management, Beijing, 100084, China, xiaoyb@sem.tsinghua.edu.cn, Qian Liu

Many customers may choose to wait for new generation of products in face of product roll-overs. We propose to adopt an exchange-old-for-new program to induce customers to make early purchase. Starting from the choice behavior of strategic customers and based on a dynamic programming model, we study the optimal pricing decision involved in the exchange program.

3 - Model and Algorithms for the Integrated Production and Vehicle Routing Problem

Ling Liu, Huazhong University of Science & Technology, 1037 Luoyu Road, Wuhan, Hubei, China, Wuhan, China, 182028870@qq.com

In this paper, the integrated production and vehicle routing problem is considered in a Make-to-Order (MTO) manufacturer, where there is a single machine for production and limited vehicles with capacity constraints for transportation. The objective is to determine the decisions about production scheduling, transportation batching and vehicle routing, to minimize the maximum order delivery time. An optimal property is proposed and based on the property, an improved genetic algorithm is developed.

4 - Optimizing Multi-item Joint Replenishment under Stochastic Demand and Uncertain Leadtime

Xueyi Ai, School of Management, Huazhong University of Science and Technology, 1037 Luoyu Road, Wuhan, China, aixueyi1030@gmail.com, Jinlong Zhang, Lin Wang

In real-life practice, leadtime uncertainty is a common phenomenon which may be caused by various factors. The purpose of this paper is to develop a more realistic joint replenishment model considering both stochastic demand and uncertain leadtime simultaneously, and propose an improved fruit fly optimization algorithm (IFOA) to solve the problem, minimizing the long-run average total costs. Experimentation results show the standard deviation of leadtime has large effect on the system.

5 - Strategy Comparison of Capacity Allocation in a Supply Chain with One Dominant Retailer

Xueyuan Cai, Huazhong University of Science and Technology, 1037 Luoyu road, Wuhan, China, comeon1644@163.com, Jianbin Li

We consider a distribution system with one supplier and two retailers. The supplier will implement allocation mechanisms or improve her wholesale price when the capacity can't match demand. Conventional wisdom thinks that the impact to the supplier by "order-inflation" mechanisms is not the same as that by "truth-telling" mechanisms. But we show that this is not true in our setting where each retailer faces a oligopoly market and places order to the supplier considering the capacity constraints.

■ WA57

57-Room 109B, CC

Electric Transportation Systems Modelling

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Ramteen Sioshansi, Associate Professor, The Ohio State University, Integrated Systems Engineering, 1971 Neil Avenue, Columbus, OH, 43210, United States of America, sioshansi.1@osu.edu

1 - Optimization of Incentive Policies for Plug-in Electric Vehicles

Yu Nie, Northwestern University, Evanston, IL, United States of America, y-nie@northwestern.edu, Mehrnaz Ghamami

High initial purchase prices and the lack of supporting infrastructure are major hurdles to the adoption of plug-in electric vehicles (PEVs). It is widely recognized that the government could help break these barriers through incentive policies, such as offering purchase rebates and funding charging stations. The objective of this paper is to propose a modeling framework to optimize the design of such incentive policies.

2 - Incentive-compatible Charging Mechanisms for Plug-in Electric Vehicles

Mark Nejad, Assistant Professor, University of Oklahoma, Industrial and Systems Engineering, Norman, OK, United States of America, mark.nejad@ou.edu, Lena Mashayekhy

We design charging mechanisms for plug-in electric vehicles considering different charging rates. We prove that our proposed mechanisms are dominant-strategy incentive compatible, so that EV drivers have no incentive to misreport their charging requests or their arrival-departure dynamics.

3 - Public Electric Vehicle Fast Charging Station**Management Strategies**

Fei Wu, The Ohio State university, 1971 Neil Ave., Columbus, OH, 43210, United States of America, wu.1557@osu.edu, Ramteen Sioshanshi

Fast EV charging stations typically use high-power chargers. Without control, transformers serving the stations will suffer accelerated aging. A charging station control model (CSCM) is introduced. It is formulated as a two-stage stochastic programming model to minimize the station's expected operation cost. A sequential sampling procedure with sample average approximation is proposed to solve the CSCM. Simulations show that the operation costs are significantly reduced by using the CSCM.

■ WA58

58-Room 110A, CC

Renewables Integration: Market Clearing, Optimal Siting and Energy Storage

Sponsor: ENRE – Energy II – Other (e.g., Policy, Natural Gas, Climate Change)

Sponsored Session

Chair: Dalia Patino-Echeverri, Assistant Professor, Duke University, Box 90328, Duke University, Durham, NC, 27708, United States of America, dalia.patino@duke.edu

1 - Co-optimizing Battery Storage for Energy Arbitrage and Frequency Regulation

Bolong Cheng, Princeton University, Olden Street Engineering Quadrangle, Electrical Engineering, Princeton, NJ, 08544, United States of America, bcheng@princeton.edu, Warren Powell

We want to optimize battery storage for multiple applications; this problem requires the battery to make charging/discharging decisions at different time scales while accounting for the stochastic information. Solving the problem for even a single-day operation would be computationally inefficient due to the large state space and time steps. We propose a dynamic programming approach that takes advantage of the nested structure of the problem by solving smaller sub-problems of different sizes.

2 - Optimizing Wind Site Placement to Minimize Variability Effect

Amelia Musselman, Graduate Research Assistant, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, amusselman@gatech.edu, Valerie Thomas, Dima Nazzal

As a result of increased environmental awareness, wind power has drawn considerable attention as a potential renewable energy alternative. However, the intermittency and uncontrollability of wind warrant concerns about its reliability as an energy resource. In this research we develop a power generation expansion planning model that aims to mitigate the effects of wind variability by selecting sites to complement each other such that the overall wind energy available is both high and consistent.

3 - Assessing Operation of Wind-coal Hybrid Units with Flexible Carbon Capture and Storage(CCS) in MISO

Rubenka Bandyopadhyay, PhD Candidate, Duke University, Box 90328, Duke University, Durham, NC, 27707, United States of America, rb171@duke.edu, Xin Li, Ali Daraeepour, Dalia Patino-Echeverri

We simulate the optimal dispatch of coal-wind hybrid units (i.e. existing coal plants retrofitted with flexible post-combustion amine based CCS and co-located wind farms) in a Unit Commitment/Economic Dispatch (UC/ED) model of MISO. We assess market benefits derived from provision of ramp-capability and its impacts on wind curtailment, system reliability and systems costs.

4 - Generation Expansion Planning under Flexible Performance Standards with Alternative Compliance Payments

Dalia Patino-Echeverri, Assistant Professor, Duke University, Box 90328, Duke University, Durham, NC, 27708, United States of America, dalia.patino@duke.edu

This research explores the effects on costs and emissions from making Alternative Compliance Payments (ACP) part of the policy mechanisms for reducing CO₂ emissions from power plants. Under an ACP States set an emissions rate target, a fee (the ACP) that emitters pay for each ton of emissions in excess of the target, and a deadline to permanently reduce emissions (by retrofitting or replacement). A Stochastic Mixed Integer Linear Program represents the decisions of a regulated electric utility.

■ WA59

59-Room 110B, CC

Joint Session ENRE & Integer and Discrete Optimization: Emerging Operational Approaches in Electric Power Systems – Transmission Switching, Data-Driven Maintenance, and Natural Gas Coordination

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Andy Sun, Assistant Professor, Georgia Institute of Technology, 755 Ferst Drive, Atlanta, GA, 30332, United States of America, andy.sun@isye.gatech.edu

1 - New Formulation and Strong MISOCP Relaxations for AC Optimal Transmission Switching Problem

Burak Kocuk, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, burak.kocuk@gatech.edu, Santanu Dey, Andy Sun

In this work, we formulate the AC Optimal Transmission Switching (AC OTS) problem as a MINLP. We propose a mixed integer SOCP (MISOCP) relaxation and strengthen this relaxation via several types of valid inequalities, some of which have demonstrated excellent performance for AC OPF and some others are specifically developed for the AC OTS. Finally, we propose practical algorithms that utilize the solutions from the MISOCP relaxation to obtain high quality feasible solutions for AC OTS problem.

2 - Flexible Transmission Decision Support: Scalable Heuristics for Power Flow Control Devices

Kory Hedman, Professor, Arizona State University, P.O. Box 875706, GWC 206 School of ECEE, Tempe, AZ, 85287-5706, United States of America, Kory.Hedman@asu.edu, Mostafa Ardakani, Xingpeng Li, Mojdeh Abdi-khorsand, Pranavamoorthy Balasubramanian

While power flow control devices can greatly enhance the efficiency and reliability of the high voltage power grid, the modeling of such devices in network flow (optimal power flow) models is limited due to the added computational burden. We will present two types of power flow control: transmission switching and variable impedance based series devices. We will present simple heuristics that reduce the computational burden, are scalable, and still produce high quality solutions.

3 - Sensor Driven Condition Based Generation Maintenance

Murat Yildirim, PhD Student, Georgia Institute of Technology, 755 Ferst Drive, Atlanta, GA, 30332, United States of America, murat@gatech.edu, Nagi Gebrael, Andy Sun

We provide an adaptive optimization model to determine the optimal generation maintenance scheduling by leveraging sensor health monitoring data and considering network constrained unit commitment decisions. We propose new mixed-integer optimization models and efficient algorithms that exploit the special structure of the proposed formulation. We present extensive computational experiment results to show proposed models achieve significant improvements in cost and reliability.

4 - Incorporating Natural Gas Pipeline Constraints in Intraday Unit Commitment and Dispatch

Jeff Baker, Southern Company, 600 18th Street North, Birmingham, AL, United States of America, jeffbake@southernco.com

Southern Company secures a reliable natural gas supply for its generation fleet by procuring firm transportation on several pipelines under long-term contracts. When there is a significant discrepancy between the day ahead and real time demand, utilization of gas along a pipeline must be optimized. This talk will discuss the impact of adding gas burn constraints into intraday unit commitment and dispatch algorithms as well as the impacts to scheduling on system operators.

■ WA60

60-Room 111A, CC

Electricity Access in Developing Countries

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Valerie Thomas, Professor, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, United States of America, valerie.thomas@isye.gatech.edu

1 - The Case for Distributed Energy in the Developing World

Todd Levin, Energy Systems Engineer, Argonne National Laboratory, 9700 S Cass Ave, Lemont, IL, 60439, United States of America, tlevin@anl.gov, Valerie Thomas

In developing countries where infrastructure is underdeveloped, there may be potential for decentralized technologies to leapfrog the centralized electrification model. We present a service based economic analysis that incorporates the true, unsubsidized cost of energy access in rural regions. We show that distributed options may be cost-effective if consumption is modest and suggest that some grid subsidies may be more effectively channeled to support distributed approaches to energy access.

2 - Risk-aware Control of Solar Micro-grids

Carlos Abad, Columbia University, 500 W 120th St. Rm 321, New York, NY, 10027, United States of America, carlos.abad@columbia.edu, Garud Iyengar, Vijay Modi

Providing power to widely spread out communities using the conventional power grid is not economically feasible. The most attractive alternative source of affordable energy for these communities is solar micro-grids. We discuss risk-aware robust methods to optimally size and operate micro-grids in the presence of uncertain demand and uncertain generation. These algorithms help system operators to increase their revenue while making their systems more resilient to inclement weather conditions.

■ WA61

61-Room 111B, CC

Research in Environmentally Sustainable and Socially Responsible Operations

Sponsor: ENRE – Environment I – Environment and Sustainability

Sponsored Session

Chair: Jason Nguyen, University of Minnesota, 321 19th Ave S, Minneapolis, MN, 55455, United States of America, nguy1762@umn.edu

1 - Perceived Operational Impacts and Investment in Carbon Abatement

Chien-ming Chen, Nanyang Technological University, 50 Nanyang Avenue, Singapore, Singapore, cmchen@ntu.edu.sg, Maria Montes-sancho

This study examines how the perceived operational impacts from reducing carbon emissions are associated with long-term investment in environmental technology portfolios. We examine our hypotheses based on recent carbon disclosure data.

2 - Evaluating Alternative Strategies for Fostering Responsibility Among Suppliers

Avijit Raychaudhuri, PhD Candidate, Nanyang Business School, Nanyang Technological University, 50 Nanyang Avenue, South Spine S3-01B-73, Singapore, 639798, Singapore, avijit001@e.ntu.edu.sg, Fang Liu, S Viswanathan

We look at global supply chains which comprise suppliers of varying degrees of responsibility. In order to promote responsibility in such supply chains, global buyers generally follow a strategy of dual investment in supplier responsibility audit and supplier improvement. We evaluate the relative profitability of these strategies under different scenarios. We also analyze how the buyer's optimal investment policy affects supply chain responsibility.

3 - A Bilevel Optimization Model for Bioenergy Contract Price Determination

Lizhi Wang, Associate Professor, Iowa State University, 3016 Black Engineering, Ames, IA, 50011, United States of America, lwzhang@iastate.edu, Liu Su, Guiping Hu, Emily Heaton

We study farmers crop selection problem in the face of crop price uncertainty, yield uncertainty, and environmental concerns. We then propose a bilevel optimization to help bioenergy companies determine appropriate contract prices to encourage farmers to switch from conventional crops to energy crops.

4 - Net-zero Carbon Manufacturing and Supply Chain Operations: A Fantasy or a Possibility?

Tongdan Jin, Texas State University, 601 University Drive, San Marcos, United States of America, tj17@txstate.edu, An Pham, Fei Sun

We address two fundamental questions confronted by manufacturing and supply chain design: 1) is it cost-effective to deploy onsite wind and solar power to achieve net-zero carbon environmental performance? and 2) how to design a reliable onsite energy system to meet the variable demand without storage devices? We conclude that zero carbon operations are achievable at affordable cost provided the local wind speed is above 5 m/s or the overcast days are less than 35% of a year.

■ WA62

62-Room 112A, CC

Energy and Supply Chain Management

Cluster: Energy Systems: Design, Operation, Reliability and Maintenance

Invited Session

Chair: Yao Zhao, Rutgers University, 1 Washington street, Newark, NJ, 07102, United States of America, yaozhao@andromeda.rutgers.edu

1 - Energy Supply Chain: Insights, Security, and Sustainability

Kwon Gi Mun, PhD Candidate, Rutgers University, SCM, Rutgers Business School, 1 Washington Park, Newark, NJ, 07102, United States of America, kwongimun@gmail.com, Yao Zhao, Endre Boros, Rafique Raza

We test and design heuristics and an optimal decision model for introducing new strategies to design energy supply network. A main contribution is that well-formulated energy supply network can explain how to ensure energy supply and energy security. We consider all of possible T&D technology such as HVAC/HADC together, and we found that a design of energy supply network may cause an inefficient supply of electricity unless it is optimized with an integrated network.

2 - Expected Value and Chance Constrained Stochastic Unit Commitment Ensuring Wind Power Utilization

Chaoyue Zhao, Oklahoma State University, 322G Engineering North, Stillwater, OK, United States of America, chaoyue.zhao@okstate.edu

In this talk, we propose an expected value and chance constrained stochastic optimization approach for the unit commitment problem with uncertain wind power output. A combined SAA framework that considers both the expected value and the chance constraints is proposed to construct statistical upper and lower bounds for the optimization problem. Finally, a revised IEEE 118-bus system is studied to show the scalability of the proposed model and algorithm.

3 - Energy Supply Chain: Future Energy Security

Raza Rafique, Assistant Professor, Lahore University of Management Science, Suleman Dawood School of Business, Lahore, 54600, Pakistan, raza.ali@lums.edu.pk, Yao Zhao, Kwon Gi Mun

Electricity crisis is a major hindrance towards economic growth of Pakistan and poses a serious national security threat to the country. The crisis has resulted into political turmoil and social instability. We have provided a framework to address energy supply chain design. The study shows great potential and provide guidelines to ensure future energy security of Pakistan.

4 - Data-Oriented Decision Making in Demand Response

Weiwei Chen, Assistant Professor, Rutgers University, Rutgers Business School, Newark, NJ, 07102, United States of America, wchen@business.rutgers.edu

Demand response (DR) programs have emerged among electric utilities to reduce peak electricity demand and enhance customer satisfaction. A critical issue is to accurately estimate the customers' baseline power consumptions and the load reduction. A cohort based approach is introduced to improve the estimation accuracy utilizing customer historic data. Then, methods to manage various DR events considering exogenous information are developed to optimize the expected savings for utility companies.

■ **WA63**

63-Room 112B, CC

Operations Management III

Contributed Session

Chair: Sang Jo Kim, MIT-Zaragoza International Logistics Program, Calle Bari 55, Edificio Nayade 5, Zaragoza, 50197, Spain, sjkim@zlc.edu.es

1 - A New Approach to the Multi-Product Newsvendor Problem with Customer Choice

Amr Farahat, Washington University in St. Louis, One Brookings Drive, St. Louis, MO, 63104, United States of America, farahat@wustl.edu, Joonkyum Lee

We present a methodology that yields upper bounds and feasible solutions to the multiproduct newsvendor problem with customer choice. The methodology is based on an approximate Jordan decomposition of the state transition matrix. Specializations include a decomposition by customer into a sequence of assortment optimization problems and a decomposition by product into a collection of independent newsvendor problems.

2 - Stackelberg-game Analysis of Retailers' Joint Procurement

Tianyuan Wang, Lingnan (University) College of Sun Yat-Sen University, NO.135, Xingang West Road, Guangzhou, China, wty-2@163.com, Ke Fu

We consider two retailers who face a Stackelberg game in joint procurement. They have to determine the optimal inventory and pricing strategies in the presence of both cooperation and competition. We show that both retailers prefer joint purchasing if they have similar market penetrations. We demonstrate how different problem parameters affect the game outcomes.

3 - Consumer Showrooming and the Length of Product Line

Yilong Luo, PhD Candidate, Illinois Institute of Technology, 6716 Idaho Ave., Hammond, IN, 46323, United States of America, luoyilong@gmail.com, Jiong Sun

It is known that consumers' showrooming behavior, i.e., inspecting products at brick-and-mortar stores and then making a purchase at a competing online store, can result in the brick-and-mortar store losing potential customers. We show that such showrooming behavior can soften competition and hence can benefit both retailers. We also show that this showrooming behavior may or may not induce the brick-and-mortar retailer to reduce the length of the product line it carries.

4 - The Optimal Dynamic Policy for Periodic Stocking and Bundling

Sang Jo Kim, MIT-Zaragoza International Logistics Program, Calle Bari 55, Edificio Nayade 5, Zaragoza, 50197, Spain, sjkim@zlc.edu.es, Youyi Feng, Jianjun Xu

We consider a firm that offers two individual products and a bundle of them. They periodically order the two products as well as bundle them aiming to maximize the total discounted profit over a finite planning horizon. We assume that the customer demand is random, unmet demand is backlogged and unsold items are carried over to the next period. Optimal joint decisions on ordering and bundling follow a well-structured policy that also draws significant managerial insights.

■ **WA64**

64-Room 113A, CC

Risk-Based Decision Making in Interdependent Systems

Sponsor: Decision Analysis

Sponsored Session

Chair: Hiba Baroud, Vanderbilt University, 400 24th Avenue South, Nashville, TN, 37205, United States of America, hiba.baroud@vanderbilt.edu

1 - Multi-criteria Inoperability Analysis of Commodity-specific Dock Disruptions of Inland Waterway Port

Mackenzie Whitman, Graduate Student, University of Oklahoma, 1018 Timber Ridge Road, Harrah, OK, 73045, United States of America, mgwhitman@ou.edu, Hiba Baroud, Kash Barker

Decision making for managing risk to infrastructure systems requires accounting for impacts of disruptions that render systems inoperable. This paper integrates a dynamic risk-based interdependency model with multi-criteria decision analysis to evaluate dock-specific resource allocation alternatives to provide tangible assessments of port preparedness planning. We analyze a set of discrete allocations for the inland waterway Port of Catoosa in Oklahoma to assess total expected loss per industry.

2 - How Much Should We Spend on Preparing for Disruptions?

Cameron MacKenzie, Assistant Professor, Iowa State University, 3004 Black Engineering, Ames, IA, 50011, United States of America, camacken@iastate.edu

Every time a disruption causes major economic damages and/or leads to several fatalities, the public questions why more wasn't done to prepare for the disruption. Prevention and preparedness require allocating resources (usually money) that could be used for other purposes. I will present a model to help a decision maker determine how much should be allocated before a disruption for both a risk neutral and risk averse case. The model is applied to the Deepwater Horizon oil spill.

3 - Infrastructure Resilience Framework for Decision Making Comparison and Real Time Monitoring

Dante Gama Dessavre, Ph. D. Candidate, Stevens Institute of Technology, Castle Point on Hudson, Hoboken, NJ, 07030, United States of America, dante.gamadessavre@gmail.com, Jose Emmanuel Ramirez-marquez

Understanding impacts of disruptions to systems is a critical component to enable infrastructure modifications that improve their resilience. We present a framework and optimization formulations that enable direct comparison of the resilient behavior of a system due to different design choices; We also show how it can be adapted to monitor the resilient behavior of a system in real time in order to enhance the tools available to decision makers for disruption management.

4 - How Performance Measure Selection Impacts Risk Characterization in Interdependent Infrastructure

Allison Reilly, Johns Hopkins University, 3400 N Charles Street, Baltimore, MD, 21218, United States of America, acr@jhu.edu, Andrew Samuel, Seth Guikema

A perturbation in one infrastructure system stemming from a failure, an investment, or some other change, is known to impact multiple performance measures in dependent systems. However, most interdependent infrastructure models evaluate influences on performance using only one measure. We evaluate the implications of using one performance metric on decision-making and system-wide risk and discuss how multiple performance measures could be used to build a more holistic view.

5 - Bayesian Method for Thermo-electric Power Generation Drought Risk Assessment

Royce Francis, George Washington University, 800 22nd St. NW B1850, Washington, DC, 21212, United States of America, seed@gwu.edu, Behailu Bekera

This paper presents a Bayesian framework for thermoelectric drought risk assessment, focusing on current and future risk of drought driven by climate and socio-economic changes. Uncertainties vary across regions based on the climate condition, technology choices, regulations, demographic changes. These factors are taken into consideration in updating uncertainty in parameters of a cost model currently being developed by the authors.

■ **WA65**

65-Room 113B, CC

Decision Analysis Applications in Operations Management

Sponsor: Decision Analysis

Sponsored Session

Chair: Barry Cobb, Missouri State University, 901 S. National Ave., Springfield, MO, 65897, United States of America, BarryCobb@MissouriState.edu

1 - Import Security: Assessing the Risks of Imported Food

Jonathan Welburn, PhD Student, University of Wisconsin - Madison, 1513 University Avenue, 3237 Mechanical Engineering, Madison, WI, 53706, United States of America, welburn@wisc.edu, Vicki Bier, Steven Hoerning

We quantitatively address risks associated with imported foods using data on the rate of FDA import violations, an indicator of risk. Using regression to analyze these risks, we explore how risk varies by product and violation type. Additionally, we explore improvements from finer categorization of product types. While this might make results more useful, inconsistencies between current databases make this difficult to achieve.

2 - Inventory Control for Returnable Transport Items in a Closed Loop Supply Chain

Barry Cobb, Missouri State University, 901 S. National Ave.,
Springfield, MO, 65897, United States of America,
BarryCobb@MissouriState.edu

A model for determining inventory control parameters for returnable transport items in a closed-loop supply chain is presented. To incorporate uncertain container returns, cycle time and return rate distributions are estimated from radio frequency identification data. The effect of estimation errors due to a partial tagging of containers is examined.

3 - Target-Oriented Utility in Operations Management

Robert Bordley, Expert Systems Engr Professional,
Booz-Allen-Hamilton, 525 Choice Court, Troy, MI, 48085,
United States of America, Bordley_Robert@bah.com

Target-Oriented Utility allows utility theory (and thus risk-attitude) to be seamlessly integrated into applications focused on meeting targets. Previous work demonstrated its applicability in project management. This paper demonstrates its applicability in production scheduling.

4 - Supplier Competition under Carbon Policy

Nikoo Sabzevar, University of Calgary, 2500 University Dr. NW,
Calgary, AB, T2N1N4, Canada, nikou.sabzvar@gmail.com, Janne
Kettunen, Joule Bergerson, Silvanus T. Enns

We assess the impacts of carbon cap policy on the profitability of two suppliers that compete against each other in supplying CO₂ emission intensive products. We capture the competitive interactions using a Cournot model. Our results show, counterintuitively, that tightening the carbon cap can, under certain conditions, increase firms' profits. Also, we show that firms can increase their profits further by engaging in bilateral trading of emission permits.

■ WA66

66-Room 113C, CC

Reducing Impact of Delay through Improved Airport Operations and Recovery Procedures

Sponsor: Aviation Applications

Sponsored Session

Chair: Heng Chen, University of Massachusetts Amherst, Isenberg School of Management, Amherst, MA, 01003, United States of America, heng@som.umass.edu

1 - Integrated Airline Recovery: Capturing Passenger Compensation Impacts

Luis Cadarso, Rey Juan Carlos University, Camino del Molino s/n,
Fuenlabrada, 28943, Spain, luis.cadarso@urjc.es, Vikrant Vaze

The European flight delay compensation regulation (EC) No 261/2004 establishes common rules on compensation to passengers in the event of disruptions. We develop an integrated approach that recovers airline timetable, fleet assignment, aircraft routings, and passenger itineraries capturing the impacts of airlines' decisions on passenger compensation. We evaluate scenarios involving disruptions, and optimize recovery decisions to maximize profits by modeling passenger no-shows after disruptions.

2 - A Large Neighborhood Search Heuristic for an Optimal Ad-hoc Hubbing Strategy in an Airport Outage

Daniel Suh, Doctoral Student, University of Pennsylvania, 210
South 34th Street #102, Philadelphia, United States of America,
dansuh@design.upenn.edu

Abrupt airport outages resulting from terrorism, natural disasters, and incidents can cause reroutes and fuel-critical situations for flights. The objective of this study is to design a heuristic that identifies an ad-hoc hubbing strategy: a strategy to reroute flights bound for a disrupted airport to a hub airport that is not disrupted, with the goal of accommodating passengers on existing flights departing the non-disrupted hub while maintaining physical feasibility.

3 - Value of using a Departure Metering Area at Airports

Senay Solak, University of Massachusetts Amherst, Isenberg School of Management, Amherst, MA, 01003, United States of America, solak@isenberg.umass.edu, Heng Chen

Departure metering is an airport surface management procedure that limits the number of aircraft at the runway queue by holding aircraft at gates or at a predesigned metering area. We identify the optimal capacity for such a metering area, and quantify the overall value of the presence of a departure metering area at airports. The analysis is performed through stochastic dynamic programming, which is used to generate optimal metering decisions based on the status of each flight.

4 - Impacts of Alternative Aircraft Taxiing Systems on Airport Operations

Yu Zhang, Associate Professor, University of South Florida,
Tampa, 4202 E. Fowler Avenue, Tampa, FL, 33620, United States
of America, yuzhang@usf.edu, Rui Guo, Yuan Wang

Alternative taxiing is an innovative way of moving aircraft between airport gates and runways without turning the main engines on. The existing alternative aircraft taxiing systems (AATS) include on-board system such as WheelTug and EGTS, and external systems such as TaxiBot. This study investigates the impacts of AATS to airport operations, from both environmental and economic point of view and use presentative US airports as the case study to demonstrate the outcomes.

■ WA67

67-Room 201A, CC

Freight Logistics

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Rodrigo Mesa Arango, Assistant Professor, Florida Institute of Technology, 150 W. University Blvd, Melbourne, FL, 32901, United States of America, rmesaara@purdue.edu

1 - Bundling and Pricing Less-than-Truckload Services with Stochastic Demand

Rodrigo Mesa Arango, Assistant Professor, Florida Institute of Technology, 150 W. University Blvd, Melbourne, FL, 32901, United States of America, rmesaara@purdue.edu

Algorithms to bundle and price Less-than-truckload (LTL) services are proposed considering stochastic demand, value-based pricing, and demand segmentation. A two-stage min-cost flow problem accounts for uncertain demand. Its deterministic equivalent is formulated as a regular min-cost flow problem and efficiently solved. Deterministic models overestimate benefits. Numerical experiments reveal the cost of uncertainty and demonstrate improvements in bundle quality.

2 - Operations Research in the Supply Chain: Narrowing the Gap Between Theory and Practice

Kevin Zweier, Vice President, Chainalytics, 2500 Cumberland Parkway, Suite 550, Atlanta, GA, 30339, United States of America, kzweier@chainalytics.com

Learn how Chainalytics employs advanced analytics, modeling and optimization tools, techniques and heuristics to help clients (a) drive fact-based transformation and improve supply chain efficiencies in transportation sourcing, routing and fleet management; network design; and inventory policy and planning and (b) benchmark their rates for competitive analysis via membership in the Freight Management Intelligence Consortium (FMIC).

■ WA68

68-Room 201B, CC

Inference and Control in Dynamic Routing

Sponsor: Transportation, Science and Logistics

Sponsored Session

Chair: Negin Ebadi, University at Buffalo, 326 Bell Hall, Buffalo, NY, 14226, United States of America, negineba@buffalo.edu

1 - Inferring Travelers' Origin-Destination and Preferences via Shared Mobility System Utilization

Anshuman Kumar, University of Buffalo, Buffalo, NY, akumar27@buffalo.edu, Alexander Nikolaev, Jee Eun Kang

This research develops new methods to identify individual travelers' preferences and at the same time, infer "true" Origin-Destination (OD) based on incomplete route information of shared mobility system uses. Based on observations of travelers' route choices of a bike sharing system under various price settings, the proposed methods performs probabilistic reasoning to infer travelers' OD and preference.

2 - Mechanism Design for Route Assignment in Traffic Networks

Tarun Rambha, tarun.1988@gmail.com, Stephen Boyles

Assuming that travelers specify their maximum willingness to pay for a trip, we explore mechanisms in which a centralized controller assigns travelers to routes to optimize social welfare while ensuring incentive compatibility. Travelers' utilities are assumed to be a function of their willingness to pay and experienced travel times.

3 - Constructing Activity-mobility Patterns of Students Base on UB Card Transactions

Negin Ebadi, University at Buffalo, 326 Bell Hall, Buffalo, NY, 14226, United States of America, negineba@buffalo.edu,
Nicholas Delgobbo, Kwangil Suh, Jee Eun Kang

This paper proposed two algorithms to construct activity-mobility patterns of students in University at Buffalo based on their UB card transactions. A combination of two different measures of error has been used to evaluate the performance of the proposed algorithms.

■ WA69

69-Room 201C, CC

Connected and Autonomous Vehicles II

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Henry Liu, University of Michigan College of Engineering, Ann Arbor, MI, henryliu@umich.edu

1 - Envy-free Intersection Control with Value of Time Heterogeneity

Roger Lloret-Batlle, rlloretb@uci.edu, R. Jayakrishnan

Current traffic signal systems do not incorporate heterogeneity in the value of time of drivers. Including this information can improve intersection efficiency. We do this by allocating the green times according to a travel cost minimization rule, and then evaluate and discuss different payment schemes with different incentive and fairness properties.

2 - Optimizing Reservation-based Intersections for System Efficiency

Michael Levin, University of Texas at Austin, Ernest Cockrell, Jr. Hall (ECJ) 6.204, 301 E. Dean Keeton St. Stop C1761, Austin, TX, 78712, United States of America, michaellevin@utexas.edu,
Stephen Boyles

Reservation-based intersection controls for autonomous vehicles (AVs) have been demonstrated to reduce delays beyond optimized traffic signals. The question we address is how to optimize the reservation controls themselves. We present an integer programming (IP) formulation for reservation controls in dynamic traffic assignment and consider delay and energy objectives. We use a heuristic to solve the IP on a city network and obtain significant improvements under user equilibrium behavior.

3 - A Cooperative Active Collision Avoidance (CACA) Model for Connected Vehicles

Henry Liu, University of Michigan, Ann Arbor, MI, United States of America, henryliu@umich.edu, Xuan Di, Guizhen Yu

The emergence of the connected vehicle technology, which enables real-time V2V/V2I, holds the potential to enhance traffic safety applications such as vehicle collision avoidance. In this paper, we develop a novel cooperative active collision avoidance system for connected vehicles that can either avoid rear-end crashes or reduce rear-end crash severity by applying deceleration to the following vehicle and acceleration to its leading vehicles

4 - Auction-based Ridesharing with Pick-up and Drop-off Time Window

Alireza Khani, Assistant Professor, University of Minnesota, St. Paul, MN, United States of America, akhani@umn.edu,
Stephen Boyles

An auction-based ridesharing system is proposed in which users place bids for guaranteed door-to-door service with time constraints, and service provider selects a subset of bids to maximize the profit given operational cost in a time-dependent network. The problem is formulated as a MIP model and solution methods are investigated.

■ WA70

70-Room 202A, CC

Recent Academic Research in Railway Applications

Sponsor: Railway Applications

Sponsored Session

Chair: Jeremiah Dirnberger, Manager-Network Modeling & Analytics, CSX, 500 Water St, J300, Jacksonville, FL, 32202, United States of America, jeremiah_dirnberger@csx.com

1 - Integrated Systems Management Framework to Analyze the Critical Role of PTC in Rail Safety

Yalda Khashe, USC, University Park Campus, Los Angeles, CA, 90089-0193, United States of America, khashe@usc.edu,
Najmedin Meshkati

It seems that there has been a rash of serious and horrific railroad crashes and derailments in the US in this year that has claimed the lives of more than 14 people and injured hundreds. Authorities have issued a new rule on tank cars and renewed the call for speeding up the installation of the PTC systems on Class I railroads. However, PTC is designed to prevent a specific group of accidents and over reliance on this technology could potentially impair the overall safety of the system.

2 - Managing Rail Transportation for Hazardous Materials

Ginger Ke, Assistant Professor, Memorial University of Newfoundland, Faculty of Business Administration, St. John's, NL, A1A4J9, Canada, gke@mun.ca, Kan Fang, Manish Verma

This paper studies the routing and scheduling of rail shipments of hazardous materials with due dates. In particular, we minimize the weighted sum of earliness and tardiness for each demand plus the holding cost at each yard, while forcing a risk threshold on each service leg at any time instant. A mixed-integer programming model and two heuristic-based solution methods are proposed for preparing the shipment plan. Numerical experiments are conducted to provide managerial insights.

3 - Potential Areas Affected by a Liquid Hazardous Material Release

Jose Manuel Martin Ramos, University of Illinois (RailTEC), 205 N. Mathews Ave., Urbana, IL, United States of America, mrtmrms2@illinois.edu, Mohd Rapik Saat

The increase of crude oil traffic by rail in the U.S. and several severe release incidents highlight the need to further improve railroad transportation safety. Accurate estimation of the potential consequences of a release incident is a key element in risk assessment. This paper describes a specific methodology for evaluating more precisely the consequences of liquid hazardous releases. The model is developed using GIS software allowing anybody to easily implement it in time-efficient manner.

4 - A General Solution for Rail Yard Simulation with Conflicting Routes

Yuan Wang, SWJTU, 111 Erhuan Road Bei Yi Duan, Chengdu, China, yuan_wang2@hotmail.com, Gongyuan Lu

The biggest challenge in the yard simulation is to handle route conflicts of trains if their moving has shared tracks. The traditional agent-based simulation is usually very complicated and can hardly describe a lot of details. We will present a general event-based solution which can simplify the modeling process tremendously for all kinds of yards. A successful use case from the largest high-speed train station in Asian will be presented.

■ WA71

71-Room 202B, CC

Traffic Management

Contributed Session

Chair: Xiaolei Guo, Associate Professor, University of Windsor, 834 Hacienda Court, Odette School of Business, Windsor, Canada, guoxl@uwindsor.ca

1 - Using Cumulative Prospect Theory to Model Unexpected Driver Response to Congestion Pricing

Christopher Gaffney, Drexel University, 3141 Chestnut St, Philadelphia, PA, 19104, United States of America, cgaffney@stevens.edu, Michael Pennock

Dynamic congestion pricing is commonly used to reduce demand on roads. In practice, stated preference surveys are used to gauge drivers' value of time and set toll prices, while utility theory is often used for theoretical modeling. Evidence from Minneapolis and San Diego has shown the unexpected result that demand for tolled lanes increases with toll price. To account for this, we argue that an alternative measure of driver response to tolling, such as prospect theory, is needed.

2 - A New Quantitative Measure of Network Resilience

Hongcheng Liu, Pennsylvania State University, 240 Leonhard Building, State College, PA, United States of America, hql5143liu@gmail.com, Afroz Ansari, Terry Friesz, Wenjing Song, Haipeng Wang, Yiou Wang, Tao Yao, Zhao Fan

We propose a new quantitative measure of network resilience, called performance centrality, which generalizes the notion of betweenness centrality to explicitly capture not only topology but also distribution of demand and traffic controls. Numerical experiments indicate that performance centrality is a useful resilience index that provides new insights regarding how well traditional network resilience may be integrated with road network operational characteristics.

3 - Optimization of Active Traffic Management Strategies using Mixed Integer Linear Programming

Joseph Trask, North Carolina State University, 909 Capability Dr, Raleigh, NC, 27606, United States of America, jltrask@ncsu.edu, John Baugh, Nagui Roupail, Behzad Aghdash

In order to reduce congestion and improve travel times Active Traffic Management (ATM) strategies are often used to better control flow on freeways. This work presents a Mixed Integer Linear Programming formulation for the oversaturated method of the Highway Capacity Manual. The model is then used to optimize and provide insight into the usage of ATM strategies such as hard shoulder running and ramp metering.

4 - Constrained Optimization for the Morning Commute Problem with Flat Toll and Nonidentical Commuters

Xiaolei Guo, Associate Professor, University of Windsor, 834 Hacienda Court, Odette School of Business, Windsor, Canada, guoxl@uwindsor.ca, Da Xu

We study the morning commute problem with a peak period flat toll on a single bottleneck. Commuters' values of time are assumed to be continuously distributed. We consider that, for public acceptance reason, the toll has a maximum acceptable toll level and a maximum acceptable length of tolling period, both exogenously given. Under such a constrained optimization setup, we investigate the problems of system cost minimization, Pareto improvement, and revenue maximization.

5 - Research on the Decision Method of Concession Period for Bot Highway Projects

Yinhua Yang, Huazhong University of Science and Technology, Luoyu Road 1037, Hongshan District, Wuhan, China, 1143185408@qq.com

Private provision of public roads through build-operate-transfer (BOT) contracts is increasing around the world. In this paper, based on a flexible BOT contract with demand updating, we build a decision model of Concession Period for Highway BOT Projects to maximize social welfare and allow the private sector an acceptable profit. Finally, we select a BOT project of Guangfu highway for concession period decision-making analysis.

■ WA72

72-Room 203A, CC

Design and Analysis of Computer Experiments

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Ying Hung, Department of Statistics, Rutgers University, yhung@stat.rutgers.edu

1 - Modeling an Augmented Lagrangian for Improved Blackbox Constrained Optimization

Robert Gramacy, The University of Chicago, 5807 S Woodlawn Ave, Chicago, IL, 60605, United States of America, rbgramacy@chicagobooth.edu

We propose a combination of response surface modeling, expected improvement (EI), and the augmented Lagrangian (AL) numerical optimization framework, allowing the statistical model to think globally and the AL to act locally. Our hybridization presents a simple yet effective solution that allows existing objective-oriented statistical approaches, like those based on Gaussian process surrogates and EI, to be applied to the constrained setting with minor modification.

2 - Empirical Orthogonal Function Calibration with Simulator Uncertainty

Matthew Pratola, Assistant Professor, The Ohio State University, 1958 Neil Avenue, Columbus, OH, 43210, United States of America, mpratola@stat.osu.edu

Model-assisted inference has become increasingly popular when predicting real-world processes. Computer model calibration is a statistical framework combining mathematical model simulators of the process with statistical techniques to improve predictions by treating the simulator as deterministic. However, these simulators are often uncertain. We develop a Bayesian approach to incorporate such uncertainty using EOF's, and map simulator uncertainty into inferences for parameters and predictions.

3 - Challenges in Solar Power Forecasting Based on Multiple Computer Models

Youngdeok Hwang, Research Staff Member, IBM Research, 1101 Kitchawan Road, Route 134, Rm 34-224, NY, 10603, United States of America, yhwang@us.ibm.com

Solar energy forecasting based on large scale computer model needs to address some unique challenges. Development of a forecasting system requires both the accuracy and stability for large scale operation. Statistics has an important role in quantifying uncertainty and providing guidance to decision-makers in the

market. I will discuss some of these unique challenges and research opportunities in using complex computer models in solar energy industry.

4 - Multivariate Gaussian Process Model with Sparse Covariance Estimation

Qiong Zhang, Virginia Commonwealth University, 1015 Floyd Avenue, Richmond, VA, 23294, United States of America, qzhang4@vcu.edu

We propose a method to obtain a sparse estimation of the covariance matrix for multivariate Gaussian process model. We formulate the optimization problem as the L1 penalized log-likelihood function. To solve the optimization problem, we applied the majorization-minimization approach and the generalized gradient descent algorithm. Numerical experiments are provided to show the computational efficiency of the proposed method.

■ WA73

73-Room 203B, CC

Reliability Analysis of Complex Engineering Systems

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Rong Pan, Associate Professor, Arizona State University, P.O. Box 878809, Tempe, AZ, United States of America, rong.pan@asu.edu

1 - Start-up Demonstration Tests with Sparse Connection

David Coit, Professor, Rutgers University, coit@rci.rutgers.edu, Xiaoyue Wang, Xian Zhao

A start-up demonstration test is important for selecting equipment with high start-up reliability. Based on the concept of sparse connection, three tests with sparse connection are introduced which are called CSTF with sparse d1, TSCF with sparse d2 and CSCF with sparse d3 and d4. By finite Markov chain imbedding approach, probabilistic indexes are given. Besides, the procedure for obtaining optimal parameters of tests is proposed and new tests have higher efficiency than traditional ones.

2 - Bayesian Melding Methods for System Reliability Inference using Multilevel Information

Zhaojun Li, Assistant Professor, Western New England University, 1215 Wilbraham Rd, Springfield, MA, 01119, United States of America, zhaojun.li@wne.edu, Jian Guo

This paper investigates Bayesian melding methods for the system reliability analysis using various sources of test data and expert knowledge at both subsystem and system levels. The adaptive Sample Importance Resampling (SIR) method is proposed to address the computational challenges for updating the subsystem and system level posterior reliability. System posterior reliability assessments are compared under three scenarios of available subsystem and system data and prior information.

3 - Early System Reliability Analysis for New Products using Existing Components

Xiaoping Du, Professor, Missouri Science and Technology University, 400 West 13th Street, Toomey Hall, Rolla, MO, 65409, United States of America, dux@mst.edu

A new product may use existing components, and predicting its reliability is difficult due to dependent components. This presentation discusses how to address this issue. One way is to provide a narrow bound of the system reliability by a physics-based approach. The other way is to require component designers provide the relationship between the component reliability and the component load. This allows for an accurate prediction of the system reliability.

4 - A Computational Bayesian Approach to Dependency Assessment in System Reliability

Petek Yontay, Research Associate, Arizona State University, 699 S. Mill Ave., Tempe, AZ, 85281, United States of America, pyontay@asu.edu, Rong Pan

Due to the increasing complexity of engineered products, it is of great importance to use a model that can handle the complex reliability dependency among components, subsystems and systems. We propose a Bayesian network approach for assessing conditional dependencies within a complex system, using a hierarchical setting. We estimate the posterior distributions of these conditional probabilities in the Bayesian network by combining failure information at component, subsystem and system levels.

■ **WA74**

74-Room 204A, CC

Decision Analysis Approaches and Predictive Modeling to Managing Uncertainty in Manufacturing and Service Systems Design & Operations

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Zhenyu Kong, Associate Professor, Virginia Tech University, 123 Durham Hall (MC 0118) 1145 Perry Str, Blacksburg, VA, 24061, United States of America, zkong@vt.edu

1 - Self-Organizing Network for Variable Clustering and Predictive Analytics

Gang Liu, University of South Florida, 4202 E. Fowler Ave.
ENB118, Tampa, FL, United States of America, gliu@mail.usf.edu,
Hui Yang

This paper presents a new methodology of self-organizing network for variable clustering and predictive modeling. Specifically, nonlinear interdependence structures are characterized and measured among variables. Further, we embedded these variables as nodes in a complex network. Nonlinear-coupling forces move these nodes to derive a self-organizing topology of network. As a result, sub-network communities delineates the cluster structure of variables.

2 - A State Space Model for Multivariate Poisson Count Series

Nan Chen, National University of Singapore, isecn@nus.edu.sg,
Chen Zhang

This paper proposes a state space model to model and monitor multivariate count series. The model is built on multivariate log-normal mixture of independent Poisson distribution and allows for serial dependence by considering the Poisson mean vector as a latent process driven by a state space model. Based on this model, we furthermore propose a statistical process control scheme for multivariate count series. Finally we present a case study in an electrical system.

3 - Generalized Wavelet Shrinkage of Raman Spectra for Quality Control of Continuous Nanomanufacturing

Xiaowei Yue, Georgia Institute of Technology, 755 Ferst Drive
NW, Atlanta, GA, 30332, United States of America,
xiaowei.ysye@gmail.com, J.g. Park, Jianjun Shi, Hao Yan, Kan
Wang, Chuck Zhang, Zhiyong Liang

Raman spectroscopy is an attractive in-line quality characterization and quantification tool for continuous nanomanufacturing. A signal analysis model with signal-dependent noises for Raman spectra is developed and validated. And a novel generalized wavelet shrinkage approach is introduced to remove noise in all wavelet coefficients by applying individual adaptive wavelet thresholds. The effectiveness of this method is demonstrated using both simulation and experimental case studies.

4 - A Novel Bayesian Learning Algorithm for Sparse Estimation under Mixed Gaussian-Laplacian Noise

Babak Barazandeh, Research Assistant, Virginia Tech University,
Room 211 Graduate life center- 155 Otey, Blacksburg, VA, 24061,
United States of America, babak7@vt.edu, Zhenyu Kong,
Kaveh Bastani

Sparse estimation problem is very challenging due to the ill-posedness of the problem. Typically the sparsity assumption provides some viable algorithms to approximate the solution. However, most of these algorithms minimize the l_2 norm error due to the Gaussian noise assumption, which is sensitive to outliers caused by Laplacian noise. We propose a novel Bayesian learning algorithm with a parameterized prior encouraging sparsity under the mixture of Gaussian and Laplacian noise.

■ **WA75**

75-Room 204B, CC

Supply Chain Management IX

Contributed Session

Chair: Wan Libing, Huazhong University of Science & Technology, 1037 Luoyu Road, Wuhan, P.R. China, Wuhan, China,
wanlibingwlb@163.com

1 - A Mathematical Model of Vehicle Routing Problem for Third-Party Logistics Service Providers

Birasnav M, New York Institute of Technology, Broadway,
61st Street, Manhattan, NY, 10023, United States of America,
birasnav@gmail.com

Third-party logistics service providers play a major role in the distribution of matchboxes from southern towns to northern towns of India. These service providers operate a facility called cross-docking that receives bundles of

matchboxes from various suppliers located around the facility and consolidates and dispatches these bundles to customers.

2 - Multi Region Input Output Model for Scope-based Carbon Footprint Accounting

Murat Kucukvar, Assistant Professor, Istanbul Sehir University,
Altunizade, No 27, Istanbul, 34662, Turkey,
muratkucukvar@sehir.edu.tr, Vural Aksakalli

This research aims to advance the body of knowledge on carbon footprint analysis of the manufacturing sectors with a holistic approach combining the scope-based carbon footprint accounting standards with a time series multi-region input-output (MRIO) analysis framework. To achieve this goal, a global scope-based carbon footprint analysis of the Turkish manufacturing sectors has been conducted as a case study.

3 - Optimal Remanufacturing Strategies in Name-your-own-price Auctions with Limited Capacity

Qifei Wang, Huazhong University of Science and Technology,
Luoyu Road, 1037 Building, Wuhan, Hubei, Wuhan, China,
qifeiwang@hust.edu.cn, Chengxiu Gao, Hong Yan, Stuart X. Zhu,
Jianbin Li

We study optimal remanufacturing strategies in a closed-loop supply chain. The returns are collected under a name-your-own-price (NYOP) bidding mechanism. We find the manufacturer's optimal strategies mainly depend on bidding cost, cost saving, production capacity, and market scale. We also compare this mechanism with traditional list price mechanism and find the conditions under which the manufacturer prefers the NYOP mechanism. Some managerial insights are obtained through numerical studies.

4 - Optimal Price and Sales Effort Level in a Dual-channel Supply Chain in Case of Bidirectional Free Riding

Mengping Zhu, Huazhong University of Science and Technology,
Luoyu Road, 1037 Building, Wuhan, Hubei, Wuhan, China,
zhumpluck@163.com, Jianbin Li, Bin Dai

We study the optimal policy in case of bidirectional free riding and price competition. Results show that: in the decentralized supply chain, retailers' optimal sales effort depends on wholesale price, effort cost and the free riding coefficient: when the effort cost is too high or too low, the manufacturer will offer the same wholesale price for both retailers, otherwise, the manufacturer engages in wholesale price discrimination.

5 - The Competition Strategy Analysis in a Mixed Duopoly Market

Wan Libing, Huazhong University of Science & Technology, 1037
Luoyu Road, Wuhan, P.R. China, Wuhan, China,
wanlibingwlb@163.com

So far, China's express industry has formed a mixed oligopoly market in which state-owned enterprise and private enterprises compete together. This thesis studies duopoly express service providers' price and capacity based on mathematical models. We compare social welfare between the two competition strategies of state-owned company. The result shows that state-owned company should either maximum social welfare or maximum profit as its objective which is depended on technological conditions.

■ **WA76**

76-Room 204C, CC

Simulation I

Contributed Session

Chair: Pratik Misra, Air Products and Chemicals, Inc., 7201 Hamilton
Boulevard, Allentown, PA, 18195, United States of America,
Misrap@airproducts.com

1 - Optimal Design Models for 3d Automated Parking Systems

Guangmei Wu, Doctoral Student, Huazhong University of Science
& Technology, 1037 Luoyu Road, Wuhan, 430070, China,
wuguangmei163@163.com, Xianhao Xu, Yeming Gong

In this paper, we consider a newly designed for automatic parking garage system. We mainly use queuing network models to estimate the system expected travel time when we retrieve the cars. Our research objective is to analyze the system performance and optimally design for automatic parking garage system.

2 - Efficient Sampling of the Brown-resnick Process

Zhipeng Liu, PhD Candidate, Columbia University, 424 West
119th Street, 6B, New York, NY, 10027, United States of America,
zl2337@columbia.edu, Jose Blanchet

We propose a perfect simulation algorithm for the Brown-Resnick process. This algorithm has an optimal computational cost in the sense that it has nearly linear complexity with simulation of the basic Gaussian Random field. We mainly use importance sampling and acceptance-rejection procedure to construct this algorithm.

3 - Modeling Processing Times for Based on Expert's Estimates: Pert or Triangular? Uniform or Beta?

Martha Centeno, Full Professor, University of Turabo, P.O. Box 3030, Industrial and Management Engineering, Gurabo, 00778-3030, Puerto Rico, centenom1@suagm.edu, Kimberly Diaz, Karla Acevedo

Simulating a system may require relying on the estimates of the experts to obtain a range and a most likely value. The question is: what is to use: Triangular or Pert? We present a study of the effect on typical measures of performance of using Pert or Triangular, Uniform or Beta. Based on results, we present guidelines to select one of these distributions. For example, Pert and concave Beta should be used for conservative decision making and triangular and convex Beta for an optimistic one.

4 - Agent Based Modeling of Uncertain Dynamic Markets with Contracts

Pratik Misra, Air Products and Chemicals, Inc., 7201 Hamilton Boulevard, Allentown, PA, 18195, United States of America, Misrap@airproducts.com, Sanjay Mehta, Cem Ozen, Yang Liu, Erdem Arslan

Agent based modeling technique is employed to simulate uncertain markets that have geographical limits due high distribution costs and have time-bound contracts. Suppliers and customers are modelled as agents and macro-economic conditions are modelled as environment in which the agents interact and follow their programmed decision-rules. In this presentation, we will present general features of these models and share example case studies to show their utility in understanding such markets.

5 - An Agent Based Modeling Approach to Predicting Adoption of Critical Health Practices

Noshir Contractor, Northwestern University, 2145 Sheridan Road, Tech D241, Evanston, IL, 60208, United States of America, nosh@northwestern.edu, Aaron Schecter

The adoption of new health practices in rural areas is driven by a variety of factors, including opinions, opportunity, and external influences. However, it is analytically infeasible to determine exactly how opinions spread. Thus, we propose a series of agent based models to uncover the processes that lead to widespread adoption, as well as which individuals are most influential. Our models are based on survey data collected from over 10,000 government agents in India.

■ WA77

77-Room 300, CC

Supply Chain Closed Loop I

Contributed Session

Chair: Mohammadsadegh Mobin, PhD Fellow, Western New England University, 1215 Wilbraham Road., Springfield, MA, 01119, United States of America, mm337076@wne.edu

1 - Quality Uncertainty and the Value of Coordination in a Closed Loop Supply Chain

Juan Pedro Sepúlveda-Rojas, Associate Professor, University of Santiago de Chile, 3769 Ecuador Ave, Santiago, Chile, juan.sepulveda.ro@usach.cl

We analyze total cost optimization in a SC with returns through global coordination. We develop a LP model that incorporates a quality factor about returning items for remanufacturing processes; the model is validated with different demand and returns scenarios, allowing comparison between instances with different variability in customer demand. The results highlight the value of the quantity and quality of returned products for supply chain members and how it might influence the uncertainty

2 - An Accelerated Benders Decomposition for Closed-Loop Supply Chain Network Design

Mohammad Jeihoonian, PhD Candidate, Concordia University, 1455 De Maisonneuve Blvd. W., Montreal, QC, H3G 1M8, Canada, m_jeihoon@encs.concordia.ca, Michel Gendreau, Masoumeh Kazemi Zanjani

We present a mixed-integer programming formulation to design a closed-loop supply chain network for modular-structured products. The choice of the recovery option depends on the quality level of the composing components in the returned product. We develop an accelerated Benders decomposition-based solution algorithm. Computational results illustrate the efficiency of the solution method.

3 - Performance Evaluation of Closed Loop Systems with General Failure and Repair Times

Mohammadsadegh Mobin, PhD Fellow, Western New England University, 1215 Wilbraham Road., Springfield, MA, 01119, United States of America, mm337076@wne.edu, Morteza Assadi, S. Hossein Cheraghi, Zhaojun Li

This paper evaluates the performance of closed loop supply systems using the proposed modified extended bottleneck algorithm. It is shown that the algorithm exhibits better performance than the existing bottleneck algorithm for closed loop systems with generally distributed failure and repair times. The effectiveness of the developed algorithm is verified using a simulation model.

■ WA78

78-Room 301, CC

Energy Applications

Contributed Session

Chair: Zhenhong Lin, Oak Ridge National Laboratory, 2360 Cherehala Blvd, Knoxville, TN, 37932, United States of America, linz@ornl.gov

1 - A Risk-Based Approach to Modeling Industrial Loads in Non-Residential Buildings

Seyed Vaghefi, Research Associate, Center for Advanced Infrastructure and Transportation, 100 Brett Rd, Piscataway Township, NJ, 08854, United States of America, vaghefi@rutgers.edu, Mohsen Jafari, Farbod Farzan

This work aims to develop a data-driven framework to predict and optimally control industrial loads in nonresidential buildings. In this framework, first, a set of predictive analytics tools are employed to identify the patterns of industrial loads over time. This includes a high-dimensional cluster analysis and a classification model to predict the day-ahead load profiles. The results are fed into a cost-based risk model to calculate and evaluate the total risk of energy decisions.

2 - An Iterative Two-stage Convex Relaxation Approach for Natural Gas Pipeline Transmission: A CNPC Case

Mengying Xue, Tsinghua University, Department of Industrial Engineering, Beijing, 100084, China, xmy14@mails.tsinghua.edu.cn, Dingzhi Liu, Tianhu Deng

The optimal dynamic planning of natural gas consumption is important to a nation's economic sustainability and environmental protection. We study how China National Petroleum Corporation, the largest oil and natural gas producer and supplier in China, should dynamically plan its gas production, transportation and sales amount under certain nonlinear physical requirements. The designed system has been implemented and used and is projected to save \$34Billion from 2016-2020.

3 - Natural Gas Storage Valuation under Uncertainty

Ebisa Wollega, Assistant Professor, Colorado State University-Pueblo, 2200 Bonforte Blvd, Pueblo, CO, 81001, United States of America, ebisa.wollega@csupueblo.edu, Hank Grant

This paper presents a heuristic algorithm that natural gas storage decision makers can use to make storage decisions under uncertainty. The algorithm decreases the computation time significantly from hundreds of days to fractions of a second at a reasonable solution quality.

4 - Scenario Generation via Copula-arima Models: Risk Management for a Gas-fired Power Plant

Xiaojia Guo, University College London, Dept. of Management and Innovation, Gower Street, London, WC1E 6BT, United Kingdom, x.guo.11@ucl.ac.uk, Afzal Siddiqui, Giampiero Marra

Gas-fired power plants face uncertainty in both electricity and natural gas prices, which tend to be positively correlated. We propose a copula-based approach to link two independent models and to generate scenarios for solving stochastic programming problems. We compare our approach with established methods, e.g., independent ARMA models and transfer functions, in terms of forecasting performance and providing solutions for the stochastic programming problem.

5 - Optimize Electric Driving Range under Range Uncertainty

Zhenhong Lin, Oak Ridge National Laboratory, 2360 Cherehala Blvd, Knoxville, TN, 37932, United States of America, linz@ornl.gov

This paper optimizes the driving ranges of battery electric vehicles (BEV) for U.S. drivers based on driving pattern, household vehicle flexibility, vehicle price, range anxiety, range uncertainty. Key results are the cumulative share of U.S. BEV consumers for a given optimal range and the sensitivity of such range distributions to battery cost, charging infrastructure, and range uncertainty.

■ **WA79**

79-Room 302, CC

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - Optimization Direct, Inc. – Solving Large Scale Optimization Problems using CPLEX Optimization Studio

Robert Ashford, Optimization Direct, Inc., Alkis Vazacopoulos

Recent advancements in Linear and Mixed Programming give us the capability to solve larger Optimization Problems. CPLEX Optimization Studio solves large-scale optimization problems and enables better business decisions and resulting financial benefits in areas such as supply chain management, operations, healthcare, retail, transportation, logistics and asset management. In this tutorial using CPLEX Optimization Studio we will discuss modeling practices, case studies and demonstrate good practices for solving Hard Optimization Problems. We will also discuss recent CPLEX performance improvements and recently added features.

2 - Introducing New Release 5.0 of the MPL Modeling System and the OptiMax Component Library

Bjarni Kristjansson, Maximal Software Inc.,
2111 Wilson Boulevard, Suite 700, Arlington, VA.,
bjarni@maximalsoftware.com,

Maximal Software is introducing a new major release 5.0 of the MPL Modeling System, which represents a major milestone for MPL. We will be demonstrating the many new features and enhancements of MPL, including new directory structure, redesigned documentation, new solver updates, Reverse Hessian for nonlinear models, and enhanced Stochastic support. Major updates for the MPL OptiMax Library and the MPL Callable Library, include also new callbacks, new exception handlers, and enhanced multi-threaded support.

Wednesday, 11:00am - 12:30pm■ **WB01**

01-Room 301, Marriott

MAS Tutorial: A Logistics Planning System for Military Contingency Missions

Sponsor: Military Applications

Sponsored Session

Chair: Greg Parlier, Past President, MAS of INFORMS, 255 Avian Lane, Madison, AL, 35758, United States of America, gparlier@knology.net

1 - A Logistics Planning System for Military Contingency Missions

Matthew B. Rogers, U.S. Army / N.C. State University, 121 E. Cedar Ave, Wake Forest, NC, 27587, United States of America, mbroger2@ncsu.edu, Greg Parlier, Russell King, Brandon Mcconnell, Kristin Thoney-barletta, Thom Hodgson, Michael Kay

Logistical considerations are a critical part of mission planning for contingency operations. A form of (near real-time) adaptive discrete event simulation is used to identify requirements for a logistic system during contingency mission planning. Mission-based forecasting is used to generate sustainment demand for the simulation. Network performance is used to modify interactively the logistic network until the contingency mission can be properly supported.

■ **WB02**

02-Room 302, Marriott

Scheduling II

Contributed Session

Chair: Vadim Timkovski, Keiser University, Fort Lauderdale, FL, United States of American, vtimkovski@keiseruniversity.edu

1 - Risk Measures of Machine Breakdowns in Job Shop Scheduling

Shu-dong Sun, Prof, Northwestern Polytechnical University,
No127 West Youyi RD, Xi'An, China, sdsun@nwpu.edu.cn,
Zhigao Wu

A mathematical measure for the risk of job shop scheduling with random machine breakdowns is presented. However, the mathematical measure is too hard to implement, a simulation-based and a calculation-based approximate measures are put forward. The performance of the two approximate measures is studied. Experiment results show that the calculation-based risk measure is more time saving than the simulation-based risk measure while the performance of the two measures are nearly the same.

2 - A Computational Study of the Two-Machine No-Wait Flow Shop Problem Subject to Unequal Release Dates and Non-Availability Constraints

Mohamed Labidi, Assistant Professor, King Saud University,
Industrial Engineering Dept., Riyadh, Saudi Arabia,
mlabidi@ksu.edu.sa, Anis Kooli, Talel Ladhari

We consider the problem of scheduling a set of jobs subject to unequal release dates on a two-machine flow shop where the no-wait and non-availability constraints are considered so as to minimize the makespan. We propose several new lower bounds that are embedded within a branch-and-bound algorithm. Computational results show that our procedure outperforms state-of-the art exact method.

3 - Heuristic Approach for an Unrelated Parallel Machine Scheduling Problem with Ready Times, Due Dates

Bin Li, University of Arkansas, 4110 Bell Engineering Center,
Fayetteville, AR, 72701, United States of America,
binli@email.uark.edu, Ashlea Milburn

We present a scheduling problem with unrelated parallel machines, ready times, due dates, limited machine availability and job splitting. The objective is to minimize the total job processing time. This research is motivated by a real warehouse labor scheduling problem. The effectiveness of exact and heuristic methods in developing solutions to a large variety of test instances are compared in a computational study. Results are presented.

4 - Single-machine Preemptive Scheduling of Equal-processing-time Jobs

Vadim Timkovski, Keiser University, Fort Lauderdale, FL,
United States of America, vtimkovski@keiseruniversity.edu

We show that the problem of minimizing the total weighted tardiness with different release dates can be solved in pseudo-polynomial time.

5 - Integrated Production and Shipping Scheduling for A Single Manufacturer and Multiple Customers

Fangzhou Sun, Virginia Tech, 250 Durham Hall, 1145 Perry
Street, Blacksburg, VA, 24060, United States of America,
fangzhou@vt.edu, Subhash C. Sarin, Yuqiang Wang

We investigate a supply chain scheduling problem consisting of a single manufacturer and multiple customers, which integrates the production and shipping decisions so as to minimize the weighted sum of costs incurred due to shipping and number of tardy orders. We develop a heuristic and an optimum-seeking algorithm both of which exploit the structural properties of the problem. Computational results reveal efficacy of the proposed methods and significant benefits that accrue from integration.

■ **WB03**

03-Room 303, Marriott

Newsvendor Model and Extensions

Contributed Session

Chair: Layth Alwan, Associate Professor, University of Wisconsin-Milwaukee, P.O. Box 742, Milwaukee, WI, 53201, United States of America, alwan@uwm.edu

1 - Can Server Behavior and Service System Design Outweigh the Benefits of Pooling?

Marilyn Lucas, University of Vermont, 55 Colchester Ave.,
Burlington, VT, 05405, United States of America,
mlucas@bsad.uvm.edu, Hung Do, David Novak, Masha Shunko

It is widely accepted that multi-server single-queue (SQ) systems outperform multi-server parallel-queue (PQ) systems due to the pooling effect. We investigate the impact of two server behaviors - social loafing and workload-dependent speedup - and one physical factor - walking time - on the performance of SQ and PQ systems.

2 - Either Forecast Optimally or Opt Out: Newsvendor Perspective

Layth Alwan, Associate Professor, University of Wisconsin-Milwaukee, P.O. Box 742, Milwaukee, WI, 53201,
United States of America, alwan@uwm.edu, Xiaohang Yue

The newsvendor model assumes IID demand. In application, demand can exhibit serial correlation. The natural adaptation is to develop a forecast-based implementation. For stationary processes, such as an AR(1), an implementation based on an MSE optimal forecasting method always provides long-term savings. However, under certain conditions, commonly implemented smoothing methods fail to provide long-term benefits. As a result, it best to ignore the correlation and opt out of forecasting.

■ WB04

04-Room 304, Marriott

Economics III

Contributed Session

Chair: Wei Ye, Tongji University, Shanghai, China, Siping Rd 1239, Shanghai, China, Shanghai, China, yw0129@126.com

1 - Contractual Adaptation through Voluntary Renegotiation

Jiulin Teng, HEC Paris, 1 rue de la Liberation, Department of Strategy, Jouy-en-Josas, 78351, France, jiulin.teng@hec.edu

I study the efficiency benefits of contractual adaptation. With a game theoretic model that delves into the microfoundation of bilateral interaction in a non-stochastic, non-deterministic environment, I find the dynamic contract that is 'temporarily' renegotiation-proof benefits from inter-temporal, Pareto-improving updates – I refer to them as 'voluntary renegotiation'. Their efficiency advantage over static contracting alternatives arises from the balance between flexibility and precision.

2 - Evaluation of City-Production Integration Based on DEA Model and Coupling Method

Jingjing Jia, Tongji University, School of Economic and Management, Siping Road No.1239, Shanghai, China, yjshsl@163.com, Lin Su, Yixi Xue

The level of city-production integration is essential for urban development; however the current research mainly focuses on the definition of the concept. In this paper, we took typical cities in China as cases by using the combination of Dea Model And Coupling Method to quantitatively evaluate and classify the level of city-production fusion, and finally proposed policy recommendations.

3 - The Impact of Corporate Welfare Policy on Firm's Productivity: Evidence from Unemployment Insurance

Heedong Kim, PhD Student, Robert H. Smith School of Business, University of Maryland, 6100 Westchester Park Drive, Apt. 1007, College Park, MD, 20740, United States of America, hekim@rhsmith.umd.edu, Emanuel Zur, Masako Darrouh

We examine the relation between the state-run unemployment insurance benefits (UIBs) and firm productivity. We test two competing theories and find that our results support the efficiency wage rather than the compensating wage differential theory. We find that an increase in UIBs is likely to exacerbate moral hazard and leads to a decrease in firm productivity. We also find that firms tend to enhance their employee welfare policies as a complementary mechanism to manage moral hazard problems.

4 - How the Family Life Cycle Affects Rural Labor Migration: Evidence from China

Wei Ye, Tongji University, Shanghai, China, Siping Rd 1239, Shanghai, China, Shanghai, China, yw0129@126.com

This paper studies how the family life cycle affects rural labor migration in China. We constructed an unique 5-stage family life cycle model and used a logistic regression model to examine the effect. The original data is from a valid questionnaire of 2107. Empirical results showed that the family life cycle has significant impact on rural labor migration. Different stage has different impact on migration. As the family becomes older, the possibility of migration shows a "S-curve" fluctuation.

■ WB05

05-Room 305, Marriott

Better Business using Social Media Analytics

Cluster: Social Media Analytics

Invited Session

Chair: Chris Smith, TRAC-MTRY, 28 Lupin Lane, Carmel Valley, CA, 93924, United States of America, cmsmith1@nps.edu

1 - Predicting Digital Currency Price from Social and Traditional Media

Peng Xie, Georgia Institute of Technology, Room 907, 100 10th Street, Atlanta, GA, 30309, United States of America, peng.xie@scheller.gatech.edu

Using daily Bitcoin price data and Bitcoin Forum discussion, we try to understand if social media can affect Bitcoin price and how long does it take. We use the percentage of negative words as the measure of the article sentiment. The results show that social media can affect price. However, for information sources focusing on speculation, the effects on prices are immediate. In contrast, information concerning fundamentals impacts prices in a longer holding period.

2 - What Products to Feature on Retail Website Landing Pages?

Patrali Chatterjee, Professor, Montclair State University, 1 Normal Avenue, Montclair, NJ, 07043, United States of America, chatterjee@montclair.edu

Landing pages on retailer websites are critical in inducing new shoppers to browse deeper and ultimately purchase. Using field-experiment data this research examines the relative effectiveness of using various real-time marketing analytics like social media likes/pins (unique vs. shared) with site-specific behavioral data (most purchased/most placed in cart/searched) on conversion.

3 - Decision Sciences Initiative in Analytics: The Nexus of Operations Efficiency and Big Data

Tom Stafford, Editor, Decision Sciences Journal, Fogelman College of Business, University of Memphis, Memphis, TN, 38152, United States of America, descieditor@gmail.com, Ramesh Sharda

Decision Sciences Journal has a strong interest in the analysis and understanding of large-scale data. We offer a panel describing analytics research publication opportunities, and prospective authors will receive one-on-one mentorship with key editors in preparation for Journal submission. Topics of interest span social media, descriptive, predictive and prescriptive analytics.

4 - Situational Understanding: A Military Perspective of Where we Need to Go and the Exploitation of Open Source Data Utilizing "Social Signal Processing for Anomaly Determination"

Michael A. Kolodny, Senior Technology Advisor, Army Research Laboratory, michael.a.kolodny.ctr@mail.mil

We are drowning in the deluge of data that is being collected world-wide, while at the same time starving for knowledge and understanding. In the military domain, there is a need to autonomously access & synthesize all relevant available data & information into situational understanding for the Warfighters to rapidly & effectively make critical decisions. A key aspect of this process is to provide only information that is relevant and useful for the needed mission decision at hand. Innovative research is needed to achieve the necessary situational understanding required by military decision makers especially at the tactical edge. This presentation will discuss the following topics: • The different levels of understanding from physical representation to the levels of comprehension (insight) and prediction (foresight). • The types of data processing and analytics needed to understand group behaviors and their mutability and resiliency. • A military perspective on data-to-decision to provide Situational Understanding at the tactical edge. • The exploitation of open-source data such as social media for the determination of anomalous group behaviors • The ARL's initiatives to enable collaborative research "Social Signal Processing for Anomaly Determination".

■ WB06

06-Room 306, Marriott

Real Options

Sponsor: Financial Services

Sponsored Session

Chair: Kuno Huismans, Tilburg University, Post Office Box 90153, Tilburg, 5000LE, Netherlands, k.j.m.huismans@tilburguniversity.edu

1 - Entry Deterrence by Location under Stochastic Demand

Kuno Huismans, Tilburg University, Post Office Box 90153, Tilburg, 5000LE, Netherlands, k.j.m.huismans@tilburguniversity.edu, Peter Kort

Huismans and Kort (2015, RJE) showed that by overinvesting an incumbent firm can delay entry by a competitor. This paper analyzes how location can play a role in entry deterrence strategies. Location can be geographical, but can also relate to product positioning

2 - Assessing Pollution Abatement Investment Policy under Ambiguity

Motoh Tsujimura, Associate Professor, Doshisha University, Kamigyo-ku, Kyoto, 602-8580, Japan, mtsujimu@mail.doshisha.ac.jp

This paper investigates a pollution abatement investment policy under ambiguity. We consider there are representative consumer and firm in an economy and formulate the social welfare maximization problem. Then we derive the optimal abatement investment timing. Furthermore, we analyze the comparative static effects of the model's parameters.

3 - Product Innovation under Declining Demand and Uncertainty

Verena Hagspiel, Norwegian University of Science and Technology, Alfred Getz vei 3, Trondheim, Norway, verena.hagspiel@iot.ntnu.no, Peter Kort, Claudia Nunes

This paper studies a firm's optimal product innovation decision facing volatile and deteriorating product demand. The firm has to decide about the optimal time to adopt new technology required to successfully launch a new product generation and therewith boost demand. The innovation process is considered stochastic with uncertainty about the speed of the arrival. Besides timing we also study the optimal capacity choice for the new product.

4 - Competitive Capacity Investment with Learning

Youngee Kim, University of Illinois at Urbana-Champaign,
Urbana, IL, ykim180@illinois.edu, Dharma Kwon,
Kuno Huisman, Verena Hagspiel

Two competing firms consider an investment with uncertain profitability. In particular, each firm needs to decide when to invest as well as how much to invest. Depending on the order of the investment, the leader and the follower naturally arise, and whoever becomes the follower can learn the leader's performance and take that information into consideration. We investigate the equilibrium strategy in this game and study the impact of learning on the equilibrium.

WB07

07-Room 307, Marriott

Large-scale Portfolio Risk

Cluster: Risk Management

Invited Session

Chair: Justin Sirignano, Stanford University, Huang Engineering Center, Stanford, CA, 93404, United States of America, jasirign@stanford.edu

1 - Large-Scale Loan Portfolio Selection

Justin Sirignano, Stanford University, Huang Engineering Center, Stanford, CA, 93404, United States of America, jasirign@stanford.edu, Kay Giesecke, Gerry Tsoukalas

The problem of optimally selecting a large portfolio of risky loans is a high-dimensional nonlinear integer program. Portfolios can range from thousands to even hundreds of thousands, making the problem extremely computationally challenging. Using weak convergence results, we develop an approximate optimization approach which is accurate and typically significantly faster than nonlinear integer program solvers.

2 - Modeling Large Portfolio Risks with Covariates

Jianqing Fan, Princeton, Dept of Operations Res & Fin Eng, Princeton University, Princeton, NJ, 08544, United States of America, jqfan@princeton.edu, Weichen Wang, Yuan Liao

We propose a flexible factor model for estimating large covariance matrices with covariates and introduce a Projected-PCA technique. We show that the unobserved latent factors can be more accurately estimated than the conventional. By using the newly proposed Projected-PCA, the rates of convergence of the smooth factor loading matrices are obtained, which are much faster than those of the conventional factor analysis. The proposed methods are illustrated by extensive numerical studies.

3 - Geometry of Defaults

Richard Sowers, Professor, University of Illinois at Urbana-Champaign, Urbana, IL, 61801, United States of America, r-sowers@illinois.edu

We develop a geometric picture of defaults in an Eisenberg-Noe setting. We adapt some recent work to generate global rankings from local (pairwise) comparisons based on shortfalls. This work is joint with Henry Schenck and Rui Song

WB08

08-Room 308, Marriott

Optimization Nonlinear Programming II

Contributed Session

Chair: Alex Feild, Human Systems Engineer, Naval Surface Warfare Center, 18444 Frontage Road, Ste 327, Dahlgren, VA, 22405, United States of America, alexander.feild1@navy.mil

1 - A Hub-and-Spoke Network Design with Nonlinear Penalty Function

Ramez Kian, Bilkent University, Industrial engineering Department, Bilkent University, Ankara, Turkey, ramezk@bilkent.edu.tr, Kamyar Kargar

In this paper, a bi-objective uncapacitated hub location problem is addressed. The first objective is to minimize the traditional cost function and the second objective tries to maximize the amount of flow transported via the hub network. It corresponds to logistics companies which makes it impossible for them to route all the flow in the network. The mixed integer nonlinear model, the proposed solution approaches and numerical results are provided.

2 - Convex Relaxations in Gas Network Optimization Problems

Pelin Cay, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, pec212@lehigh.edu, Camilo Mancilla, Robert Storer, Luis Zuluaga

Non-convexity, non-linearity and the need for a real time solutions are the main

challenges of gas network optimization problems. In this study, we show the benefits of using convex SOCP relaxations of the problem. This convexification provides lower bound information which can be useful in solving large scale real life problems more efficiently.

3 - Goal Reaching Kinematic Chain using a General Purpose Inverse Kinematic Approach

Alex Feild, Human Systems Engineer, Naval Surface Warfare Center, 18444 Frontage Road, Ste 327, Dahlgren, VA, 22405, United States of America, alexander.feild1@navy.mil, Michael Hamilton, Patrick Mead

The goal was to solve the problem of creating a general purpose model for partially analytical goal reaching kinematic chain. Our model is largely based on the Cyclic Coordinate Descent algorithm (CDD). We included a step in the cycle where the joint under evaluation was able to use its parent's axial freedom to rotate its hinge axis prior to applying its own rotation. The model implementation took 56% fewer iteration and an estimated 27% fewer calculations to stabilize than a traditional CCD.

WB09

09-Room 309, Marriott

Venture Capital Funding, Crowd Sourcing, New Product Development, and Supply Chain Transparency

Sponsor: Technology, Innovation Management & Entrepreneurship
Sponsored Session

Chair: Zhili Tian, Assistant Professor, Florida International University, 11200 S.W. 8th Street, Miami, FL, United States of America, ztian@fiu.edu

1 - Too Successful to Innovate? Dynamic Entrepreneurial Reputation and Venture Capital

Noam Shamir, Assistant Professor, Tel-Aviv University, Haim Levanon, Tel-Aviv, Israel, nshamir@post.tau.ac.il, David Zvilichovsky

This research integrates entrepreneurial experience, success, reputation and venture financing into a dynamic model which explores the execution of innovative projects under asymmetric information. We are interested in exploring the tension between the desire of the entrepreneur to exploit the current project opportunity and her understanding that the success or failure in this current project also impacts her future reputation.

2 - Hunters and Gatherers: Strategy Identification of the Leading Open Firms

John Angelis, Elizabethtown College, 1 Alpha Drive, Elizabethtown, PA, United States of America, angelisj@etown.edu, John Ettlie, Joseph Miller

We analyzed 73 (of 100 original) firm open innovation efforts via their press releases. Using path and cluster analysis to analyze the coded data, we obtained statistically significant results. Our data shows at least two types of crowdsourcing: 1) Hunters, incumbent firms, learning open methodologies, that accelerate a single (often one time) experiment to implement crowd sourcing; or 2) Gatherers, often newcomers, born open, with less urgency that continuously interact with the crowd.

3 - Product Development by a Firm and its Supplier: Insights from a Problem-solving Approach

Mohsen Jafari Songhori, Jsps Research Fellow, Tokyo Institute of Technology, J2 Bldg., Room 1704, 4259 Nagatsuta-cho., Tokyo, 226-8502, Japan, mj2417@gmail.com, Takao Terano, Sunny S. Yang

This study conceptualizes Product Development (PD) by a firm and a supplier as a problem solving process. The firms decompose the PD problem into sub-problems, and use different solution strategies (e.g. different design approaches with costs, quality). We investigate the firms' problems (e.g. optimal design strategy) and their interactions (e.g. contract setting).

4 - An Empirically Grounded Model of Supply Chain Transparency

Anton Shevchenko, York University, 4700 Keele St, Toronto, Canada, absh1986@gmail.com, Moren Lévesque, Mark Pagell, David Johnston

Using multiple case studies our study explores how firms achieve the requisite transparency to manage their supply chains. We explore the barriers and enablers of transparency inherent in complex networks of buyer-supplier relationships and external stakeholder involvement before discussing firm strategies for managing escalating requirements for transparency.

5 - Advantages of Dual Sourcing in the Presence of a Demand-exploiting Supplier

Sunny S. Yang, Southampton Business School,
University of Southampton, Southampton, United Kingdom,
s.s.yang@soton.ac.uk, Li-ming Chen, Moren Lévesque

Dual sourcing has become a widespread supply-chain structure in today's rapidly changing, competitive global markets. We analyze a supply chain model involving a new unproven supplier that is potentially unreliable but has the capability of increasing the end-product demand. We show that a business start-up can leverage its growth through an experienced supplier in the supply chain competing for the buyer's order.

■ WB10

10-Room 310, Marriott

Openness and IT

Sponsor: E-Business

Sponsored Session

Chair: Chen Zhang, Associate Professor, University of Memphis,
Department of MIS, Fogelman College of Business and Econ, Memphis,
TN, 38152, United States of America, czhang12@memphis.edu

1 - Adoption of Big Data Analytics in Healthcare:

An Economic Perspective

He Li, PhD Student, The University of Memphis,
Fogelman College of Business and Economi, Memphis, TN,
United States of America, oliver.lihe@gmail.com, Jing Wu

We investigate the effects of big data analytics (BDA) on health IT products competition. We model BDA's healthcare efficiency and privacy risk from consumer perspective and BDA's benefit and cost from provider perspective in a two-dimensional differentiation framework. Our model shows the impacts of BDA on firms' performances and social welfare. The conditions when firms should invest on BDA are pointed. Implications, limitations, and future directions are also discussed.

2 - Platform Openness and Evolution of its Ecosystem

Qizhi Dai, Associate Professor, Drexel University,
United States of America, qd24@drexel.edu, Chen Zhang

An IT platform and products compatible with this platform form an ecosystem, where the strategy of the platform provider plays a central role in determining the structure and evolutionary path of the ecosystem. This study empirically investigates the impact of the platform provider's openness strategy on the performance of firms in its ecosystem, which in turn influences the performance of the platform provider.

3 - Adoption of Interorganizational Systems Standards under Two-sided Network Effects

Kexin Zhao, Associate Professor, University of North Carolina at
Charlotte, 9201 University City Blvd, Charlotte, NC,
United States of America, kzha02@uncc.edu

Interorganizational systems (IOS) standards play a critical role in achieving interoperability among supply chain partners. While users and vendors play distinct yet complementary roles in the market, no prior research has examined their adoption decisions simultaneously in a single study. We investigate IOS standards adoption from both users' and vendors' perspectives to reveal interesting cross-group complementarity in the technology adoption stage.

4 - An Empirical Study of Open Data Mobile Application Services

Deepti Agrawal, Assistant Professor, College of Charleston, 66
George Street, Charleston, SC, 29424, United States of America,
agrawald@cofc.edu

Open data in government refers to making data generated by government transactions and sources available public in a usable format. Recently there has been a rise in mobile apps developed by government agencies and third parties that mash open data from different sources to enhance citizens' experience and interaction with the government. This study aims to empirically examine the factors that influence the adoption of the open data mobile apps.

■ WB11

11-Franklin 1, Marriott

Planning

Contributed Session

Chair: Phillip O. Kriett, Technische Universitaat München,
TUM School of Management, Arcisstraße 21, München, 80333,
Germany, phillip.kriett@tum.de

1 - Large-scale Transmission Capacity Expansion Planning under N-1 Contingency Analysis

Mohammad Majidi Qadikolai, University of Texas at Austin,
1616 Guadalupe UTA 2.304, Austin, TX, 78712-1684,
United States of America, m.majidi@utexas.edu, Ross Baldick

We propose a method for large scale transmission expansion planning (TEP) by integrating N-1 contingency analysis into a mixed integer programming formulation. It uses contingency identification index integrated into a filtering algorithm to detect unimportant lines for contingency analysis in different loading conditions and remove them from the TEP optimization problem to reduce problem size. The numerical result shows the capabilities of the proposed method for solving challenging problems.

2 - Automatic Cell Design for Production Facility

Manoj Gupta, XEROX, PTP, Karnataka, India,
manoj.gupta@xerox.com, Sudhendu Rai, Jagadeesh Prabhakara

Consider a cell design algorithm in a print shop facility in which we have to assign machines to cells such that for the arriving jobs, the following quantities are minimized. 1) Number of late jobs. 2) Define the inter cellular movement of a job J, the inter cellular movement of J is the number of times a job J moves from one cell to the other. We design an algorithm that assigns machines to cells such that both the above quantities are minimized.

3 - Optimization Technique for Energy Storage Control in Distribution Network

Khashayar Mahani, Rutgers the State University of New Jersey,
96 Frelinghuysen Road, Piscataway, NJ, United States of America,
mahani.khashayar@gmail.com, Mohsen Jafari

Finding near optimal control schemes, including various applications of Energy Storage Systems (ESSs) has been a challenge for utilities and micro-grid (MG) operators. In this presentation, we consider a utility-owned distribution system or MG with high penetration of renewable resources. We present an approximate model for both capacity planning and optimal operation of ESSs in the distribution network. Efficient control is obtained by analyzing the inputs' behavior which affects the optimal action.

4 - Confessions of a Supply Chain Architect

Katariina Kemppainen, School of Business, Aalto University,
Runeberginkatu 22-24, Helsinki, 00076 Aalt, Finland,
katariina.kemppainen@aalto.fi

Coming from the POMS community and landing as Vice President at AMR Best Supply Chain Award Winner, what did I see over the seven years? A highly integrated Sales & Operations Planning process with basic methods, decision-making biases and myopic KPIs for outrageously complex and dynamic operations, and a major transformation program to bring it up-to-date. Come to share our experiences dealing with the epic business process that could boost the relevance and rigor of our research.

5 - Generation of Low-dimensional Capacity Constraints for Unrelated Parallel Machines

Phillip O. Kriett, Technische Universität München, TUM School of
Management, Arcisstraße 21, München, 80333, Germany,
phillip.kriett@tum.de, Martin Grunow

We generate the non-redundant set of low-dimensional linear capacity constraints that model the feasible throughput of unrelated parallel machines. Such constraints allow rapid feasibility assessment of production plans by simple insertion. We decompose constraint generation into the Minkowski addition and the facet enumeration of convex polytopes. Since the complexity of solution algorithms is critical, we reduce the problem size based on symmetries among machines and graph partitioning.

■ **WB12**

12-Franklin 2, Marriott

Optimization Stochastic II

Contributed Session

Chair: Ruediger Schultz, Prof., University of Duisburg-Essen, Faculty of Mathematics, Thea-Leymann-Str. 9, Essen, D-45127, Germany, ruediger.schultz@uni-due.de

1 - Sampling-based Approximation Schemes for Capacitated Stochastic Inventory Control Models

Wang Chi Cheung, Graduate Student, Massachusetts Institute of Technology, 77 Massachusetts Ave, Cambridge, MA, 02139, United States of America, wangchimit@gmail.com,
David Simchi-levi

We study the multi-period capacitated stochastic inventory control problem in a data-driven setting, where the demand distributions can only be accessed through samples. We apply the Sample Average Approximation (SAA) method, and establish a polynomial upper bound on the number of samples needed for achieving near-optimality. However, the underlying SAA problem is #P-hard. Thus we provide a polynomial time approximation scheme, which involves a subgradient sparsification procedure.

2 - Competitive Capacity Investment under Uncertainty

Xishu Li, PhD Candidate, Erasmus University, Dept. Technology&Operations Management, Burgemeester Oudlaan 50, Rotterdam, Ro, 3062 PA, Netherlands, x.li@rsm.nl, Rob Zuidwijk, Rommert Dekker, Rene De Koster

Our research explores a fleet capacity investment problem under market uncertainty. We study how competition between firms affects investment strategies, and investigate the optimal investment policy. Here, we focus on a single vessel type with the intention to extend our results to also incorporate green vessels.

3 - ADMM for Two-Stage Stochastic Programs with Quadratic Objective Function

Sebastian Arpon, Universidad Adolfo Ibañez, Diagonal Las Torres 2640, Peñalolen, Santiago, Chile, sebarpon@gmail.com,
Tito Homem-de-mello, Bernardo Pagnoncelli

We discuss a decomposition method for two-stage stochastic programs with quadratic objective functions. Our algorithm is based on the Alternating Direction Method of Multipliers (ADMM) developed in the literature, and decomposes the problem by scenarios. Some attractive features of the algorithm are the low computational cost per iteration and its suitability for parallelization. We discuss some aspects related to convergence of the method and present numerical results to illustrate the ideas.

4 - The Dynamic Multi-newsvendor Problem

Zhaohu Fan, PhD Student, The Pennsylvania State University, 244 Leonhard Building, State College, PA, 1680001, United States of America, zxf109@psu.edu, Terry Friesz, Yiu Wang, Tao Yao

We articulate a dynamic model of newsvendors where a set of service providers form an oligopoly that is equilibrium tending. The price setting mechanism involving the providers resembles the replicator dynamics of evolutionary game theory. We show that generalization of the news vendor problem to a Cournot-Nash differential game based on replicator dynamics in a stochastic setting takes the form of a stochastic differential variational inequality.

5 - Stochastic Programming in Gas Transportation using Symbolic Computation

Ruediger Schultz, Prof., University of Duisburg-Essen, Faculty of Mathematics, Thea-Leymann-Str. 9, Essen, D-45127, Germany, ruediger.schultz@uni-due.de

Nomination validation, i.e., to decide technical feasibility of a transportation order with balanced in- and output, is among the challenges in daily operation of gas networks. We address the problem in the steady-state case with uncertain orders. In particular we provide parametric solution procedures for polynomial equations resulting from Kirchhoff's Laws based on insights and procedures from computational algebra.

■ **WB13**

13-Franklin 3, Marriott

Robust Optimization: Theory and Applications

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Chaitanya Bandi, Kellogg School of Management, Northwestern University, Evanston, United States of America, c-band@kellogg.northwestern.edu

1 - On the Adaptivity Gap in Two-stage Robust Linear Optimization under Constraints

Vineet Goyal, Columbia University IEOR department, 500 West 120th Street, 304 Mudd, New York, NY, 10027, United States of America, vg2277@columbia.edu, Brian Lu

We consider two-stage adjustable robust linear optimization problem with uncertain constraint coefficients that models many important applications including resource allocation with uncertain requirements. The adjustable problem is hard to approximate within a factor better than $O(\log n)$ in general. We show that the static solution gives a $O(\log^2 n)$ -approximation for the adjustable robust problem. Surprisingly, this is nearly the best possible approximation for the problem.

2 - A Robust Optimization Approach to Optimizing Expected Performance

Nataly Youssef, MIT, 20 Palermo Street, Cambridge, MA, United States of America, youssefn@mit.edu

We propose a tractable approach for optimizing the expected performance of stochastic systems via robust optimization. We model uncertainty via parameterized polyhedral sets inspired by probabilistic limit laws and characterized by variability parameters. We then cast the performance optimization problem as a robust optimization problem. We demonstrate the tractability and accuracy of our approach via an inventory management example.

3 - Resource Allocation under Coherent Distortion Risk Measures

Chaitanya Bandi, Kellogg School of Management, Northwestern University, Evanston, IL, United States of America, c-band@kellogg.northwestern.edu, Paat Rusmevichientong

We consider high dimensional resource allocation problems faced by a decision maker with a sophisticated risk attitude modeled by a fairly general risk measure known as a coherent distorted risk measure (CDRM) which encompasses many popular risk measures such as spectral risk measures and law-invariant coherent risk measures. We address the problem of tractability and obtain explicit closed form solution for the this problem while identifying new properties of the optimal solution.

■ **WB14**

14-Franklin 4, Marriott

Risk-Averse Control of Markov Systems

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Andrzej Ruszczyński, Rutgers University, 100 Rockafeller Road, Rutgers Business School, Piscataway, NJ, 08854, United States of America, rusz@business.rutgers.edu

1 - Risk-averse Control of Markov Chains in Discrete and Continuous Time

Andrzej Ruszczyński, Rutgers University, 100 Rockafeller Road, Rutgers Business School, Piscataway, NJ, 08854, United States of America, rusz@business.rutgers.edu

We shall consider risk-averse control problems for controlled Markov chains in discrete and continuous time. The concept of a dynamic risk measure and its of time consistency will be resined. We shall derive optimality conditions and discuss solution methods for discrete-time problems. For continuous-time problems, we shall derive the structure of time-consistent Markov risk measures and optimality conditions.

2 - Process-based Risk Measures for Observable and Partially Observable Discrete-time Controlled Systems

Jingnan Fan, Rutgers University, 100 Rockafeller Road, Rutgers Business School, Piscataway, NJ, 08854, United States of America, jingnan.fan@rutgers.edu, Andrzej Ruszczyński

For controlled discrete-time stochastic processes we introduce process-based dynamic risk measures to measure risk of processes. We also introduce a new concept of conditional stochastic time consistency and we derive the structure of risk measures enjoying this property. We show that they can be equivalently represented by a collection of static law-invariant risk measures on the space of functions of the state space. This structure can be applied to Markov controlled problems, including POMDP.

3 - Risk-averse Optimal Learning for Clinical Trial Design

Curtis Mc Ginity, Rutgers University, Piscataway, NJ, United States of America, curtis.mcginity@rutgers.edu

We formulate the risk-averse optimal learning problem for the exploration vs. exploitation dilemma in clinical trial design. We establish the class of logistic toxicity models leading to log-concave posteriors in the Markov model. We then offer risk-averse approximate dynamic programming methods of the resulting single- and multistage problems. Finally, we compare performance of prominent policies for this problem class in terms of multivariate stochastic dominance.

4 - Risk-averse Control of Diffusion Processes

Jianing Yao, Doctoral Student, Rutgers University, 18M Reading Road, Edison, NJ, 08817, United States of America, jy346@scarletmail.rutgers.edu

In this paper, we study the risk-averse control problem for diffusion processes. We make use of a forward-backward system of stochastic differential equations to evaluate a fixed policy and to formulate the optimal control problem. Weak formulation is established to facilitate the derivation of the risk-averse dynamic programming equation. We prove that the value function of the risk-averse control problem is a viscosity solution of a risk-averse analog of HJB equation.

WB15

15-Franklin 5, Marriott

Healthcare Informatics

Sponsor: Optimization in Healthcare

Sponsored Session

Chair: Satyender Goel, Research Assistant Professor, Northwestern University, 633 St. Clair St, 20th floor, Chicago, IL, 60611, United States of America, s-goel@northwestern.edu

1 - Hep C Registry to Link, Track, Test and Treat Patients in Chicago

Satyender Goel, Research Assistant Professor, Northwestern University, 633 St. Clair St, 20th Floor, Chicago, IL, 60611, United States of America, s-goel@northwestern.edu, Abel Kho

Health information technology is the key to identify and track specific patient population cohorts and improve public health surveillance and follow-up. The CDC-funded Hepatitis C Community Alliance to Test and Treat (HepCCATT) technical infrastructure supports connections among multiple public and private partners including: community clinic sites, community and specialty pharmacies, public and private healthcare systems, city and state departments of public health, and labs.

2 - The Pragmatic Trial App Suite (PTAS): using Tablets to Engage Patients at the Point of Care

Eliel Oliveira, Associate Director, LPHI, eoliveira@lphi.org, Iben Ricket, Elizabeth Nauman, Rebekah Angove, Kristin Layman, Lindsay Hendryx, Thomas Carton

PTAS is an electronic medical record agnostic, tablet-based software system integrated in examination rooms designed to engage patients in research by electronically recruiting them in pragmatic research trials, providing targeted health information, and facilitating trial management. A pilot of PTAS is currently recruiting patients into a research network. The pilot began in March 2015 and has recruited 320 patients into HiOH (30%) and collected GLOBAL PROMIS surveys from 457 patients (40%).

WB16

16-Franklin 6, Marriott

Game Theory III

Contributed Session

Chair: Igor Kozeletskyi, University of Duisburg-Essen, Lotharstr. 65, Duisburg, 47057, Germany, igor.kozeletskyi@uni-due.de

1 - Finding a Nash Equilibrium in EPCC: An Application to Dynamic Electricity Markets

Sébastien Debia, PhD Candidate, HEC Montréal, 10-6100 Av, Wilderton, Montréal, QC, Canada, sebastien.debia@hec.ca

Equilibrium Problem with Complementarity Constraints (EPCC) formulation is widely used to analyze strategic interactions in electricity markets. However, each individual problem is not convex, and the collection of problems is not square. Hence a Nash Equilibrium is not proven to exist. This contribution aims at showing sufficient conditions to find numerically a Nash Equilibrium if it exists. We provide an application to dynamic electricity markets with hydro-power.

2 - Recycling Models of Power Batteries in Electric Vehicles Based on Product Life Cycle Theory

Qihao Jin, Huazhong University of Science and Technology, School of Management, 1037 Luoyu Road, Wuhan, 430074, China, 390987833@qq.com, Zhixue Liu

This paper studies impacts of different characteristics of electric vehicle power batteries recycling in four life cycles of the electric vehicle development on recycling models of power batteries. Closed-loop supply chains are established with the manufacturer, the Stackelberg leader, having three reverse channels: (1) it collects by itself, (2) it collects by a retailer, (3) it subcontracts the collection. Decisions of the manufacturer on recycling channels in four life cycles are considered.

3 - Cooperative Games with Multiple Objectives by Means of Bi-Allocation Games

Igor Kozeletskyi, University of Duisburg-Essen, Lotharstr. 65, Duisburg, 47057, Germany, igor.kozeletskyi@uni-due.de, Alf Kimms, Ana Meca

In this presentation a new class of non-transferable utility games is introduced. This class of games describes multi-objective cooperative situations where every player follows two objectives: his individual objective and a common objective for all players. For bi-allocation games we present a solution concept, defined as an extension of the Shapley NTU value, state that this value always exists and introduce a computation algorithm based on iterative search and multi-objective optimization.

4 - Easier Than We Thought – A Practical Scheme to Compute Pessimistic Bilevel Optimization Problems

Bo Zeng, Assistant Professor, University of Pittsburgh, 3700 O'Hara Street, Pittsburgh, PA, 15261, United States of America, bzeng@pitt.edu

We present a new computation scheme for pessimistic bilevel optimization problems (PBL), which so far does not have any computational methods generally applicable yet. We first develop a tight relaxation and then design a simple scheme to ensure a feasible and optimal solution to PBL. Then, we discuss using this scheme to compute linear PBL and several variants. We also provide numerical demonstrations on linear PBL problems.

5 - Claudico and the First Heads-up No-limit Texas Hold'em Man-machine Match

Tuomas Sandholm, Professor, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, sandholm@cs.cmu.edu, Sam Ganzfried, Noam Brown

Claudico is the next-generation version of our Tartanian7 program, which won the 2014 Annual Computer Poker Competition in heads-up no-limit Texas Hold'em by beating all opponents with statistical significance. This talk will discuss Claudico and the "Brains vs. AI" match where four top-10 heads-up no-limit Texas Hold'em pros played 80,000 hands of poker against Claudico under controlled conditions for two weeks in 2015.

WB17

17-Franklin 7, Marriott

Network Optimization and its Applications

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Tachun Lin, Assistant Professor, Bradley University, 1501 W Bradley Ave, Peoria, IL, 61625, United States of America, djlin@fsmail.bradley.edu

1 - Routing Battery Electric Vehicles in Stochastic Networks Considering Vehicle Range Uncertainty

Xing Wu, Assistant Professor, Lamar University, P.O. Box 10024, Cherry Engineering Building RM C-2032, Beaumont, TX, 77710, United States of America, xwu1@lamar.edu, Changzheng Liu

The distance that a battery electric vehicle (BEV) can travel with a full charge varies greatly in the real driving environment. Based on the collected BEV travel data, this study assumes a stochastic effective battery range following a normal distribution. With such an assumption, this paper aims to develop the optimal routing policy for a BEV in a stochastic network, considering the uncertainty of both travel time and vehicle range.

2 - Selecting Inland Waterway Maintenance Projects Subject to Random Disruptions

Khatereh Ahadi, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, AR, 72701, United States of America, kahadi@uark.edu, Kelly Sullivan

We study the problem of maintenance project selection for the inland waterway transportation network. Uncertainty arises from unpredictable natural/hydrologic conditions associated with shoaling. Thus, we propose a scenario-based stochastic programming model which considers project interdependence and multi-commodity flow between several supply and demand nodes. We model this problem as a mathematical program, develop solution approaches, and analyze computational results.

3 - Optimizing Electric Bus Operations and Charging Station Deployment in Singapore

Tachun Lin, Assistant Professor, Bradley University, 1501 W Bradley Ave, Peoria, IL, 61625, United States of America, djlin@fmail.bradley.edu, Zhili Zhou

In this study, we build a framework for electric bus deployment in urban area, which supports charging facility deployment and impacts analysis on both traffic network and power grid with limited data sources. This framework can be utilized as a test bed for cities considering electric bus adoption and as a fundamental structure for exploring the impacts of electric vehicles to local power distribution networks.

■ WB18

18-Franklin 8, Marriott

Optimization Combinatorial II

Contributed Session

Chair: Chong Hyun Park, PhD Candidate, Purdue University, 403 W. State St., West Lafayette, IN, 47907, United States of America, park456@purdue.edu

1 - Procedures for The Bin Packing Problem with Precedence Constraints

Jordi Pereira, Universidad Adolfo Ibáñez, Avda. Pedro Hurtado 750, Viña del Mar, Chile, jorge.pereira@uai.cl

The bin packing problem with precedence constraints is a recently proposed variation of the bin packing problem, which corresponds to a basic model featuring many underlying characteristics of several scheduling and assembly line balancing problems. In this work we propose a dynamic programming based heuristic, and a modified exact enumeration procedure. These methods use several new lower bounds and dominance rules. The results show the effectiveness of the proposed methods.

2 - Does Road Network Density Matter in Optimally Locating Facilities?

Johan Hakansson, Professor, Dalarna University, Sweden, Högskolan Dalarna, 79188 Falun, Falun, 79188, Sweden, jhk@du.se, Pascal Rebreyend, Xiaoyun Zhao

The aim is to investigate how the density of a road network affects solutions of heuristics by applying the specific case of p-median model in finding optimal location of facilities. The specific experiments are conducted by optimally locating 5 to 50 facilities on a complex road network of Dalarna, Sweden. Two different heuristics being the vertex-substitution method and the simulated annealing algorithm are applied to solve the p-median problem to have a benchmark and validated performance.

3 - Statistical Bounds in Combinatorial Optimization

Xiangli Meng, Dr, Dalarna University, Dalarna University, Falun, Da, 79188, Sweden, xme@du.se, Kenneth Carling

We use statistical optimum estimation techniques (SOETs) to assess the quality of heuristic solutions in combinatorial optimization. We examine the performance of different implementations of SOETs and compare with deterministic bounds. Performance is assessed by extensive computer experiments on test problems. We find SOET to give (substantially) tighter gap than deterministic bounds, but SOET needs to be applied cautiously.

4 - Parametric Approaches to Fractional Combinatorial Problems: Analytical and Computational Studies

Chong Hyun Park, PhD Candidate, Purdue University, 403 W. State St., West Lafayette, IN, 47907, United States of America, park456@purdue.edu, Yanjun Li, Robert Plante

A parametric modeling approach provides effective technique for obtaining optimal solutions of the linear fractional combinatorial optimization problems. We consider two algorithms for solving the parametric model and investigate the efficiency of the algorithms both theoretically and computationally. For the computational study, the algorithms are used to solve fractional knapsack problems and are compared to other algorithms (e.g., Newton's method).

5 - Combinatorial Auctions with Items Arranged in Rows

Dries Goossens, Ghent University, Tweekerkenstraat 2, Gent, 9000, Belgium, Dries.Goossens@ugent.be, Bart Vangerven, Frits Spieksma

We consider combinatorial auctions of similar goods (seats, land, ...) that can be arranged in rows. We describe a dynamic programming algorithm which, for a 2-row problem with connected and gap-free bids, solves the winner determination problem optimally in polynomial time. We also study a number of extensions, and generalize our result to a setting with connected bids in a 3-row problem. Finally, we study the complexity for bids in a grid, complementing known results in literature.

■ WB19

19-Franklin 9, Marriott

Retail Analytics and Optimization

Sponsor: Computing Society

Sponsored Session

Chair: Tulay Flamand, University of Massachusetts, Amherst, Isenberg School of Management, 121 Presidents Drive, Amherst, MA, 01003, United States of America, tulayvarol@gmail.com

1 - Maximizing Impulse Buying via Store-wide Shelf Space Analytics

Bacel Maddah, Associate Professor, American University of Beirut, Beirut, Lebanon, bacel.maddah@aub.edu.lb, Tulay Flamand, Ahmed Ghoniem

Impulse (unplanned) buying constitutes a common shopping behavior. We investigate how retailers can optimize product shelf allocation in a fashion that improves product visibility to consumers and maximizes impulse buying. We examine the interplay between a retail store layout, the location of products, and their allocated shelf space with the notion of impulse buying. Specifically, we develop and analyze a mixed-integer nonlinear program (NLP) that allocates shelf space to product categories.

2 - Optimization Approaches for Generalized Assignment Problems with Location/allocation Considerations

Tulay Flamand, University of Massachusetts, Amherst, Isenberg School of Management, 121 Presidents Drive, Amherst, MA, 01003, United States of America, tulayvarol@gmail.com, Ahmed Ghoniem, Mohamed Haouari

We address a novel type of generalized assignment problems with location/allocation considerations that arise in retail shelf space allocation. Single- and multiple-knapsack variants of this problem are formulated along with modeling enhancements. Our proposed branch-and-price algorithm yields significant computational savings over the branch-and-bound/cut algorithm in CPLEX for challenging instances.

3 - Dynamic Assortment Planning under Cross-selling and Cannibalization Effects

Ameera Ibrahim, Assistant Professor, Saint Mary's College of California, 1928 St. Marys Rd, Moraga, CA, 94556, United States of America, ai7@stmarys-ca.edu, Ahmed Ghoniem, Bacel Maddah

We study the problem where a decision-maker optimizes the assortment and release times of products that belong to different categories over a multi-period horizon. Products have a longevity over which their attractiveness decays while being positively or negatively impacted by the specific mix of products that were introduced. We propose a 0-1 fractional program that employs an attraction demand model. A mixed-integer linear reformulation is developed that enables exact solutions to the problem.

■ WB21

21-Franklin 11, Marriott

Operations Research Applications in Vaccine Pricing and Distribution

Sponsor: Health Applications

Sponsored Session

Chair: Maryam Hasanazadeh Mofrad, University of Pittsburgh, 1048 Benedum Hall, Pittsburgh, 15261, United States of America, hasanazadeh.mofrad@gmail.com

1 - Exploring Market Segmentation in a Centralized Vaccine Market under Stochastic Reservation Prices

Galo Mosquera, Vaccine Access And Affordability In a Centralized Market Under Stochastic Reservation Prices, Rochester Institute of Technology, 81 Lomb Memorial Drive, Rochester, NY, 14623, United States of America, gem9454@mail.rit.edu, Ruben Proano

We consider a vaccine market in which, a monopsonistic entity aims to maximize total social surplus and the willingness to pay for different vaccines are stochastic. Preliminary experimental results show that increasing the number of market segments has undesirable effects on the profitability and affordability of key market segments.

2 - Redesign of Vaccine Distribution Networks in Low and Middle-income Countries

Jung Lim, Ph. D. Candidate, University of Pittsburgh,
1048 Benedum hall, 3700 O'hara st., Pittsburgh, PA, 15261,
United States of America, gljace@gmail.com, Bryan Norman,
Jayant Rajgopal

In many low and middle income countries, vaccines are distributed through a legacy medical supply chain, which is typically not cost-efficient. In order to improve vaccine distribution, redesigning the vaccine supply chain is considered, which includes: choosing intermediate hub locations, determining flow paths and vehicles for each flow path, and selecting storage devices for each location. We develop a mixed-integer optimization model and also suggest heuristic methods for larger problems.

3 - Optimal Two-phase Vaccine Allocation to Geographically Different Regions under Uncertainty

Hamed Yarmand, Umass Boston, College of Management,
University of Massachusetts Boston, Boston, MA, 02125,
United States of America, hamed.yarmand@umb.edu,
Brian Denton, Alun Lloyd, Julie Ivy

We consider a two-phase vaccine allocation policy which is formulated as a two-stage stochastic linear program (2-SLP) and then reduced to a linear program with a similar size to that of the first stage problem. We also present a Newsvendor model formulation of the problem which provides a closed form solution for the optimal allocation. Numerical results for seasonal influenza in North Carolina show a considerable reduction in the attack rate and vaccination cost.

4 - Joint Optimization of Vaccine Clinic Locations and Outreach Trips under Various Constraints

Maryam Hasanzadeh Mofrad, University of Pittsburgh, 1048
Benedum Hall, Pittsburgh, 15261, United States of America,
hasanzadeh.mofrad@gmail.com, Bryan Norman, Jayant Rajgopal,
Lisa Maillart

We investigate the tradeoffs involved with establishing (additional) healthcare clinics versus conducting outreach trips to vaccinate patients in remote locations. Given a network of population centers, we develop a mixed integer linear programming model to minimize cost over a specified period of time subject to constraints on coverage, trip distance, trip size, trip frequency and patient travel.

■ WB22

22-Franklin 12, Marriott

Queueing Models for Manufacturing and Service Systems

Cluster: Stochastic Models: Theory and Applications

Invited Session

Chair: Tugce Martagan, Eindhoven University of Technology, 5600 MB
Eindhoven, Eindhoven, Netherlands, T.G.Martagan@tue.nl

1 - Delay Announcement for Admission Control under Competition

Siddharth Prakash Singh, PhD Candidate, Tepper School of
Business, Carnegie Mellon University, 5000 Forbes Avenue,
Pittsburgh, PA, United States of America, sps1@andrew.cmu.edu,
Mohammad Delasay, Alan Scheller-wolf

We study queueing models of two competing service providers, e.g., emergency departments or restaurants, where one of the service providers, the "participant," is capable of announcing its delay information to customers by incurring some cost. We characterize conditions under which the participant could benefit by making real-time announcements, while the other provider continues not to disclose delay information.

2 - Sourcing Strategies for Assembled Products under Information Leakage and Competition

Ashesh Kumar Sinha, University of Wisconsin-Madison, 1402
Regent St, Apt. 731C, Madison, WI, 53711, United States of
America, asinha4@wisc.edu, Ananth Krishnamurthy

We analyze a multi-period decentralized assembly system where a product is assembled from multiple components sourced from vendors. The assembler provides the pricing scheme to the vendor whereas the vendor determines the production quantity for each component. Using stochastic games, we analyze tradeoffs and determine sourcing strategies to mitigate risks of divulging product knowledge while meeting costs and service level objectives.

3 - Simultaneous Buffer and Service Rate Allocation in Open Finite Queueing Networks

James Smith, University of Massachusetts Amherst,
jmgsmith@acad.umass.edu

Simultaneous buffer and service rate allocation in finite queueing networks is an NP-Hard optimization problem. We utilize an efficient performance algorithm combined with a mixed integer sequential quadratic programming algorithm to solve a number of open network design problems involving series, split, and merge topologies.

4 - On the Many-servers Queues under SJF Discipline

Amir Motaei, PhD Student, University of Florida, Department of
Industrial and Systems Eng, 303 Weil Hall, P.O. Box 116595,
Gainesville, FL, 32611-6595, United States of America,
motaei@ufl.edu

We are studying the $G/GI/n$ under the Shortest-Job-First (SJF) discipline in the Halfin-Whitt regime. Process-level convergence of the number of customers in the system is established in terms of the limit of corresponding infinite-server model. This is accomplished by relating $G/GI/n$ under SJF to a family of two class priority queueing systems where within each class the arrival to service happens according to a FCFS discipline.

■ WB23

23-Franklin 13, Marriott

Modern Market Microstructure: Stochastic Models of Limit Order Books

Sponsor: Applied Probability

Sponsored Session

Chair: Costis Maglaras, Columbia Business School, New York, NY,
10027, United States of America, c.maglaras@gsb.columbia.edu

Co-Chair: Ciamac Moallemi, Columbia Business School, 3022
Broadway, Uris Hall, New York, United States of America,
ciamac@gsb.columbia.edu

1 - Optimal Execution in a Limit Order Book and an Associated Microstructure Market Impact Model

Hua Zheng, Columbia University, 3022 Broadway, New York,
United States of America, hzheng14@gsb.columbia.edu,
Costis Maglaras, Ciamac Moallemi

We model an electronic limit order book as a multi-class queueing system under fluid dynamics, and formulate and solve a problem of limit and market order placement to optimally buy a block of shares over a short, predetermined time horizon. We use structure of the optimal policy to identify microstructure variables that affect short-term costs and propose a microstructure-based market impact model. Analysis of a proprietary dataset highlights its increased accuracy over macroscopic models.

2 - A Closed-form Execution Strategy to Target Vwap

Sebastian Jaimungal, University of Toronto,
Department of Statistical Sciences, Toronto, ON, Canada,
sebastian.jaimungal@utoronto.ca, Alvaro Cartea

We provide two explicit closed-form optimal execution strategies to target VWAP. We do this under very general assumptions about the volume process, and account for permanent price impact stemming from all agents. The first strategy consists of TWAP adjusted upward by instantaneous order-flow and adjusted downward by expected future order-flow. The second strategy consists of the Almgren-Chriss execution strategy adjusted by expected volume and net order-flow during the life of the strategy.

3 - Hydrodynamic Limit of Order Book Dynamics

Xuefeng Gao, Assistant Professor, The Chinese University of Hong
Kong, xfgao@se.cuhk.edu.hk, J. G. Dai, Ton Dieker, Shijie Deng

We study the temporal evolution of limit order book shape on the macroscopic time scale, motivated by a desire to better understand the interplay among order flows, order book shape and price impact. Our main result states that in the scaling regime where time goes to infinity and price tick size goes to zero, a pair of measure-valued processes representing the sell side shape and buy-side shape of an order book converges weakly to a pair of deterministic measure-valued processes.

■ **WB24**

24-Room 401, Marriott

Joint Session AI/ICS: Decision Diagrams for Optimization and Artificial Intelligence

Sponsor: Artificial Intelligence and ICS

Sponsored Session

Chair: Andre Augusto Cire, Assistant Professor, University of Toronto Scarborough, 1265 Military Trail, Toronto, ON, M1C 1A4, Canada, acire@utsc.utoronto.ca

1 - Consistency as Projection

John Hooker, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, jh38@andrew.cmu.edu

We interpret various forms of consistency in constraint programming as projection and propose a new form of consistency, J-consistency, that is achieved by projecting the constraint set onto a subset J of variables. We show how J-consistency can reduce backtracking when constraints are propagated through decision diagrams. We introduce J-consistency algorithms for SAT, among, sequence, regular, and alldiff constraints.

2 - Decision Diagram Decomposition of Optimization Problems

David Bergman, David.Bergman@business.uconn.edu, Andre Augusto Cire

Decision diagrams (DDs) can be used to compactly represent solutions to optimization problems, but the representation grows exponentially large in general, prohibiting their direct application. However, it is often the case that the diagram has limited size when representing the solution set for a substructure of a given problem. In this talk we discuss how DDs can be used when a problem decomposes in such a way that each individual portion has a limited-size DD.

3 - Decision Diagrams for Efficient Inference and Optimization in Expressive Continuous Domains

Scott Sanner, Asst. Professor, Oregon State University, 1148 Kelley Engineering Center, Corvallis, OR, 97331, United States of America, ssanner@gmail.com

I will introduce the XADD — an extension of the algebraic decision diagram to continuous variables — and show how to define and efficiently compute elementary arithmetic operations, integrals, and maximization for various restrictions of these functions. I will then cover a range of applications where the XADD has yielded novel closed-form solutions: (a) structured probabilistic inference, (b) parametric constrained optimization, and (c) sequential decision-making problems.

4 - Sentential Decision Diagrams and their Applications

Adnan Darwiche, UCLA, 4532-D Boelter Hall, Los Angeles, CA, 90095-1596, United States of America, darwiche@cs.ucla.edu, Guy Van Den Broeck, Arthur Choi

Sentential decision diagrams (SDDs) are a new class of decision diagrams that branch on arbitrary sentences instead of individual variables. They generalize ordered binary decision diagrams (OBDDs) and carry over many desirable OBDD properties, such as canonicity and support for bottom-up compilation with Boolean operators, while being more compact than OBDDs. These key properties have enabled several successful AI applications in recent years, particularly for reasoning about uncertainty.

■ **WB25**

25-Room 402, Marriott

Economics of Information Systems

Sponsor: Information Systems

Sponsored Session

Chair: Liangfei Qiu, Assistant Professor, University of Florida, Department of ISOM, Gainesville, FL, United States of America, liangfei@ufl.edu

1 - Cross-market Integration and Sabotage

Hong Guo, University of Notre Dame, 356 Mendoza College of Business, Notre Dame, IN, 46556, United States of America, hguo@nd.edu, Yabing Jiang, Asoo Vakharia, Arthur Lim

Recent industry developments motivate the study of cross-market firm integrations, which often raises controversies and regulatory concerns due to the potential negative effects through the integrated firms' sabotage activities. In this paper, we analyze integrations of firms in two interrelated markets and the integrated firm's incentive to sabotage its rival in both markets. Our findings provide important managerial and policy implications for cross-market firm integrations.

2 - What Makes Geeks Tick? A Study of Stack Overflow Careers

Tingting Nian, NYU Stern, 44 West 4th Street, New York, NY, 10012, United States of America, tnian@stern.nyu.edu, Luis Cabral, Lei Xu

We study user contributions to Stack Overflow, the largest online programmers community. Using a diff-in-diff approach, we show that the event of finding a new job implies a reduction of 25% in reputation-generating activity, but only a reduction of 8% in non-reputation-generating activity. We consider a series of robustness tests to tease out alternative explanations for these variations; together, the results suggest that career concerns play an important role in explaining user contributions.

3 - Sentiment Manipulation in Online Platforms and Opinion Forums: A Regression Discontinuity Approach

Shun-yang Lee, University of Texas at Austin, Austin, TX, United States of America, shunyang.lee@utexas.edu, Andrew Whinston, Liangfei Qiu

Online platforms are prone to abuse and manipulations from strategic parties. We characterize strategic firms' manipulation incentives through a rational expectation equilibrium framework (REE), and conduct empirical analysis on a Twitter data set through a regression discontinuity design (RDD) approach. We find that both the average Twitter sentiment and the proportion of highly positive tweets exhibit a significant drop on the movie's release day, suggesting firms' strategic manipulation.

4 - Open Platform Ecosystem Dynamics and System Efficiency with Advertising Investment

Gou Qinglong, Associate Professor, University of Science & Technology of China, No.96, JinZhai Road Baohe District, Hefei, China, tslg@ustc.edu.cn, Ruibing Wang, Yonghua Ji

We utilize a dynamic model to explore the advertising strategies for an open platform ecosystem where the platform and app are to determine their advertising efforts. We find that a transfer payment can improve system efficiency significantly.

■ **WB26**

26-Room 403, Marriott

Production and Scheduling III

Contributed Session

Chair: Alejandro MacCawley, Assistant Professor, P. Universidad Catolica de Chile, Vicuna Mackenna 4860 Macul, Santiago, 7820436, Chile, amac@ing.puc.cl

1 - Minimizing Demand Oriented Maintenance Cost

Marcus Poggi, PUC-Rio Informatica, Rua Marquês de São Vicente, 225, Gávea, Rio de Janeiro, Brazil, poggi@inf.puc-rio.br, Ivan Lima

In a production environment, machines fail with a given probability, function of its operating time since last maintenance. Facing a demand scenario for a planning horizon, one is interested in estimating the efficient frontier for maintenance cost and risk of not fulfilling a demand SLA. This stochastic problem with endogenous uncertainty is modeled over a discrete space-time network. Heuristic and exact approaches are devised.

2 - Minimizing Working Capital Requirements in a Dynamic Lot Sizing Model with Infinite Capacity

Thomas Yeung, Associate Professor, Ecole des Mines de Nantes, 4 Rue Alfred Kastler, BP20722, Nantes, 44307, France, thomas.yeung@mines-nantes.fr, Nathalie Bostel, David Lemoine, Yuan Bian

Traditional tactical production planning models do not consider a minimum financial need in terms of working capital requirements (WCR) to maintain operations. We introduce a first link by proposing a new generic WCR model for the dynamic lot sizing problem with single-site/level/product and infinite capacity. We show that our model adheres to the zero-inventory ordering policy allowing an exact polynomial algorithm to be formulated. Numerical tests compare the results with traditional models.

3 - Minimizing Tardiness and Maintenance Costs in Flow Shop Scheduling using Lower-bound-based GA

Andrew Yu, Associate Professor, The University of Tennessee, Industrial and Systems Engineering, Knoxville, TN, 37996, United States of America, ajyu@utk.edu, Javad Seif

A permutation flow shop scheduling problem is reformulated as a mixed-integer linear program after incorporating flexible and diverse maintenance activities for minimizing tardiness and maintenance costs. The MILP model is NP-hard for a large size of problem. Thus a lower-bound based genetic algorithm is developed. The algorithm is further tuned using design experiment to control and determine the GA parameters.

4 - Lot Sizing on Multiple Lines with a Single Setup Operator

Dirk Briskorn, University of Wuppertal, Rainer-Gruenter-Str. 21,
Lehrstuhl für Produktion und Logistik, Wuppertal, 42119,
Germany, briskorn@uni-wuppertal.de

We consider a lot sizing problem with multiple production lines. There is a single setup operator who needs to be present at a line during setup operations. The lines are otherwise independent and underlie the characteristics of the capacitated lot sizing problem. We present an heuristic approach focussing on the setup sequence of the setup operator. We outline a method yielding initial solutions to be fed to a neighbourhood search algorithm. Finally, we provide first computational results.

5 - Stochastic Lot-sizing and Cyclical Scheduling with Sequence Dependent Setup Time: The Case of Wine

Alejandro Mac Cawley, Assistant Professor, P. Universidad
Catolica de Chile, Vicuna Mackenna 4860 Macul, Santiago,
7820436, Chile, amac@ing.puc.cl

We modified a dynamic vehicle routing formulation to determine optimal cyclical schedules and lot sizes with a stochastic component. Which is: variability of setup times and the probability of a certain product or SKU to require production on a given planning horizon is added into the formulation. Solutions will be benchmarked using the variability (variance) of the optimized solution and two different metrics for the objective function: first, line utilization and second, minimize total costs.

■ WB27

27-Room 404, Marriott

Applications and Methodological issues on MCDM

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Danielle Morais, Assistant Professor, Universidade Federal de Pernambuco, Management Engineering Department, Recife, PE, Brazil, daniellemorais@yahoo.com.br

Co-Chair: Adiel T De Almeida, Professor, Universidade Federal de Pernambuco, Caixa Postal 7462, Recife, PE, 50630-971, Brazil, almeidaatd@gmail.com

1 - Subcontractor Selection in Civil Construction

Luciana Alencar, UFPE, Rua Académico Hélio Ramos, s.n.,
Recife, Brazil, alencarlh@gmail.com, Adiel T De Almeida

Most of the activities in construction projects are carried out by subcontractors. Based on this, it is essential for the contractor to have a structured methodology for selecting them. In this study, it is presented a model for subcontractor selection using an additive-veto multicriteria model, in which the contractors can incorporate the veto notion for those subcontractors' criteria performances that he thinks that is unacceptable. An application is presented.

2 - An Mcdm Model to Assist Preventive Maintenance for a Water Well Equipment in a Low Income Community

Adiel De Almeida Filho, Assistant Professor, Universidade Federal de Pernambuco, Caixa Postal 7471, Recife, PE, 50630-971, Brazil, adieltaf@googlegmail.com, Madson Monte

This work presents a multiple criteria decision model for the preventive maintenance planning of a water well equipment located at a low-income community in Brazil. This specific problem has been addressed considering the local context and limitations in order to find a compromise between cost and service level when defining the time interval for preventive maintenance.

3 - PROMETHEE Method with Surrogate Weights for Group Decision Making

Danielle Morais, Assistant Professor, Universidade Federal de Pernambuco, Management Engineering Department, Recife, PE, Brazil, daniellemorais@yahoo.com.br, Luciana Alencar, Tharcylla Negreiros, Adiel T De Almeida

A large number of multicriteria group decision models have been developed, differing from each other the quality and quantity of information required. PROMETHEE has been applied in many group decisions, mainly when it is possible to define criteria weights. However, establishing weights can be hard and in some cases is necessary deal with imprecise information regarding the importance of criteria. Thus, we propose a group decision model, integrating the PROMETHEE method with surrogate weights.

■ WB28

28-Room 405, Marriott

Economics of Auctions

Cluster: Auctions

Invited Session

Chair: Lin Hao, University of Notre Dame, 351 Mendoza College of Business, Notre Dame, IN, United States of America, lhao@nd.edu

1 - Who Benefits from Free Lunch? An Examination of Return Policies at Private Fashion Sale Sites

Yixin Lu, Assistant Professor, VU University Amsterdam, Netherlands, y2.lu@vu.nl, Alok Gupta, Wolf Ketter

This paper examines the role of return policy at private fashion sale sites (PFSS) that offer limited-time deals of fashion merchandise to registered customers. Compared to traditional online fashion retailers, PFSS often employ more strict return policies to minimize the product return rate. We propose a simulation framework to compare the effects of different return policies on seller's revenue.

2 - The Cost of Running an Auction and Implications to the Optimal Reserve Price

Zohar Strinka, PhD Candidate, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, zstrinka@umich.edu

A common question in the auction literature is whether a seller can credibly commit to keep a good if the bidders fail to meet the reserve price. This paper shows that by modeling the seller's problem as a multi-round auction with reserve prices in each round, we can distinguish an inability to commit from failure to model the full problem. In addition to our parametric analysis, this modeling framework opens the door to a more sophisticated understanding of the costs of a failed auction.

3 - Understanding the Effect of Jump Bidding in Overlapping Online Auctions

Lin Hao, University of Notre Dame, 351 Mendoza College of Business, Notre Dame, IN, United States of America, lhao@nd.edu, Yong Tan, Arvind Tripathi

In electronic markets, overlapping online auction has emerged as a viable and efficient mechanism for large retailers desiring to clear off their excessive inventories. In this paper, using a dataset from a reputable website we empirically studied the effect of jump bidding behavior on the outcomes of overlapping online auctions.

■ WB29

29-Room 406, Marriott

Data Analytics in Pricing and Revenue Management

Sponsor: Analytics

Sponsored Session

Chair: Jian Wang, Vice President, Research & Development, The Rainmaker Group, 4550 North Point Parkway, Alpharetta, GA, 30022, United States of America, jwang@letitrain.com

1 - Competitive Rate Information: Use and Misuse in Hospitality Revenue Management

Alex Dietz, Advisory Industry Consultant, SAS Institute, 100 SAS Campus Drive, Cary, NC, 27513, United States of America, Alex.Dietz@sas.com

In today's Big Data environment, most hotels that are actively managing their pricing use a competitive rate shop mechanism as a vital tool to assist them in pricing. But simply following the lead of competitors can lead to a significant loss in revenue. This presentation will discuss the importance of rate information, how this information can be used in revenue management, and common traps associated with use of this data – including data quality, limitations, and misuses of the information.

2 - Making Television Ad Inventory More Valuable through Optimization

Bob Bress, Sr. Director, Prod. Mgmt & Analytics, Visible World, 460 W. 34th Street, NY, NY, 10001, United States of America, bob.bress@visibleworld.com

Approaching TV advertising programmatically with advanced data and dynamic decisioning provides the ability to add tremendous value to TV inventory. In this session we will cover: iHow optimization methods are being deployed to enhance the value of TV inventory through dynamic decisioning iHow analytics are allowing advertisers to benefit from advanced data through more targeted advertising iHow both inventory holders and advertisers are benefiting through new data-driven applications for TV.

3 - Why Revenue Management is a Good Thing?

Emmanuel Carrier, Delta, emmanuel.carrier@delta.com

From its roots in the airline industry, RM has expanded to many industries such as hospitality, retail and B2B. While they are affecting a growing number of B2C and B2B transactions, RM practices have become increasingly controversial with consumers. In this paper, we look at long series of empirical data to show that RM is a win-win strategy for producers and consumers and leads to higher utilization rates. We discuss how to keep this legacy alive given the emergence of “big data” techniques.

4 - A Heuristic Approach to Predicting Customer Lifetime Values for Apartment Tenants

Jian Wang, Vice President, Research & Development, The Rainmaker Group, 4550 North Point Parkway, Alpharetta, GA, 30022, United States of America, jwang@letitrain.com

Estimating tenant lifetime values is important for apartment revenue management. We propose a heuristic approach to predicting renewal likelihoods and estimating tenant lifetime values. We then present empirical results based on real apartment data.

■ WB30

30-Room 407, Marriott

Information Systems I

Contributed Session

Chair: Xu Han, Uconn School of Business, 2100 Hillside Rd, Storrs, CT, 06268, United States of America, xu.han@business.uconn.edu

1 - The Impact of it Maturity and IS Planning Process on IS Planning Success

Tomoaki Shimada, Associate Professor Of Operations Management, Kobe University, 2-1 Rokkodai-cho, Nada-ku, Kobe, 657-8501, Japan, shimada@b.kobe-u.ac.jp,
Robert De Souza, James Ang, Yoshiaki Matsui, Darren Ee

In this study, we examine the impact of information technology (IT) maturity and information system (IS) planning process on IS planning success. Using data collected from the self-administrated questionnaire survey, we show complex relationships between IT maturity and IS planning success as well as between IS planning process and IS planning success in a non-linear regression approach.

2 - Why Do High-tech Firms Offer Perks at Work?

Xuan Ye, PhD Student, New York University, 44 West 4th ST, KMEC 8-186, New York, NY, 10012, United States of America, xye@stern.nyu.edu, Prasanna Tambe

We study whether and why high-tech firms rely more heavily on non-wage benefits, such as free meals, transportation subsidies, and athletic facilities (“work-related perks”). We find that employers engaged in IT innovation are more likely to offer work-related perks. Additionally, we find that high-tech firms offer work-related perks to attract and motivate IT workers who can quickly adapt to technological change.

3 - Merger and Acquisitions in it Industry

Kangkang Qi, Michigan State University, 632 Bogue Street, BCC N204, East Lansing, United States of America, qikang@broad.msu.edu

I study M&A in IT industry. There are three major research questions: (1) Does making M&A really help IT firms with long term profitability and/or innovation gains? (2) For each specific M&A, what are the antecedents that are related to market reaction? (3) Can we attribute the misalignment between firms' characteristics and M&A decision to CEO overconfidence/narcissism?

4 - Nursing Home Rating System Fraud Detection

Xu Han, Uconn School of Business, 2100 Hillside Rd, Storrs, CT, 06268, United States of America, xu.han@business.uconn.edu,
Niam Yaraghi, Ram Gopal

Potential fraud may exist in the rating procedure of CMS's Nursing Home Compare System, leading to misuses of ratings. This study empirically examines the factors affecting the ratings. We find a significant association between ratings and profits, pointing to a financial incentive to cheat. We show that this association does not always lead to legitimate efforts, but can induce cheating. A prediction model is then developed, and 6% of the suspect nursing homes are identified as likely cheaters.

■ WB31

31-Room 408, Marriott

Data Analytics for Manufacturing and Healthcare Enterprise System

Sponsor: Data Mining

Sponsored Session

Chair: Kaibo Liu, Assistant Professor, UW-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, kliu8@wisc.edu

1 - Quantitative Imaging in Medicine

Teresa Wu, Arizona State University, Tempe, AZ, United States of America, teresa.wu@asu.edu

The ASU-Mayo Clinic Imaging Informatics Laboratory is a collaborative effort between the Industrial Engineering program at Arizona State University and the Department of Radiology at Mayo Clinic Arizona. Our goal is to improve patient care by analyzing and managing information in radiology images and databases. In this talk, I will briefly discuss some on-going projects on the use of quantitative imaging in the clinical context.

2 - Process Execution Monitoring and Controlled Violations

Russell Barton, Senior Associate Dean, Penn State, Smeal College of Business, 210 Business Building, University Park, PA, 16802, United States of America, rrb2@psu.edu, Akhil Kumar

Service processes do not lend themselves to SPC methods common in manufacturing settings. Monitoring activity timing and activity sequencing presents special opportunities for statistical characterization, and opportunities for taking corrective action. Violations in activity timing and/or sequencing are unavoidable. We show how to monitor a running process, and through constraint satisfaction find a schedule for its completion to minimize total penalty from the violations.

3 - Data Driven Approach for Modeling the Coupled Dynamics of Machine Degradation and Repair Processes

Hoang Tran, Texas A&M University, College, TX, United States of America, tran@tamu.edu, Satish Bukkapatnam

We proposed a data driven approach to model the coupled dynamics of recurring degradation and restoration processes that take place in manufacturing systems. Unlike previous methods, interactions between the two processes that influence downtimes and throughput rate can be explicitly considered. Theoretical and numerical analyses prove that our model can capture multimodal distribution and dynamic couplings between the time between failures and the time to repair.

■ WB32

32-Room 409, Marriott

Data Mining in Health Care

Contributed Session

Chair: Hamed Majidi Zolbanin

Oklahoma State University, 309 S. West St, Unit 6, Stillwater, Ok, 74075, United States of America, hamed.majidi@gmail.com

1 - Predicting Inpatient Ward Demand Based on The Emergency Department Patient Characteristics

Nooshin Valibeig, Northeastern University, 334 Snell engineering, Boston, 02115, United States of America, nooshin.valibeig@gmail.com, Jacqueline Griffin

Bed assignment is the process of assigning patients to the targeted ward in a reasonable time or to an overflow ward when the assignment time increases. Predicting demand for each ward helps bed managers to decrease assignment time and overflow assignments which results in lower costs and better quality of care. In our study we apply data mining methods on historical data of an emergency department (ED) to predict the probability of inpatient admission and potential targeted ward for ED patients.

2 - Mining Process Patterns from Noisy Audit Logs with Application to Emr Systems

He Zhang, Assistant Professor, University of South Florida, 4202 E. Fowler Avenue, CIS1040, Tampa, 33620, United States of America, hezhang@usf.edu, Sanjay Mehrotra, David Liebovitz, Carl Gunter, Bradley Malin

We present a four-step framework to analyze process models with noise. The first step is to establish correlations among events and separate each trace of access logs into blocks. These blocks are then clustered into several groups and the original traces of access logs are transformed to traces consisting of high level blocks. The traces are then clustered into subgroups, each of which can be used to analyze the process. We implement our approach using data from a large academic medical center.

3 - Using Linear Programming Based Exploratory Techniques in Gene Expression Consensus Clustering

Victoria Ellison, North Carolina State University, Campus Box 7913, 2500 Stinson Drive, Raleigh, NC, 27695, United States of America, vmelliso@ncsu.edu, Yahya Fathi, Amy Langville

We propose a divisive hierarchical consensus clustering algorithm (DHCCA) by modifying a BILP formulation of the Median Partition problem and applying several proposed parametric programming algorithms based on the optimal partition parametric programming algorithm. We prove that executing our DHCCA, under certain assumptions, is equivalent to solving the minimum ratio cut problem. This equivalency can be useful in creating fast heuristics to the Median Partition problem.

4 - Using Data Mining to Predict Drug Courts Outcome

Hamed Majidi Zolbanin, Oklahoma State University, 309 S. West St, Unit 6, Stillwater, Ok, 74075, United States of America, hamed.majidi@gmail.com, Durand Crosby, Dursun Delen

Drug court is an alternative for traditional criminal courts that attempts to shift from a punitive to a therapeutic jurisprudence. Under this new philosophy, the eligible offenders are held as individuals in need of rehabilitative treatments. The initiative is proved to be effective in lowering the costs and breaking the cycle of narcotics use. To better manage the resources and maximize the benefits, this study develops a model to predict who will or will not graduate from these courts.

■ WB33

33-Room 410, Marriott

Methods and Applications in Disease Detection and Treatment

Sponsor: Health Applications

Sponsored Session

Chair: Shan Liu, Assistant Professor, University of Washington, Seattle, WA, United States of America, liushan@uw.edu

1 - Sequencing Chemotherapy Agents for Metastatic Colorectal Cancer Patients

Lakovos Toumazis, PhD Candidate, Department of Industrial and Systems Engineering, University at Buffalo, SUNY, Buffalo, United States of America, iakovost@buffalo.edu, Artemis Toumazi, Loukia Karacosta, Daniel A. Goldstein, Changhyun Kwon, Murat Kurt

Colorectal cancer is the third most lethal cancer in the US affecting both genders. Despite advancements in chemotherapy treatment, long-term survival for the advanced stage of the disease remains poor. With the goal of improving the effectiveness of chemotherapy treatment for metastatic colorectal cancer patients we developed a Markov decision process model that jointly optimize the duration and sequence of the available drugs. The obtained optimal policy improves survival by at least 6 months.

2 - Large-scale Personalized Health Surveillance by Selective Sensing

Ying Lin, University of Washington, Box 352650, Seattle, WA, 98195-2650, United States of America, linyeliana.ie@gmail.com, Shan Liu, Shuai Huang

Detecting subjects who have been on the trajectory towards disease onset holds promises for preventative healthcare. Development of personalized health surveillance is enabled by sensing and information technologies. To scale up personalized surveillance, we developed a selective sensing method that integrates degradation modeling, prognosis, and optimization, which can cost-effectively monitor a large number of individuals by exploiting the similarities of their disease trajectories.

3 - Cost Effectiveness of Expanding Anti-retroviral Therapy to Untreated Subpopulations in Botswana

Thomas Keller, University of Minnesota, 111 Church St. SE, Minneapolis, MN, 55455, United States of America, kelle665@umn.edu, Gregory Bisson, Diana Negoescu, Daniel Winetsky

In 2002 the Botswana government initiated Africa's first national anti-retroviral program, which has enrolled over 200,000 Botswana HIV-infected patients since its inception. We develop a dynamic compartmental model to evaluate the cost effectiveness of expanding this program to serve more Botswana citizens as well as migrant workers, who constitute a significant proportion of HIV-infected patients.

4 - Minimizing Overdiagnosis in Cancer Screening

Maboubeh Madadi, University of Arkansas, mmadadi@uark.edu, Shengfan Zhang, Edward Pohl, Chase Rainwater

Overdiagnosis is defined as the diagnosis of screen-detected cancers that would not have presented clinically in a woman's lifetime in the absence of screening. Overdiagnosis is known to be the most important disadvantage of cancer screening and it can adversely affect people's lives. In this study a mathematical programming model is developed to find the optimal cancer screening policy with respect to overdiagnosis risk, while maintaining the lifetime cancer mortality risk at a low threshold.

■ WB34

34-Room 411, Marriott

Medical Decision Making

Sponsor: Health Applications

Sponsored Session

Chair: Pooyan Kazemian, PhD Candidate, University of Michigan-Ann Arbor, 1205 Beal Ave., Ann Arbor, MI, 48105, United States of America, pooyan@umich.edu

1 - Why is Screening so Common for Some Diseases when Evidence is so Uncertain?

Ozge Karanfil, PhD Candidate, MIT Sloan School of Management, 100 Main Street, E62-379, Cambridge, MA, 02142, United States of America, karanfil@mit.edu, John D. Sterman

Practice guidelines for routine screening such as mammography or PSA testing have changed significantly over time. Evidence-based guidelines are often not followed by clinicians and patients, with significant over or under screening. In this study we describe a dynamic model to explain changes in policy action thresholds. We use quantitative and qualitative data to document evidence of gaps between guidelines and practice. Qualitative data includes interviews with health/medical professionals.

2 - Planning for HIV Screening, Testing, and Care at the Veteran's Health Administration

Kumar Rajaram, Professor of Decisions, Operations, and Technology Management, UCLA Anderson School of Management, B410 Gold Hall, UCLA Anderson, Los Angeles, CA, 90024, United States of America, krajaram@anderson.ucla.edu, Matthew Goetz, Uday Karmarkar, Sandeep Rath, Sarang Deo

CDC has recommended a routine screening policy for HIV. We modeled a QALY maximizing nonlinear mixed integer program incorporating system dynamics and disease progression and found that routine screening may not be always feasible. We applied this model to the Greater Los Angeles station of the Veterans Health Administration and used it to develop and evaluate managerially relevant policies within existent capacity and budgetary constraints to improve upon the current screening policy.

3 - Value of Patient-centric Treatment Policies for Pelvic Organ Prolapse in Women

Yueran Zhuo, Ph.D. Candidate, University of Massachusetts Amherst, Isenberg School of Management, Amherst, MA, 01003, United States of America, yzhuo@som.umass.edu, Senay Solak

Pelvic organ prolapse (POP) is a common condition that impacts many women's health and quality of life. The selection of a treatment option for POP depends on several factors, but personal preferences of the patient play a more significant role than most other similar conditions. We specifically take this aspect of POP into account and identify patient-centric treatment recommendations for this syndrome. The value of these policies is then assessed through comparisons with physician decisions.

4 - On Low-cost In-home Sensor Placement for Personalized Tracking of Activity of Older Adults

Alexander Nikolaev, Assistant Professor, University at Buffalo (SUNY), 312 Bell Hall, Buffalo, NY, 14260-2050, United States of America, anikolaev@buffalo.edu, Ann Bisantz, Siddhartha Nambiar, Melissa Green, Lora Cavuoto

Activity-tracking sensors can now be used for personalized care; yet, challenges with usability and cost may prevent their adoption by the elderly. We assess how low-cost in-home sensor systems help infer physical activity levels of tenants. The American Time Use Survey and real apartment layouts are used to study optimal sensor count, placement, and activity prediction error levels. We describe sensor placement strategies and apartment layouts best suited for sensor technology use.

■ **WB35**

35-Room 412, Marriott

Urban Planning

Contributed Session

Chair: Richard Zapata, Universidad del Desarrollo, Avda Sanhueza 1750, Concepcion, Ch, 4040418, Chile, rlzapata@gmail.com

1 - Parking Equilibrium Model with Urban Truck Tour Deliveries

Joseph Chow, Assistant Professor, Ryerson University,
350 Victoria Street, MON 407, Toronto, ON, M5B 2K3, Canada,
joseph.chow@ryerson.ca, Ahmed Amer

Arnott and Inci's (2006) parking equilibrium model is extended to include urban truck tour deliveries and corresponding variables: double-parking stock, delivery duration, number of stops on tour, tour length, and fleet size. Effects of double-parking on traffic flow are estimated using AIMSUN microsimulation. The model is applied to downtown Toronto to provide policy recommendations including pricing, scheduling, geometric design, and zoning.

2 - Urban Freight Distribution with Batch Arrivals

Marco Schutten, Associate Professor, University of Twente,
P.O. Box 217, Enschede, 7500 AE, Netherlands,
m.schutten@utwente.nl, Martijn Mes, Wouter Van Heeswijk

We study a dispatch problem with uncontrolled batch arrivals of LTL orders at an urban consolidation center. The specific order properties may be highly varying in city logistics. Directly distributing an incoming batch may yield high costs. Instead, the hub operator may decide to wait for incoming batches that allow for more efficient distribution. We show that an ADP approach closely approximates the exact values for small instances, and outperforms two benchmark policies for larger instances.

3 - Evaluating Overtopping Risks of Reservoir Systems Based on Rare Event Simulation

Qianli Deng, University of Maryland, College Park, 0147H
Engineering Lab Building, College Park, MD, 20742,
United States of America, dqianli@umd.edu, Gregory B. Baecher

Overtopping risks of reservoir systems, in most cases, have very small probabilities of occurring. Estimation with crude Monte-Carlo simulation requires a prohibitively large numbers of trials. Otherwise, estimation would not be accurate. Computational expense served as one of the prohibitive reasons that simulation has not been widely applied to reservoir operation. A rare event simulation-based approach is thus proposed in this study to address the overtopping risks of reservoir systems.

4 - Effect of Infrastructure Investment and Freight Accessibility on Gross Domestic Product

Ruben Yie Pinedo, Full Time Professor, Universidad del Norte,
Km5 via Puerto Colombia, Barranquilla, AT, Colombia,
ryie@uninorte.edu.co, Maria Saltarin, Carlos Paternina,
Julian Arellana

This paper analyzes the effect of infrastructure investment and freight accessibility on Gross Domestic Product (GDP) by using a non-linear regression approach. We use accessibility measurements to test improvements in transportation costs as road networks are improved. Our results show that GDP significantly benefits from (i) higher investments in infrastructure and better accessibility, and (ii) from multimodal transportation compared to pure road transportation.

5 - Integrating Land Use and Urban Water Management through Mathematical Models

Richard Zapata, Universidad del Desarrollo, Avda Sanhueza 1750,
Concepcion, CH, 4040418, Chile, rlzapata@gmail.com,
Cristian Palma

The urban land use planning and the water resources management are not always integrated. This lack of integration usually translates into over cost for users and even no chance for companies to provide the service in some areas. In this talk, we describe how we estimate the water demand by land use, and how we integrate this demand with the water supply and the land use planning process.

■ **WB36**

36-Room 413, Marriott

Humanitarian Applications IV

Sponsor: Public Sector OR

Sponsored Session

Chair: Tina Wakolbinger, Professor, Vienna University of Economics and Business (WU), Welthandelsplatz 1, Vienna, 1020, Austria,
tina.wakolbinger@wu.ac.at

1 - Data Driven Resource Allocation Decisions: Fema's Disaster Recovery Centers

Julia Moline, FEMA, FEMA, Washington, DC, United States of America, julia.moline@fema.dhs.gov, Erica Gralla,
Jarrod Goentzel

We create a data-driven decision process for Federal Emergency Management Agency's (FEMA) Disaster Recovery Centers (DRCs) program. We develop thresholds and optimization models to dynamically locate, size, and staff DRCs. We apply the process to recent disaster response scenarios and show that FEMA could have reduced cost significantly while providing sufficient capacity.

2 - Humanitarian Logistics: Pre-Positioning of Relief Items in Istanbul

Serhan Duran, Associate Professor, Middle East Technical
University, ODTU Endustri Muhendisligi Bolumu, Ankara, 06800,
Turkey, sduran@metu.edu.tr, Sinem Konu, Ertan Yakici

In this study, we investigate pre-positioning of relief items while considering the transportation vulnerability effect of a potential earthquake in Istanbul and suggest disaster response facility locations accordingly, utilizing the data and information about Istanbul from the JICA Report. The model considers the effects of combined transportation mean vulnerability, warehouse building vulnerability, demand intensity and distance traveled based on warehouse location decision.

3 - Outsourcing Humanitarian Logistics Activities to Commercial Logistics Providers

Ioanna Falagara Sigala, Research Fellow, Vienna University of
Economics and Business (WU), Welthandelsplatz 1, Vienna, 1020,
Austria, ioanna.falagara.sigala@wu.ac.at, Tina Wakolbinger

This study explores the potential of outsourcing humanitarian logistics activities to commercial logistics providers. We follow a qualitative approach by interviewing both private and humanitarian organizations to identify the current status and to determine the potential of future cooperation between those two sectors. We integrate both Transaction Cost and Resource-Based View theories to suggest propositions leading to the construction of a framework for outsourcing in the humanitarian sector.

■ **WB37**

37-Room 414, Marriott

Modeling and Optimization of Health Care Processes

Contributed Session

Chair: Yifeng Yu, PhD Student, Penn State University, 445 Waupelani
Dr, Apt A14, State College, PA, 16801, United States of America,
yyf870314@gmail.com

1 - Monitoring Hip-Surgery Quality by Risk-Adjusted Control Charts

Yifeng Yu, PhD Student, Penn State University, 445 Waupelani
Dr, Apt. A14, State College, PA, 16801, United States of America,
yyf870314@gmail.com, Harriet Nembhard

Risk-adjusted statistical process control charts are used for real-time monitoring of the readmission rate after hip surgery. An alarm occurs if sufficient evidence shows that there is a change in readmission rate. A logistic regression model is incorporated to determine the pre-surgery risk of each patient. The difference in pre-surgery risk is revealed in the risk-adjusted control statistics, thus changes in the hip-surgery quality can be detected.

2 - Improving Patient Care using Integrated Health Monitoring Systems for Diabetes and Hypertension

Saligrama Agnihotri, Professor, Binghamton University,
Binghamton University, Binghamton, NY, 13902,
United States of America, Agni@binghamton.edu, Anu Banerjee

Patient care can be improved using smart technology in home health monitoring systems. We implement a smart mobile application integrating 1200 patients and multiple providers to improve communication, change treatment plans, and reduce office visits. We provide preliminary data analysis for the vital signs and identify stakeholder's impact.

3 - Managing Access to Primary Care Facilities

Sina Faridimehr, Wayne State University, 4815 Fourth St.,
Detroit, MI, United States of America, fb1562@wayne.edu,
Ratna Babu Chinnam

In this research, we propose an MDP model to improve timely access for patients while maintaining clinic capacity utilization in primary care facilities. The model leverages correlations between scheduling practice, panel size management and access performance. Results from testing the models at VA facilities are promising.

4 - Comparing Emergency Room Performances Before and After Initiating Full Capacity Protocol

Suman Mallik, University of Kansas, 1300 Sunnyside Ave,
Lawrence, KS, 66045, United States of America, suman@ku.edu,
Mazhar Arikian, Lu Wang

Using a data from a large teaching hospital we compare the emergency department operating performances before after initiation of the full capacity protocol (a set of rules designed to alleviate crowding).

5 - Why are Medical Device Connectivity Standards so Elusive?

John Zaleski, Chief Informatics Officer, Nuvon, Inc.,
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United States of America, jzaleski@nuvon.com

Medical devices still remain highly proprietary in terms of interoperability. Health Level Seven (HL7), as a healthcare information standard, only works when medical devices can export data in this common format. Gaps remain between the proprietary, manufacturer-specific language of many devices and the HL7 messaging format. Here we explore approaches for standardizing proprietary equipment around HL7 and related messaging languages and how lack of interoperability impacts patient care.

■ WB38

38-Room 415, Marriott

Bayesian Approach II

Contributed Session

Chair: Ray Fung, Self-Employed, 10 Soden Street, #16, Cambridge, MA, 02139, United States of America, raymondfung@gmail.com

1 - Enterprise Personalized Learning At Scale

Ashish Jagmohan, IBM Research, 1101 Kitchawan Road,
Yorktown Heights, United States of America,
ashishja@us.ibm.com, Wesley Gifford, Anshul Sheopuri,
Yi-min Chee, Noi Sukaviriya, John Ambrose, Laura Rexford,
Sue Rodeman

We address the problem of facilitating skill development in enterprises by devising personalized learning paths. Traditional methods of manual curation are incapable of scaling to meet the needs of growing user bases and content-libraries. The proposed system uses big-data cognitive technology to reason about large-scale user behavior and content characteristics. We will discuss algorithmic data mining and Bayesian techniques to identify learning sequences best suited for each user's goals.

2 - Identifying Key Rule-based Subgroups for Driver Or Graphical Models via Modified Decision Tree Logic

Michael Egner, Senior Vice President, Ipsos, 10567 Jefferson
Blvd., Culver City, CA, 90232, United States of America,
mike.egner@ipsos.com, Andrew Christianson, Richard Timpone

Modelers often wish to understand the role of moderator variables. In some cases, such as graphical models, the typical solution (adding interaction terms) can fall short. Building on previous research modifying decision trees to split on the strength of bivariate relationships, this study explores modifying tree logic to maximize differences in association matrices, such that researchers can obtain practical, rule-based splits for generating maximally-different drivers or graphical models.

3 - Causal vs. Correlational Analysis using Bayesian Networks

Ray Fung, Self-Employed, 10 Soden Street, #16, Cambridge, MA,
02139, United States of America, raymondfung@gmail.com

I show how Bayesian Networks can be utilized not only to differentiate correlation and causation in an intuitive manner but also how to illuminate difficult-to-understand scenarios such as Simpson's Paradox, the Ecological Fallacy, and the Low Birthweight Paradox. I also show how concepts such as instrumental variables, LATE, overidentification tests, natural experiments, ITT, block randomization, mediation tests, colliders, and measurement error can be easily illustrated.

■ WB39

39-Room 100, CC

Channel Management and Pricing

Cluster: Operations/Marketing Interface

Invited Session

Chair: Shuya Yin, University of California, Irvine, Merage School of Business, Irvine, United States of America, shuya.yin@uci.edu

Co-Chair: Saibal Ray, Professor, McGill University, 1001 Sherbrooke Street West, Montreal, Canada, saibal.ray@mcgill.ca

1 - Strategic Value of Bogo Offers under Competition

Sreekumar Bhaskaran, sbhaskar@mail.cox.smu.edu,
Saibal Ray, Haresh Gurnani

In the grocery and retail industries, firms routinely offer BOGO (buy one get one off) offers in which a consumer is able to obtain lower price on larger quantity purchases. We examine the a firm's pricing decision for such BOGO bundles under competition. The effect of consumer heterogeneity and market characteristics on this decision is also considered.

2 - Signing Up for Guaranteed Buyback Programs? Perspectives of Manufacturers and Customers

Shuya Yin, University of California, Irvine, Merage School of Business, Irvine, United States of America, shuya.yin@uci.edu,
Saibal Ray, Houcai Shen, Wenju Niu, Mehmet Gumus

Guaranteed buyback programs offer customers protection against price drops and encourage them to upgrade their products. This, in turn, motivates manufacturers to improve and innovate their products. These insurance contracts are often offered by third-parties. Our goal is to understand how such programs impact the preferences of the manufacturer and the customers.

3 - Analyzing the Entry of Big-box Retailers in an Emerging Market

Aditya Jain, Baruch College, New York City, New York,
United States of America, Aditya_Jain@isb.edu, Saibal Ray,
Mehmet Gumus

We consider the impact of the entry of a big-box retailer (BBR) in a market dominated by small, mom-and-pop retailers. The small retailers are characterized by local coverage of the market, whereas BBR provides services valued by all customers. Since both types of retailers obtain supplies from a common manufacturer, BBR's entry affects the supply conditions. Our work thus highlights roles of direct competition as well as indirect supply side effect on small retailers and customers.

4 - Channel Contract Preferences under Dynamic Market Conditions

Long Gao, Associate Professor of Operations and Supply Chain
Mgt, University of California Riverside, 900 University Ave,
Riverside, CA, 92507, United States of America,
long.gao@ucr.edu

Downstream retailers often have private information about consumer market conditions that may evolve over time. We study the long-term channel contracting problem under market fluctuations. We characterize the optimal contract, and show that incorporating market evolution is critical for contract design and execution.

■ WB40

40- Room 101, CC

Operations Management/Marketing Interface I

Contributed Session

Chair: Alejandro Lamas, Assistant Professor, NEOMA Business School,
1 Rue du MarÉchal Juin, Mont Saint Aignan Cedex, 76825, France,
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1 - Competitive Time-Locked Free Trial Strategy

Hai-ping Wang, Xi'an Jiaotong University, School of
Management, Xi'an, China, whp1989@stu.xjtu.edu.cn,
Jun Lin, Shu-lin Liu

Offering time-locked free trials has been a common practice in the software industry to reduce consumers' uncertainty about product quality. This paper develops a game-theoretic model to determine the optimal time-locked free trial strategy in a duopoly market. Allowing consumers to have very different, and even opposite experiences after trial, this paper analyzes the impact of consumer learning heterogeneity on the equilibrium outcome. Several new and important insights are provided.

2 - Should Firms Invest in Joint Promotions?

Salma Karray, UOIT, 2000 Simcoe Street North, Oshawa, ON, Canada, salma.karray@uoit.ca, Simon Pierre Sigue

We investigate whether firms should invest in joint promotions for their complementary products with partners that are competitors in other product categories. We develop a game-theoretic model and solve for Nash equilibrium strategies. The main results show that spillover effects significantly affect the viability of such promotions.

3 - The Lot Sizing Problem under Price Competition

Alejandro Lamas, Assistant Professor, NEOMA Business School, 1 Rue du Maréchal Juin, Mont Saint Aignan Cedex, 76825, France, alejandro.lamas@neoma-bs.fr, Philippe Chevalier

We study simultaneous pricing and operations planning when two competitors face price sensitive demands. We model the operations of each competitor as a Lot Sizing Problem. We assume competitors choose prices from a discrete set, thus the complexity of computing a Nash Equilibrium increases with the size of the instance. By characterizing a Nash Equilibrium, we reduce the computational time of the problem.

■ WB41

41-Room 102A, CC

Joint Session MSOM-Health/HAS: Incentives in Healthcare Value Chain for Drugs and Consumables

Sponsor: Manufacturing & Service Oper
Mgmt/Healthcare Operations
Sponsored Session

Chair: Sepehr Nemati, Postdoctoral Fellow, Ivey School of Business, University of Western Ontario, 1255 Western Road London, London, Canada, Sproon@ivey.uwo.ca

1 - Modeling the Ethics of Donating Dated Medical Supplies

Quan Zhou, University of Auckland, 12 Grafton Road, Auckland, 1010, New Zealand, q.zhou@auckland.ac.nz, Tava Olsen

Many developed countries hold medical supplies in reserve for emergencies that eventually become dated. For example, sterile packaging begins to lose its sterile seal over time. Although donating such dated medical supplies to developing nations could reduce expiration and benefit the recipients, it is not encouraged due to ethical concerns. Using a series of stochastic models, we investigate how donation would impact a recipient country's social welfare, considering possible corruption effects.

2 - Two-Echelon Pharmaceutical Reverse Supply Chain Coordination with Customer Incentives

Du'a Weraikat, PhD Candidate, Concordia University, 1420 Rue Towers Apt. 317, Montreal, Canada, d_wer@encs.concordia.ca, Masoumeh Kazemi Zanjani, Nadia Lehoux

We explore the role of providing incentives to customers to encourage the returns of unexpired medications and to improve the performance of real pharmaceutical reverse supply chains (RSC). Also, we investigate the effect of having a coordination method between RSC entities on the recovery rate. Finally, a proper technique is proposed to share the RSC savings. The results indicate that introducing incentives enhances the recovery rate by 11.5% while improving the profitability of the RSC.

3 - How to Fight Fake Medicine with SMS Verification Technology

Michael Beeler, PhD Candidate, Massachusetts Institute of Technology, 77 Massachusetts Avenue, E40-149, Cambridge, MA, 02139, United States of America, beeler@mit.edu, David Simchi-levi, Cynthia Barnhart, Louis Chen

The WHO estimates that up to 25% of medicine in poor countries could be counterfeit. We show that using covert, single-use product codes verifiable by SMS can reduce counterfeiting levels while improving manufacturer profit. Moreover, we find for certain drug markets, manufacturers can obtain further gains by offering small SMS-based rebates to consumers who verify products. Our paper presents an analytical framework for selecting such rebate levels to fight counterfeit drugs.

4 - Companion Diagnostics Co-Development with Patent Expiry and Additional Effort on Quality

Sepehr Nemati, Postdoctoral Fellow, Ivey School of Business, University of Western Ontario, 1255 Western Road London, London, Canada, Sproon@ivey.uwo.ca, Mehmet Betgen, Gregory Zaric

Developing safe and reliable companion diagnostic tests for an existing drug before the drug patent expires is shown to be a viable strategy for pharma companies to thrive their business. We study the problem that pharma companies face when they offer a contract to form partnerships with biotech companies for developing these tests. We propose a contract that maximizes the pharma's profit while giving enough incentives to the biotech company to timely develop a high quality test.

■ WB42

42-Room 102B, CC

Stochastic Models for Healthcare Applications

Sponsor: Manufacturing & Service Oper
Mgmt/Healthcare Operations
Sponsored Session

Chair: Pengyi Shi, Assistant Professor, Krannert School of Management, Purdue University, 403 W State St, West Lafayette, IN, 47907, United States of America, shi178@purdue.edu

1 - Approximating Emergency Department Census Levels via Simple Queueing Models

Wanyi Chen, University of North Carolina at Chapel Hill, 131 Providence Glen Dr, Chapel Hill, NC, 27514, United States of America, wanyic@live.unc.edu, Debbie Travers, Serhan Ziya, Nilay Argon, Kenneth Lopiano, Thomas Bohrmann, Abhi Mehrotra, Jeffery Strickler

Using data from an emergency department, we investigate whether single station queueing models with time or state dependent arrival and service rates can be used to obtain good approximations for the census levels in practice.

2 - The Impact of Delay Announcement on Hospital Network Coordination

Jing Dong, Northwestern University, 2145 Sheridan Road, Tech C210, Evanston, IL, United States of America, jing.dong@northwestern.edu, Elad Yom-tov, Galit Yom-tov

We investigate the impact of delay announcement on the coordination within hospital networks using a combination of empirical observations and numerical experiments. We provide empirical evidence that patients do take delay information into account when choosing Emergency Departments. We also investigate factors that may affect the coordination level between hospitals.

3 - Identify Optimal Overflow Policies using Approximate Dynamic Programming

Pengyi Shi, Assistant Professor, Krannert School of Management, Purdue University, 403 W State St, West Lafayette, IN, 47907, United States of America, shi178@purdue.edu, J. G. Dai

To alleviate Emergency Department congestion, boarding patients who wait to be admitted to inpatient wards may have to be overflowed to a non-primary ward when they wait too long. We develop approximate dynamic programming tools to identify the optimal overflow policies under different system states.

4 - A Data-driven Model of an Appointment-Generated Arrival Process at an Outpatient Clinic

Ward Whitt, Columbia University, IEOR Department, S. W. Mudd Building, New York, NY, United States of America, ww2040@columbia.edu, Won Chul Cha, Song Hee Kim

We analyze appointment-system data from an endocrinology outpatient clinic and develop a stochastic arrival process model that can be used to simulate the clinic and evaluate alternative appointment strategies. Variability is caused by uncertain no-shows, unscheduled arrivals and earliness or lateness, but most importantly by the schedule itself.

■ WB43

43-Room 103A, CC

Revenue Management Problems with Consumer Choice Behaviors

Sponsor: Revenue Management and Pricing
Sponsored Session

Chair: Zizhuo Wang, Assistant Professor, University of Minnesota, 111 Church Street S.E., Minneapolis, MN, United States of America, zwang@umn.edu

1 - When to Offer Upgrades?

Rowan Wang, Singapore Management University, 50 Stamford Rd, Singapore, 178899, Singapore, rowanwang@smu.edu.sg, Yimin Yu, Huihui Wang

We consider a firm that sells multiple product models corresponding to multiple classes of demand. The firm may offer customers free upgrade to a more expensive model when there is insufficient stock of the one preferred. However, customers may not accept the upgrade due to their preference on features of the desired model. It is interesting to see that, knowing some customers may reject the upgrade option, it might be optimal to offer upgrade earlier and before stockout.

2 - Eliciting Product Information via Public Rating and Local Experience Sharing

Shihong Xiao, HKUST, Clear Water Bay, Hong Kong,
Hong Kong - PRC, sxiaoab@connect.ust.hk, Ying-ju Chen

Customers resort to public ratings and friends' experience sharing in purchasing goods. This paper investigates how these two sources of information impact customers' purchase decisions and how they are manipulated by firms' selective targeting in free trials distribution. We show that more information may induce customer to make worse decision. A firm with higher quality good tends to offer limited free trials to boost product rating, which may be accompanied by lower price.

3 - Consumer Choice Models with Endogenous Network Effects

Zizhuo Wang, Assistant Professor, University of Minnesota,
111 Church Street S.E., Minneapolis, MN,
United States of America, zwang@umn.edu, Ruxian Wang

We propose and analyze a new choice model that takes into account network effects. We characterize the choice probabilities under such model and conduct comparative statics studies. Then we investigate the assortment optimization problem under such choice model. We show that a new class of assortments, called quasi-revenue-ordered assortments, is optimal under mild conditions and performs well in practice. We also conduct an empirical study on a mobile game dataset to validate our results.

■ WB44

44-Room 103B, CC

Assortment Optimization

Sponsor: Revenue Management and Pricing
Sponsored Session

Chair: Huseyin Topaloglu, Professor, Cornell University, 223 Rhodes Hall, Ithaca, NY, 14853, United States of America, ht88@cornell.edu

1 - Assortment Optimization with Consideration Sets

Jacob Feldman, Cornell University, 136 Hoy Road, Ithaca, NY,
United States of America, jbf232@cornell.edu, Huseyin Topaloglu

We consider a series of assortment optimization problems when customers only consider purchasing a subset of the offered products. This subset of products is referred to as a customer's consideration set. In very simple instances, we show that this problem is NP Hard and provide an FPTAS when the offered assortment is space or cardinality constrained.

2 - Quality Consistent Pricing under the Nested Logit Model

James Davis, Cornell University, 290 Rhodes Hall, Ithaca,
United States of America, jamesmariodavis@gmail.com,
Huseyin Topaloglu, David Williamson

We consider pricing problems where customers choose among products according to the nested logit model and there is a quality consistency constraint. The quality consistency constraint ensures that the posted prices of products reflect the quality of the products. We consider variations of this problem and provide polynomial time algorithms.

3 - Capacitated Assortment Optimization under Non-parametric Choice Models

Alice Paul, Cornell University, 136 Hoy Road, Ithaca, NY, 14850,
United States of America, ajp336@cornell.edu, Jacob Feldman,
James Davis

We consider the capacitated assortment optimization problem. Given a collection of items with associated revenues, we must choose a subset of items of size at most k to display to customers to maximize expected revenue. In this talk, we consider restricted classes of the non-parametric choice model, and present a polynomial time algorithm for the associated assortment problem.

■ WB45

45-Room 103C, CC

Sustainability I

Contributed Session

Chair: Andriy Shapoval, Georgia Institute of Technology, 765 Ferst Dr. NW, Atlanta, GA, 30332, United States of America, ashapoval3@gatech.edu

1 - Managing Production and Sales in The Presence of Scarce Resources and Market Price Variability

Xiaobo Li, University of Minnesota, 1006, 27th Ave SE, Apt. E,
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lix3195@umn.edu, Guiyun Feng, Saif Benjaafar

A firm is subject to a production allowance over a compliance period, which consists of multiple production periods. The firm sells its output to a spot market.

In each production period, the firm observes the market price, the inventory level, and the remaining allowance. It then decides on how much to produce and how much to sell. We characterize the structure of the optimal policy and study the impact of various parameters, including allowance amount, production capacity and leadtime.

2 - Socio-emotional Wealth: An Extensive Construct for CSR of Family Firms

Wei-jun Hsueh, PhD Candidate, Bocconi University, Via Sarfatti
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Socio-emotional wealth (SEW) is a dominant decision logic premised on the non-economic goals of the controlling family in family firms. It can enhance the stewardship practices of a family firm beyond economic goals. This paper expands the existing SEW construct by adding family leadership and culture to examine the stewardship practices of family firms in terms of corporate social responsibility performance. It examines the intricate relationship among various SEW dimensions of family firms.

3 - Analysis of National Transportation Sustainability Changes in the U.S. and Selected European Countries

Hamed Ahangari, PhD Candidate, University of Connecticut, 142
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hamed.ahangari@uconn.edu, Norman Garrick,
Carol Atkinson-Palombo

In this study we measure national surface transportation index in all three environmental, social, and economic dimensions. Based on these measurement we develop a composite index called National Sustainable Transportation Index (NSTI). We run these models for different time period 2005-2012 in the US and 27 selected European countries. Finally, we offer a framework to answer why some countries are improving in terms of sustainability and the others are getting worse over the course of time.

4 - Sustainability Measures in Strategic Supply Chain Management Decisions

Ismail Civelek, Assistant Professor, Western Kentucky University,
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We investigate how companies can implement sustainability measures strategically. We approach sustainable supply chains from the value chain perspective by identifying opportunities for sustainable actions and policies at different phases in the product life cycle, especially in inventory management. We discuss sustainability measures in inventory management and provide both short and long term managerial implications for a decision maker to promote sustainability in inventory management.

5 - On Sustainability and Corporate Social Responsibility Reporting

Andriy Shapoval, Georgia Institute of Technology,
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ashapoval3@gatech.edu, Henry Aigbedo, Marina Matterna,
Ivan Oliver Hilliard

Sustainability and corporate social responsibility is becoming an increasingly important topic around the world. Many businesses are uncertain about the value of reporting initiatives in this area. We provide a regression model and analyze factors leading to the decisions about voluntary reporting (and at which level, if any) in some industrial sectors.

■ WB46

46-Room 104A, CC

Role of Information in Service Systems

Sponsor: Manufacturing & Service Oper Mgmt/Service Operations
Sponsored Session

Chair: Senthil Veeraraghavan, Associate Professor, The Wharton School, 3730 Walnut St, Philadelphia, PA, 19104,
United States of America, senthilv@wharton.upenn.edu

1 - Contracting in Medical Equipment Maintenance Services: An Empirical Investigation

Tian Chan, INSEAD, TianHeong.CHAN@insead.edu,
Omar Besbes, Francis De Vericourt

Fixed-fee and pay-per-service contracts are two forms of maintenance service plans that structure payment between operators and service providers. Using data from 712 medical scanners, we empirically compare their effects on service outcomes. We exploit a warranty period to isolate incentive effects from adverse selection. We find that a pay-per-service contract leads to relatively higher reliability at a lower cost. Hence, it produces greater value to the service chain.

2 - On Public Warnings in Counterterrorism Operations

Nitin Bakshi, London Business School, Regent's Park, London, United Kingdom, nbakshi@london.edu, Edieal Pinker

Public warnings, or terror alerts, might be a victim of their own success. Previous alerts that negated an attack result in the perception of a false alarm. We study the trade-off between the short-term benefit of a deferred attack, and long-term costs such as erosion of credibility through false alarms.

3 - Dynamic Pricing, Product Evaluation Behavior, and Evolution of Product Reviews

Necati Tereyagoglu, Assistant Professor of Operations Management, Scheller College of Business, Georgia Institute of Technology, 800 W Peachtree St. NW, Suite 4424, Atlanta, GA, 30308, United States of America, Necati.Tereyagoglu@scheller.gatech.edu

Product review posters can exhibit bandwagon or differentiation behavior in their evaluations in online marketplaces. Such differences can cause changes in the composition of the posters over time, which in turn influence the evolution of the ratings environment. In this paper, we examine the relationship between the composition of posters and the evolution of the ratings environment, leading to its effect on consumers' purchase behavior, and dynamic pricing decisions of a monopolist.

WB47

47-Room 104B, CC

Sustainable Supply Chain

Sponsor: Manufacturing & Service Oper Mgmt/Sustainable Operations

Sponsored Session

Chair: Xi Chen, Assistant Professor, University of Michigan-Dearborn, 4901 Evergreen Rd, Dearborn, MI, 48128, United States of America, xichenxi@umich.edu

1 - Service Region Design for Urban Electric Vehicle Sharing Systems

Long He, University of California, Berkeley, 1117 Etcheverry Hall, University of California, Berkeley, CA, 94720, United States of America, longhe@berkeley.edu, Zuo-jun Max Shen, Ho-Yin Mak, Ying Rong

We consider the service region design problem for electric vehicle sharing systems. We then develop a model that incorporates both customer adoption behavior and fleet operations under spatially-imbalanced and time-varying travel patterns. To address the uncertainty in adoption patterns, we employ a distributionally-robust optimization framework. Applying this approach to the case of Car2Go's service in San Diego, CA, with real operations data, we address a number of planning questions.

2 - Sourcing under Supplier Responsibility Risk: The Effects of Certification, Audit and Contingency Pay

Li Chen, Associate Professor, Cornell University, 114 East Ave, Ithaca, NY, United States of America, li.chen@cornell.edu, Hau Lee

Companies that source from emerging economies often face supplier responsibility risks, namely, financial and reputational burdens that the companies have to bear when their suppliers' engagement in noncomplying labor and environmental practices is discovered by stakeholders or becomes public. In this paper, we study how certification, audit and contingency payment can help mitigate such risks.

3 - Green Sourcing-the Role of Premium Sharing and Consulting Services

Xi Chen, Assistant Professor, University of Michigan-Dearborn, 4901 Evergreen Rd, Dearborn, MI, 48128, United States of America, xichenxi@umich.edu, Niyazi Taneri, Saif Benjaafar

Certified sustainable products often times enjoy a significant green premium in the retail market. In this paper, we study a retailer's use of a sourcing contract as a tool of incentivizing suppliers to exert greening efforts which improves the chances of receiving certification, and in turn capturing the green premium. We also explore the rationale for retailer to involve in suppliers' greening efforts.

4 - Optimal Feed-in Tariff Policies: The Role of Technology Manufacturers

Shadi Goodarzi, PhD Student, HEC Paris, 1 Rue de la Liberation, Jouy en Josas, 78350, France, shadi.goodarzi@hec.edu, Andrea Masini, Sam Aflaki

We assess the effectiveness of feed-in tariff policies in promoting renewable energy technologies taking into account technology manufacturers' decisions. Modeling a three-tier supply chain that includes potential adopters, technology manufacturers and a grid operator, we show that the ability of feed-in tariffs to induce renewable energy adoption is strongly affected by the technology manufacturers' market characteristics.

WB48

48-Room 105A, CC

Information-Related Issues in Supply Chain Management

Sponsor: Manufacturing & Service Oper Mgmt/iFORM

Sponsored Session

Chair: Mohammad Nikoofal, Catolica Lisbon School of Business & Economics, UCP, Palma de Cima, Lisbon, 1649-023, Portugal, mohammad.nikoofal@ucp.pt

Co-Chair: Mehmet Gumus, McGill University, 1001 Sherbrooke Street West, Montreal, Canada, mehmet.gumus@mcgill.ca

1 - Generalized Reverse Auctions: Efficiency and Credibility under Information Asymmetry

Hedayat Alibeiki, McGill University, 1001 Sherbrooke St. West, Montreal, Qc, H3A 1G5, Canada, hedayat.alibeiki@mail.mcgill.ca, Mehmet Gumus, Shanling Li

Non-price factors such as product quality and reliability can be even more important than bidding prices for the buyers when selecting the winner of an e-Auction. In practice, buyers usually evaluate and assign an originally-private "quality score" to each supplier that determines the relative position of the supplier toward its competitors. In this paper, we study whether or not and in what fashion the buyer can credibly share suppliers' quality scores with them.

2 - Towards a Counterfeit Proof Global Supply Chain

Morteza Pourakbar, Rotterdam School of Management, Erasmus University, Rotterdam, the Netherlandsmpourakbar@rsm.nl, Rob Zuidwijk

In this paper, we study the role of customs inspection policies on mitigating the infiltration of counterfeiters in the legitimate supply chains. We characterize customs optimal inspection policies taking into account the trade-off between reducing the risk of infiltration and the detrimental impact of increased inspections on supply chains.

3 - Impact of Category Captainship on Retail Competition

Alper Nakkas, Associate Professor, Nova SBE, UNLFE, Campus de Campolide, NIF 506030636, Lisbon, 1099-032, Portugal, alper.nakkas@novasbe.pt

The increasing complexity of product categories led retailers to recognize that managing categories would be increasingly complex, time-consuming and expensive. To answer these challenges and gain competitive edge, retailers began partnering with their suppliers (i.e., category captains) for recommendations about assortment selection, shelf design, displaying issues etc. We examine the incentives of category captains in a setting where two retailers compete to increase their market shares.

4 - Supply Diagnostic Incentives in New Product Launch

Mohammad Nikoofal, Católica Lisbon School of Business & Economics, UCP, Palma de Cima, Lisbon, 1649-023, Portugal, mohammad.nikoofal@ucp.pt, Mehmet Gumus

In launching new products, the newness of the production leads to unexpected reliability issues on supply side. The adverse effect of supply risk can be mitigated via test production. We explore how such a diagnostic technology investment may affect both incentive and information asymmetries across channel partners.

WB49

49-Room 105B, CC

Supermodularity and its Applications in Operations Management

Sponsor: Manufacturing & Service Oper Mgmt/Supply Chain

Sponsored Session

Chair: Daniel Zhuoyu Long, Assistant Professor, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong - PRC, zylong@se.cuhk.edu.hk

Co-Chair: Xin Chen, University of Illinois at Urbana-Champaign, Dept. of Industrial & Enterprise Systems, 216C Transportation Building, Urbana, IL, 61801, United States of America, xinchen@illinois.edu

1 - Preservation of Structural Properties When Decision Variables Are Truncated by Random Variables

Xiangyu Gao, ISE department, UIUC, 04Transportation Building 104 S. Mathews, Urbana, IL, 61801, United States of America, xgao12@illinois.edu, Zhenyu Hu, Xin Chen

A common technical issue in many operations management models is decision variables are truncated by random variables. The challenge is that the objective functions are often not convex in the decision variables. To address this challenge, we develop a powerful transformation technique which converts a non-convex

minimization problem to an equivalent convex one, and preserves some desired structural properties such as convexity and L-natural-convexity. Three applications are discussed.

2 - Some Specially Structured Assemble-to-order Systems

Paul Zipkin, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, paul.zipkin@duke.edu

Assemble-to-order systems are important in practice but challenging computationally. This paper combines some notions from combinatorial optimization, namely polymatroids and discrete convexity, to ease the computational burden significantly, for certain specially structured models. We point out that polymatroids have a concrete, intuitive interpretation in this context.

3 - On A Stochastic Program for Inventory Control in Assemble-to-order M Systems

Qiong Wang, University of Illinois at Urbana-Champaign, 104 South Mathews Ave., Urbana, IL, United States of America, qwang04@illinois.edu, Martin I Reiman, Mustafa Dogru

We consider a two-stage stochastic program (SP) for developing inventory policies for Assemble-to-Order M systems. The first stage SP prescribes a replenishment policy and the second stage SP optimizes component allocation. We show that the M system structure allows the SP to have desirable convexity properties and an explicit form of the optimal solution. We also discuss whether these convenient features can be preserved under various generalizations of the system structure.

4 - Conditions on Preservation of Supermodularity and its Applications

Daniel Zhuoyu Long, Assistant Professor, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong - PRC, zylong@se.cuhk.edu.hk, Xin Chen, Jin Qi

The concept of supermodularity has been proved to be a useful and an important tool to derive monotone comparative statics in parametric optimization problems. One critical concern is whether the supermodularity can be preserved under dynamic programming recursions. In this paper, we provide necessary and sufficient conditions for the preservation of supermodularity in several classes of parametric optimization problems, and show how the theoretical results can be applied in some OM problems.

■ WB50

50-Room 106A, CC

New Topics in Behavioral Operations

Sponsor: Manufacturing & Service Operations Management
Sponsored Session

Chair: Javad Nasiry, Assistant Professor, Hong Kong University of Science and Technology, ISOM, LSK Building, HKUST, Hong Kong, Hong Kong - PRC, nasiry@ust.hk

1 - The Value of Project Reviews with Reference Effects

Xiaoyang Long, PhD Student, Hong Kong University of Science and Technology, Hong Kong - PRC, xlongaa@connect.ust.hk, Javad Nasiry

In uncertain environments, project reviews provide an opportunity to make continue or abandon decisions in order to maximize the project's expected payoff. However, we show that a behaviorally biased project manager may opt not to review the project and forgo the value of information provided by a review. Further, the project manager may be more likely to launch and continue the project in comparison to rationally optimal decisions.

2 - Price Competition in the Presence of Social Comparison and Demand Uncertainty

Ming Hu, Associate Professor, University of Toronto, 105 St. George Street, Toronto, Canada, Ming.Hu@Rotman.Utoronto.Ca, Yun Zhou

We consider a duopolistic price competition of differentiated substitutable products under demand uncertainty, in which the duopoly socially compare with each other. Conventional wisdom suggests social comparison leads to more competitive behavior. We demonstrate how opposite-directional social comparisons interact with demand variability to change competitive behavior. These insights are robust under multiplicative demand uncertainty, but they are reversed for complementary products.

3 - Optimal Stopping under Present-Biased Preferences

Peiwen Yu, Assistant Professor, Fudan University, Shanghai, China, freypw@connect.ust.hk, Qing Li, Javad Nasiry

We study optimal stopping problems in which agents have present-biased preferences. Agents may be naive and unaware of the bias or sophisticated and aware. We establish the optimality of a threshold stopping policy under a set of intuitive conditions. We show that sophistication may lead to counter-intuitive decisions, but we also identify simple conditions that yield robust predictions on sophisticated agents' behavior. We apply our theory to models of project management and healthcare.

4 - Behavioral Foundations and Antecedent Conditions of Service Slowdowns (and Speedups)

Mirko Kremer, Professor, Frankfurt School of Finance & Management, Room B135, 60314 Frankfurt am Main, Frankfurt, Germany, M.Kremer@fs.de

The assumption that service times are independent of system load is widespread in the operations management literature, despite growing empirical and anecdotal evidence to the contrary. We present some experimental evidence on behavioral drivers and antecedent conditions of service slowdowns (and speedups) in systems that are operated by human servers and/or customers.

■ WB51

51-Room 106B, CC

Supply Chain Outsourcing

Sponsor: Manufacturing & Service Operations Management
Sponsored Session

Chair: Morvarid Rahmani, Assistant Professor, Georgia Tech, morvarid.rahmani@scheller.gatech.edu

1 - Supply Networks for Relational Sourcing

Elena Belavina, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, United States of America, elena.belavina@chicagobooth.edu

Socially responsible sourcing has become a necessity for many global firms and a competitive advantage for others. Sourcing strategies based on social responsibility now increasingly employ long-term commitments (relational sourcing). This study examines the role that supply network configuration plays in the efficacy of relational sourcing in ensuring socially responsible behavior across the supply network (compliance).

2 - An Economic Model of Knowledge Outsourcing

Jaeseok Lee, Georgia Institute of Technology, 800 West Peachtree NW, Atlanta, GA, 30308, United States of America, Jaeseok.Lee@scheller.gatech.edu, Karthik Ramachandran, Cheryl Gaimon

We introduce a game-theoretic model of knowledge outsourcing. We study how the interaction between a knowledge buyer and supplier is affected by two salient aspects of knowledge outsourcing, which distinguish it from component outsourcing: the buyer's absorptive capacity, and the supplier's ability to reuse prior knowledge. We also investigate how uncertainty and information asymmetry influence the equilibrium outcomes of knowledge outsourcing.

3 - Incentives in Contests with Heterogeneous Solvers

Soo-Haeng Cho, Associate Professor, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, soohaeng@andrew.cmu.edu, Ersin Korpeoglu

In a crowdsourcing contest in which heterogeneous solvers make efforts to develop solutions, existing theories predict different outcomes about how solvers will change their efforts in response to increased competition (i.e., more entrants to the contest). This paper presents a unifying model that encompasses different types of heterogeneity, and offers a precise explanation about solvers' rational behavior. Our theoretical prediction is corroborated by empirical evidence.

■ WB52

52-Room 107A, CC

Retail Management II

Contributed Session

Chair: Shelby Koos, University of Miami, 268, McArthur Engineering Building, Coral Gables FL 33146, United States of America, s.koos1@umiami.edu

1 - Optimal Contract Design in a Co-storing Arrangement

Lama Moussawi-Haidar, Assistant Professor, American University of Beirut, P.O. Box 11-0236 Riad El Solh, Beirut, 1107, Lebanon, lm34@aub.edu.lb, Nagihan Comez-dolgan

We study the optimal design of a revenue sharing agreement between two retailers with complementary products, sharing the same retail location. The landlord retailer rents out some space to a tenant retailer. Each retailer has his/her own random sales, dependent on effort levels of both retailers. We model the problem as a double moral hazard and we show that a linear percentage rent, consisting of a sales share and a based rent, achieves the second-best effort levels.

2 - Efficient Workforce Size and its Schedule in the Retail Store

Peeyush Pandey, Doctoral Student, IIM INDORE, FPM block, room no.-315, IIM Indore, Prabandh Shikhar,, Indore, MP, 453331, India, f12peeyushp@iimindr.ac.in, Bhavin Shah, Ashish Sadh, Hasmukh Gajjar

A Stochastic model is proposed to determine optimal workforce size at the different point of time in the retail store. Further this optimal size is used as an input to workforce-scheduling model considering uncertain and uneven customer traffic, union contracts, labor laws, company policies etc. Proposed optimization model and solution methodology guarantees to provide efficient workforce schedule.

3 - Beyond the Forecast – Risk Based Promotion Management Applied in a Grocery Retail Environment

Ted Matwijec, Managing Director, ACT Operations Research, 1345 Legendary Lane, Morrisville, NC, 28202, United States of America, ted.matwijec@act-operationsresearch.com, Raffaele Maccioni

Promotions are one of the biggest challenges for management for businesses focused on consumer retailing. Each product promotion campaign must contribute to the businesses to attract new customers and still retain existing customers. In this paper we analyze the modeling, which is applied to promotions used at a national grocery retailer. The solution minimizes the risk of running promotions by using optimization techniques which ultimately benefits a retailer profitability.

4 - The Softer Side of Assortment Planning

Nazrul Shaikh, Assistant Professor, University of Miami, 268, McArthur Engineering Building, University of Miami, Coral Gables, FL, 33146, United States of America, n.shaikh@miami.edu, Shelby Koos

Our research focuses on the sensitivity of the optimal assortment plans to soft costs, such as backorder costs, and proposes a methodology for generating robust solutions to the assortment planning problem. This adds a useful element to extant research that only focuses on improving future demand estimates and substitution probabilities.

WB53

53-Room 107B, CC

Frontiers of Behavioral Operations Research

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Karen Zheng, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, yanchong@mit.edu

1 - A Cognitive Strategy for Reducing Managerial Bias under Censored Demand

Jordan Tong, Assistant Professor, University of Wisconsin at Madison, WI, United States of America, jordan.tong@wisc.edu, Daniel Feiler, Richard Larrick

Existing evidence suggests managers exhibit a censorship bias: demand beliefs and order decisions are biased low when demand is censored by the inventory level. We propose a new cognitive strategy, which is easily implementable in practice, for reducing this bias. Two experiments show that the strategy improves managerial performance across multiple profit margins and outperforms other plausible debiasing techniques. The results also illuminate the underlying causes of the censorship bias.

2 - The Bright and Dark Sides of Perception Biases in Inventory Decisions

Yaozhong Wu, National University of Singapore, NUS Business School, Singapore, Singapore, yaozhong.wu@nus.edu.sg

We study the impact of perception biases in competing inventory decisions. We analyze how a manager's perception bias affects each other's inventory decisions and performances in strategic interactions, and more importantly who benefits from these biases in the short and long runs. We show that a perception bias can serve as a competitive advantage in the sense that a biased manager can achieve a higher profit than an unbiased competitor.

3 - The Exploration – Execution Transition in Product Development: An Experimental Analysis

Stephen Leider, University of Michigan, 701 Tappan Ave R4486, Ann Arbor, MI, 48104, United States of America, leider@umich.edu, Evgeny Kagan, William Lovejoy

We examine experimentally the effect of exogenous and endogenous transition times on performance in a creativity task. Subjects who choose their own transition perform worse, even when the transition time is similar. We find that early design prototyping, testing and even failure improves performance, while the number of ideas does not. Idea selection and execution accounts for more of the performance difference than idea generation.

4 - Pricing When Customers have Limited Attention

Tamer Boyaci, McGill University, Montreal, Canada, tamer.boyaci@mcgill.ca, Yalcin Akcay

We study optimal pricing when customers have limited attention and capability to process information about the value (quality) of the offered products. We model customer choice based on the theory of rational inattention in the economics literature, and capture not only the impact of true qualities and prices, but also the intricate effects of customer's prior beliefs and cost of information acquisition and processing. We consider both monopolistic and competitive settings.

WB55

55-Room 108B, CC

Decision Analysis I

Contributed Session

Chair: Xiaoya Xu, PhD, University of Macau, S9-7025, Macau, Macau, xlwxy@gmail.com

1 - Managing Rental Products with Breakdown

Mohammad Firouz, PhD Candidate, The University of Alabama, 610 13th St, Apt. 19, Tuscaloosa, AL, 35401, United States of America, mfirmouz@crimson.ua.edu, Burcu Keskin, Linda Li

We investigate capacity planning problem of a rental system. Products owned by the system have a life time distribution and may breakdown for an uncertain duration of time. We solve the proposed Quasi-Birth and Death (QBD) model via matrix analytic methods. We also compare the result of our proposed approximation to the problem with the QBD. In our analysis, we prove the convexity of the approximate cost objective function and show conditions under which it may or may not be accurate.

2 - Repeat Purchase Prediction of Loyalty Customers using Survival Analysis

U Dinesh Kumar, Dr., Professor in Quantitative Methods & Information Systems, Indian Institute of Management, Bannerghatta Road, Bangalore, 560076, India, dineshk@iimb.ernet.in

The prediction of purchase behavior of loyalty customers in terms of who will repeat the purchase and when the repeat purchase of a particular category will be done. We use Survival Model combined with Logistic Model and Decision Tree to find when and who will repeat the purchase while retaining the robustness, interpretability of the models.

3 - Selling Probability Service: Profiting from Market Segment and Discrimination

Xiaoya Xu, PhD, University of Macau, S9-7025, Macau, Macau, xlwxy@gmail.com, Zhaotong Lian, Xin Li, Pengfei Guo

We consider a setting where goods A and B are offered to customers of three types: buyers who desire for A, buyers who desire for B, and the third type of buyers who are flexible. A probability selling service is created by the seller to offer the option of getting an unknown item either A or B, targeting at the third type of customers. This paper investigates the role of probability selling service provider in such a setting as Priceline and Hotwire in market segmentation.

WB57

57-Room 109B, CC

Advances in Sustainable Energy and Economic Systems Analysis

Sponsor: ENRE – Energy II – Other (e.g., Policy, Natural Gas, Climate Change)

Sponsored Session

Chair: Soheil Shayegh, Postdoctoral Research Scientist, Carnegie Institution for Science, 260 Panama St., Stanford, Ca, 94305, United States of America, sshayegh@carnegiescience.edu

1 - Adapting to Rates of Climate Change

Soheil Shayegh, Postdoctoral Research Scientist, Carnegie Institution for Science, 260 Panama St., Stanford, Ca, 94305, United States of America, sshayegh@carnegiescience.edu, Ken Caldeira, Juan Moreno-Cruz

Most of the discussion around adaptation in IPCC AR5 and other sources has focused on amounts of climate change. However, it is becoming increasingly clear that, as climate continues to change, people and ecosystems will need to continuously adapt to a moving target. We have developed a model that convincingly makes this point and illustrates it with a quantitative example involving coastal development in the face of ongoing sea level rise.

2 - Dynamic Energy Inventory Management for Wastewater Treatment

Jing Ma, Ph.D Candidate, Stanford University, 145M, 475 Via Ortega, Stanford, CA, 94305, China, jingma@stanford.edu, Craig Criddle, Erica Plambeck, Sebastien Tilmans

In this work we aim to optimize energy production and consumption to boost revenue for Wastewater treatment plants. Specifically, using the data from Plants in San Francisco, we analyze the potential benefits of controlling the magnitude of influent sewage pumping rate to minimize energy cost or total emission. We also suggest an easy-to-implement heuristic for Wastewater treatment plants.

3 - Dynamic Regulatory Distortion: Coal Procurement at U.S. Power Plants

Akshaya Jha, Assistant Professor, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, akshayaj@stanford.edu

I estimate a dynamic, plant-level model of coal purchase with storage for U.S. electricity generation plants. Holding constant the plant's pattern of input prices and output, I find that it costs a regulated plant roughly 3% more per month to procure coal relative to the same plant facing market prices. This 3% increase in costs stems primarily from dynamic distortions to when and how often regulated plants purchase coal, rather than static differences in the level of coal stockpiles held.

■ WB58

58-Room 110A, CC

Non-Convex Equilibrium Problems

Sponsor: ENRE – Energy II – Other (e.g., Policy, Natural Gas, Climate Change)

Sponsored Session

Chair: Miguel Anjos, Polytechnique Montreal, Mathematics and Industrial Engineering, Montreal, Canada, miguel-f.anjos@polymtl.ca

1 - An RIT Approach for Solving the Binary-constrained Mixed Linear Complementarity Problem

Franklin Djeumou Fomeni, Postdoc, Ecole Polytechnique Montreal, 5960 Rue Dumas, Montreal, QC, H4E 2Z6, Canada, franklin@aims.ac.za, Miguel Anjos, Steven Gabriel

The BC-MLCP is a formulation of the MLCP in which some variables are restricted to be binary. This paper presents a novel approach for solving the BC-MLCP. First we solve a series of LPs that enables us to replace the complementarity constraints with linear equations. Then we solve an equivalent MILP formulation of the BC-MLCP to guarantee a solution to the problem. Our computational results on a variety of test problems demonstrate the usefulness and effectiveness of our novel approach.

2 - Energy Pricing Problems for Demand Side and Revenue Management

Luce Brotcorne, INRIA, Parcs Scientifique de la Haute Borne, 40 Avenue Halley, Bat-B Park Plaza., Villeneuve d ascq, 59650, France, luce.brotcorne@inria.fr, Sezin Afsar, Patrice Marcotte, Gilles Savard

Pricing models for demand side management methods are traditional used to control electricity demand which became quite irregular recently and resulted in inefficiency in supply. We propose bilevel models to explore the relation and between energy suppliers and customers who are connected to a smart grid. This approach enables to integrate customer response into the optimization process of supplier who aims to maximize revenue or minimize capacity requirements. Numerical results are given.

■ WB59

59-Room 110B, CC

Strategy/Strategic Planning I

Contributed Session

Chair: Mukesh Rungta, Research Scientist, Air Liquide, 200 GBC Dr, Newark, DE, 19702, United States of America, mukeshrungta@gmail.com

1 - Organizational Decision-making and Information: Angel Investments by Venture Capital Partners

Andy Wu, PhD Candidate in Applied Economics, The Wharton School of the University of Pennsylvania, 3620 Locust Walk, Suite 3000, Philadelphia, PA, 19104, United States of America, andywu@wharton.upenn.edu

We study the role of information in organizational decision-making for the financing of entrepreneurial ventures. We formally model a decentralized set of

agents who can acquire costly information and vote to allocate resources to an uncertain project. We test our predictions in the setting of venture capital, where partners make their own angel investments. We find the venture capital partners, acting independently, make riskier investments, but have equivalent financial performance.

2 - Alliance Diversity and Multilateral Strategic Alliance Performance: A Faultline Perspective

Angelo Solarino, City Univeristy of Hong Kong, Chee Avenue, Kowloon, Hong Kong, Hong Kong - PRC, mgangelo@cityu.edu.hk, Tao Bai

We examine the effects of alliance diversity on alliance performance from a faultline perspective. We assess how firms' interacting multiple attributes influence the alliance performance jointly. We differentiate demographic from informational faultlines and tested their effects based on global pharmaceutical alliances. Contrary to previous studies, we find that both kinds of faultlines positively influence the alliance performance. Theoretical and methodological implications are discussed.

3 - Effects of Regional, National and Subnational Institutions On Firm Performance – Meta-analysis

Tao Bai, Assistant Professor, Xi'an Jiaotong-Liverpool University, Suzhou Industrial Park, Suzhou, China, baitao2010@gmail.com, Angelo Solarino, Frank McDonald

There has been a growing attention to globalization-regionalization debate in international business. To better answer the phenomenon, we conduct a meta-analysis to assess the strengths of supranational, national, and subnational institutions on firm performance. We further explore the moderating effect of international relations between countries, industry, and firm size, to help clarifying the research landscape. Theoretical implications and future research opportunities are discussed.

4 - Strategic Sourcing in the Industrial Gas Bulk Supply Chain

Mukesh Rungta, Research Scientist, Air Liquide, 200 GBC Dr, Newark, DE, 19702, United States of America, mukeshrungta@gmail.com

In a vendor managed inventory context, effective strategic sourcing is particularly important and can have significant impact on operational costs. Within the context of the industrial gas supply chain, this presentation will focus upon the assignment of customers to production sources and transportation depots in order to minimize the total landed cost subject to production and distribution constraints. A methodology will be outlined and example cases discussed.

5 - Vertical Integration, Industry Relatedness, and the Agglomeration of Multi-business Firms

Juan Alcacer, Harvard Business School, Soldiers Field, Boston, United States of America, jalcacer@hbs.edu, Jasmina Chauvin

We provide new insights into firm boundary decisions by comparing location strategies of multi-business and single-business firms in the same industry. We find that establishments belonging to multi-business firms agglomerate more, and the difference is related to the potential for sharing of labor resources. Our results suggest that strategic decisions about the geographic and product boundaries of the firm are intimately related, and that resource sharing is implicated in both decisions.

■ WB60

60-Room 111A, CC

Green Manufacturing

Contributed Session

Chair: Kejia Hu, Kellogg School of Management, Northwestern University, 2169 Campus Drive, Evanston, United States of America, k-hu@kellogg.northwestern.edu

1 - Electrical Demand Elasticity of Industrial Loads

Mostafa Ghafoorvarzaneh, University of Tennessee-Knoxville, 851 Neyland drive, 511 John D. Tickle Building, Knoxville, TN, 37996, United States of America, mghafoor@utk.edu, Rupy Sawhney

In the first phase, an optimization model will be introduced for production planning which considers different states of energy consumption (idle, working, setup, startup states) in addition to traditional production planning parameters. In the second step, a DOE will be developed based on real data of production, energy consumption and historical data of LMP. As the result distribution of elasticity and elasticity matrix will be introduced as a function of production parameters.

2 - Energy Performance Indicator in the Manufacturing Industry

Amir Abolhassani, Graduate Research Assistant, West Virginia University, Industrial and Management Systems Dept., Benjamin M. Statler College of Eng., Morgantown, WV, 26506, United States of America, aabolhas@mix.wvu.edu, Bhaskaran Gopalakrishnan

Energy efficiency is becoming an essential aspect of the manufacturing enterprise. Through a series of rigorous assessments, the facilities energy performance was classified in four basic areas of thermal and combustion systems, electrical power and operations, motor systems, and building and grounds. Fuzzy logic is utilized to process historical data obtained from assessments to derive manufacturing facilities energy performance indicator.

3 - Perceptions of Indian Manufacturing Industries in Adopting Green Supply Chain Practises -an Empirical Study

Ashwin Vijayakumar, Management Trainee, Paramount Shipping Services, Parrys, Chennai, 600020, India, vijayakumar.ashwin@gmail.com, Gopinath Bharathi, Vivekanandhan Porselvan

The benefits of adopting green supply chain practises have been realised by industries all over the world apart from India where it is still in its infancy. The study identifies key parameters that play a direct role in adopting green practises in industries such as manufacturing, services, pharmaceuticals etc. Process can be optimised and profits achieved.

4 - Does "Green" Performance Affect Market Share in the Automotive Industry? An Empirical Study

Kejia Hu, Kellogg School of Management, Northwestern University, 2169 Campus Drive, Evanston, United States of America, k-hu@kellogg.northwestern.edu, Sunil Chopra

Our goal is to understand how "Green" performance affects market share for auto manufacturers. Using emission data collected for 14 years from remote sensors installed along a European inter-country highway, our analysis shows the relationship between "Green" performance and market share to be concave. Moreover, we find that "Green" is more significant in affecting market share under loose standards or facing large upcoming reduction in standards.

WB61

61-Room 111B, CC

Integrated Biofuels Supply Chain Design

Sponsor: ENRE – Environment I – Environment and Sustainability

Sponsored Session

Chair: Krystel Castillo, Greenstar Assistant Professor In Energy, The University of Texas at San Antonio, One UTSA Circle, San Antonio, TX, 78249, United States of America, Krystel.Castillo@utsa.edu

1 - An Integrated Biofuel Supply Chain Design Stochastic Model Including Biomass Quality Variability

Krystel Castillo, Greenstar Assistant Professor In Energy, The University of Texas at San Antonio, One UTSA Circle, San Antonio, TX, 78249, United States of America, Krystel.Castillo@utsa.edu, Milad Taherkhorsandi, Sandra Eksioglu

Industry maturity for advanced biofuels supply chains (SCs) faces two main challenges: (1) quantifying and controlling biomass quality variability and (2) moving from local to large-scale SCs to satisfy a nationwide demand. We develop a two-stage stochastic model to (1) better represent the random nature of the biomass quality and technology breakthroughs, and (2) assess the impact of these uncertainties on the SC design and planning. We propose an L-shaped and a multicut L-shaped method.

2 - Analyzing the Impact of Flexible Tax Credit Schemes on Biomass Co-firing in Coal-fired Power Plants

Sandra Eksioglu, Clemson University, 134 Freeman Hall, Clemson, SC, 29634, United States of America, seksiog@clemson.edu, Hadi Karimi

We investigate the impact of flexible tax credit schemes on biomass co-firing. We propose mixed-integer programs to model and compare three schemes: (a) a flat rate tax credit per kwh of renewable energy; (b) a flexible tax rate that changes with plant capacity; (c) a flexible tax rate that is a function of the amount of renewable energy produced. We propose a Benders decomposition algorithm to solve the problems; develop a case study; and derive observations based on numerical results.

3 - An Agent-based Model for Farmers Behavior and Biomass Supply Analysis

Shiyang Huang, Iowa State University, 0076 Black Engineering, Ames, IA, 50011, United States of America, shuang@iastate.edu, Guiping Hu

We build an agent-based simulation model (ABM) with a focus on the farmers' decision making in the biofuel supply chain. The farmers face the planting decision between conventional crops and dedicated energy crops. The ABM model was implemented in AnyLogic and a case study in Iowa was conducted.

WB62

62-Room 112A, CC

Computational Advances in Power System Modeling

Cluster: Energy Systems: Design, Operation, Reliability and Maintenance

Invited Session

Chair: Ben Knueven, University of Tennessee, 519 John Tickle Building, Knoxville, TN, 37996, United States of America, bknueven@utk.edu

1 - Tight and Compact Formulation for a Single Generator in Unit Commitment

Ben Knueven, University of Tennessee, 519 John Tickle Building, Knoxville, 37996, United States of America, bknueven@utk.edu, Bernard Knueven, Jianhui Wang

In this presentation, we will show that there exists a tight and compact formulation for a single generator's operating schedule. While this formulation may not be computationally effective, it does motivate a new (loose) formulation for the unit commitment problem. Computational experiments seem to indicate the the new formulation can offer significant computational savings over traditional formulations.

2 - Modeling Flexibility Investment Decisions in a Regionally-focused Capacity Expansion Model

Elaine Hale, Senior Engineer, National Renewable Energy Laboratory, 15013 Denver West Parkway, MS RSF300, Golden, CO, 80401, United States of America, Elaine.Hale@nrel.gov, Trieu Mai, Clayton Barrows, Anthony Lopez

The Resource Planning Model (RPM) is a capacity expansion model (CEM) structured around a nodal focus region and a zonal representation of the remainder of the interconnect. This paper gives an overview of RPM, including a brief discussion of its use in analysis projects to date, and then provides detail on recent work aimed at modeling flexibility investment decisions. This will necessarily include a discussion of how to capture system flexibility needs in CEMs with coarse temporal resolution.

3 - Interior Point Schemes for Unit Commitment

Wendian Wan, The Pennsylvania State University, 351 Leonhard Building, University Park, PA, 16801, United States of America, wzw121@psu.edu, Uday Shanbhag

This paper presents a two-phase interior-point method solving unit commitment problems. We examine the scalability of the scheme and compare its performance with solutions from commercial solvers.

WB63

63-Room 112B, CC

Operations Management IV

Contributed Session

Chair: Suzanne De Treville, Professor, University of Lausanne, Faculty of Business and Economics, Anthropole 3073, Lausanne, VD, 1015, Switzerland, suzanne.detreville@unil.ch

1 - Supply Contracts Design in Decentralized Assembly Systems with Asymmetric Information

Yanfei Lan, Tianjin University, College of Management and Economics, Tianjin, China, lanyf@tju.edu.cn, Xiaoqiang Cai, Lianmin Zhang

This paper studies a supply contracts design problem, in which two heterogeneous suppliers produce complement products and deliver to the assembler, of which one is more reliable and the other is less reliable. In order to elicit the assembler's truthful report of private information, the two suppliers offer a contract to the assembler, respectively. We study the cases that either supplier moves first, as well as they move simultaneously under symmetric and asymmetric information, respectively.

2 - Planning of Container Movement by Trucks in Metropolitan Area

Samaneh Shiri, PhD Candidate, University of South Carolina,
Department of Civil and Environmental Eng, 300 Main Street,
Columbia, SC, 29208, United States of America,
samashiri@gmail.com, Nathan Huynh

To lower operation time of the drayage problem, the empty container and chassis allocation, and vehicle routing problem need to be coordinated. Most studies have considered these operations individually. In this work drayage firms hire owner-operators and should find the optimal tours for their own trucks and the owner-operators. A mathematical model is developed as an extension of the multiple traveling salesman problem with time windows that jointly schedules these operations.

3 - Using a Volatility Portfolio to Create Value

Suzanne De Treville, Professor, University of Lausanne, Faculty of
Business and Economics, Anthropole 3073, Lausanne, VD, 1015,
Switzerland, suzanne.detreville@unil.ch, Kyle Cattani

Quantitative finance tools allow us to price demand-volatility exposure: The volatility-exposure cost justifies local production. We demonstrate that a volatility portfolio combining time sensitive and time-insensitive products will outperform production of the high volatility product alone. The resulting strengthens the case for local manufacturing in a developed economy, and encourages innovation.

■ WB64

64-Room 113A, CC

Teaching Methods for Decision Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Richard McGrath, Assistant Professor, United States Naval
Academy, 572M Holloway Rd, Annapolis, MD, 21402,
United States of America, rmcgrath@usna.edu

1 - The Use of Prediction Markets in Teaching Decision Analysis

Richard McGrath, Assistant Professor, United States Naval
Academy, 572M Holloway Rd, Annapolis, MD, 21402,
United States of America, rmcgrath@usna.edu

We present an exercise in prediction markets from an introductory Decision Analysis course. For this assignment, students made predictions about the outcome of future uncertain events, and were incentivized both as individuals and as a group to make accurate predictions through the award or loss of class grade points. Events used for this exercise included major sports competitions, Federal Reserve monetary policy actions, class cancellations due to weather, and popular culture awards.

2 - Teaching Decision Making to Teens, to Executives, to the Government and to the Population at Large

Ali Abbas, Professor of Industrial and Systems Engineering and
Public Policy and Director of Create, University of Southern
California, 3710 McClintock Avenue, RTH 314, Los Angeles, CA,
United States of America, aliabbas@price.usc.edu

This talk will reflect on methods of teaching decision analysis that have been used in various settings. The talk will emphasize what works and what does not work for a given audience. Lessons learned and commonalities will also be presented.

■ WB65

65-Room 113B, CC

Decision Making: Tradeoffs, Risk Processing and Altruism

Sponsor: Decision Analysis

Sponsored Session

Chair: Yitong Wang, University of Technology Sydney, UTS Business
School, University of Technology Sydney, Sydney, NS, 2007, Australia,
Yitong.Wang@uts.edu.au

1 - Markov Cost-Effectiveness Analysis for Cancer Treatment

Jiarui Bai, University of California, Irvine, CA, 6464 Adobe Circle,
Irvine, United States of America, jiarub@uci.edu, Robin Keller

We present a way to build a Markov decision tree to model cancer progression and cost-effectiveness analysis for two or more cancer treatments. We propose several problems researchers can encounter in this kind of research and provide possible solutions.

2 - The Existence of Altruistic Value Functions

Jay Simon, American University, jaysimon@american.edu

Altruism is a popular economic and psychological explanation for a wide range of pro-social decisions and actions, and is a descriptively compelling model of behavior. This work provides a theoretical framework for the existence of ordinal and cardinal altruistic value functions based on an altruistic preference relation over a set of outcomes.

3 - Revisiting Risk-as-feelings: Cognitive Processing Style Moderates The Affect Heuristic

Eugene Chan, Lecturer, University of Technology, Sydney,
P.O. Box 123, Broadway, NS, 2008, Australia,
Eugene.Chan@uts.edu.au

People do not solely rely on their rational evaluations about risks, but also their affect-based intuitions. This paper shows that people's cognitive processing style moderates the affect heuristic. The heuristic primarily occurs among visualizers because they mentally picture risks that might ensue, making them perceive risks as more risky. Thus, this paper illuminates how different individuals perceive risks, with implications for risk research, public policy, and decision-making.

4 - An Eye Tracking Study on Decision Making: Information Processing and Reading Habits

Yitong Wang, University of Technology Sydney, UTS Business
School, University of Technology Sydney, Sydney, NS, 2007,
Australia, Yitong.Wang@uts.edu.au, Tianjun Feng,
Antonin Genot, Lei Zhao

We investigate decision makers' information-processing patterns in decisions under risk and over time by using eye-trackers. We find that decision makers employ more alternative-based than attribute-based procedures. In addition, we find that reading habits play an important role in information processing - the results suggest that screen display moderates decision makers' information-processing procedures.

■ WB66

66-Room 113C, CC

Aviation Day of Operations and Air Traffic Optimization

Sponsor: Aviation Applications

Sponsored Session

Chair: Alexandre Jacquillat, PhD Candidate, Massachusetts Institute of
Technology, 77 Massachusetts Avenue, Building E40-240, Cambridge,
MA, 02116, United States of America, alexandre.jacquillat@gmail.com

1 - A Mechanism for the Strategic Reduction of Air Traffic Congestion

Luca Corolli, Università degli Studi di Trieste, Via Valerio 10,
Trieste, 4127, Italy, lcorolli@units.it, Tatjana Bolic,
Lorenzo Castelli, Desirée Rignonat

En route congestion is currently detected on the day of operation of flights. We develop a new strategic mechanism based on integer optimization that seeks to prevent en route congestion through an early redistribution of air traffic. The mechanism assigns flights departure and arrival times and routes, based on airline requests. The benefit of using this mechanism is shown on a real instance with 30,000 European flights that is solved in short computation times.

2 - Design and Simulation of a Pushback Rate Control Policy at Philadelphia International Airport

Patrick McFarlane, Graduate Research Assistant, Massachusetts
Institute of Technology, 77 Massachusetts Avenue, Cambridge,
MA, 02139, United States of America, pmcfar@mit.edu,
Hamsa Balakrishnan

This analysis designs and simulates an airport surface congestion management policy that controls the departure pushback rate at Philadelphia airport. The policy mitigates surface congestion at the airport and results in taxi-out time reductions. The simulations also consider issues such as fairness of allocation, and the impacts of operational constraints such as gate conflicts, that would accompany actual implementation of the proposed policy.

3 - Analysis of Congestion Pricing Model to Handle "Day of Operations" Airport Capacity Reduction

Abdul Qadar Kara, Asst. Professor, King Fahd University of
Petroleum and Minerals, P.O. Box 5067, Dhahran, 31261,
Saudi Arabia, aqkara@kfupm.edu.sa

In my earlier work, a model was built on basic econometric principle of congestion pricing embedded within an optimization model. The model provided a mechanism to manage airport runway capacity reduction. The current work reports further analysis of the model and its response against the multiple unscheduled changes in capacity of the runway at different times on day of operation.

4 - The Flight Trajectory Optimization Problem

Marco Blanco, Zuse Institute Berlin, Takustr. 7, Berlin, 14195, Germany, blanco@zib.de, Ralf Borndürfer, Nam Dung Hoang, Thomas Schlechte

We study the problem of computing an optimal flight trajectory on the airway network. The goal is to minimize fuel- and overfly costs while considering weather forecasts and operative constraints. While the problem is NP-hard even in simplified versions, very fast algorithms are required in practice. We present a new solution approach that combines classical shortest-path algorithms with techniques for non-linear pseudo-boolean optimization. We also show computational results on real-world data.

■ WB67

67-Room 201A, CC

Ocean Container Transport Logistics

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Chung-Yee Lee, Chair Professor, HKUST, Dept. of IELM, Clear Water Bay, Kowloon, Hong Kong - PRC, cylee@ust.hk

1 - Coordinating Pricing and Empty Container Repositioning: An Analysis of Two-depot Shipping Systems

Tao Lu, Hong Kong University of Science & Technology, Clear Water Bay, Kowloon, Hong Kong, Hong Kong - PRC, tluaa@ust.hk, Chung-Yee Lee, Loo Hay Lee

This paper analyzes the joint decision of pricing and empty container repositioning in a two-depot shipping service. Demands (in both directions) are stochastic and dependent on the freight prices being charged. We formulate the problem as a Markov decision process with a three-dimensional state space. While challenging, we prove the L-natural-concavity of value functions, thereby characterizing the structure of optimal policies.

2 - Pricing and Competition in a Shipping Market with Waste Shipments and Empty Container Repositioning

Rongying Chen, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, Hong Kong - PRC, rchenac@connect.ust.hk, Chung-Yee Lee, Jing-xin Dong

We study a shipping market with carriers providing service between two locations. Shipments are classified into two categories: goods and waste. Trade imbalance allows low-valued waste to be shipped at bargain rates. If imbalance persists, empty containers must be repositioned. We build a monopoly and a duopoly model to find the optimal pricing strategy for carriers. We also analyze how the profit of a carrier is affected by potential imbalance, cost structure and competition intensity.

3 - The Time Value of Containerized Cargoes

Shuaian Wang, Old Dominion University, 2147 Constant Hall, IT/Decision Sciences, Old Dominion University, Norfolk, VA, 23529, United States of America, wangshuaian@gmail.com, Xiaobo Qu, Ying Yang

We propose a novel method for estimating the perceived value of transit time of containers by shipping lines. The key idea is that a shipping line's published schedule is the optimal decision that minimizes the sum of fuel cost and time-associated costs of the containers adopted by the shipping line. We estimated the adopted values of transit time for nine trans-Pacific services operated by Orient Overseas Container Line and five trans-Pacific services operated by Maersk Line.

4 - An Economic Evaluation of CO2 Emissions Reductions from Marine Transportation of LNG

Shigwki Toriumi, Associate Professor, Chuo University, 1-23-27 Kasuga, Bunkyo-ku, Tokyo, 112-8551, Japan, toriumi@ise.chuo-u.ac.jp, Ryuta Takashima

This study evaluates relation between transportation cost and reduction of CO2 emissions from marine transportation of LNG. We compare three patterns: (1) a regulation based on the current speed; (2) a regulation based on the optimum speed for minimal CO2 emissions; and (3) the speed for minimal cost with internalized CO2 emissions cost. This study is characterized by using vessel movement database and the sea lane network. Therefore we can estimate spatial distribution of the CO2 emissions.

5 - The Extended Gate Problem: Intermodal Hub Location with Multiple Actors

Yann Bouchery, Ecole de Management de Normandie, 30 Rue de Richelieu, Le Havre, 76087, France, ybouchery@em-normandie.fr, Jan Fransoo, Marco Slikker

Deep-sea terminal operators are looking for solutions to improve their container handling operations. They start opening extended gates, i.e., inland hubs connected by rail to the deep-sea terminal. Intermodal hub location problems are usually solved by considering a single decision maker even though several actors often interact in practice. We analyze here the impact of having multiple actors involved by proposing a formulation of the extended gate location problem based on game theory.

■ WB68

68-Room 201B, CC

Production and Distribution Systems

Sponsor: Transportation, Science and Logistics

Sponsored Session

Chair: Deniz Tursun, Postdoctoral Research Associate, University of Illinois, Urbana Champaign, 3308 Sharp Drive, Champaign, IL, 61822, United States of America, utursu2@illinois.edu

1 - Determining Transportation Mode Choice to Minimize Distribution Cost

Luca Bertazzi, Associate Professor, University of Brescia, Via Santa Chiara, Brescia, Italy, luca.bertazzi@unibs.it, Jeffrey Ohlmann

We consider a problem in which a supplier must determine the transportation mode for product deliveries to satisfy demand from a set of retailers. Four transportation modes are available: Direct Shipping, Transit Point, 2-Routing and Routing. We provide the tight worst-case performance bound for each couple of transportation modes and we compare their performance in a set of instances generated on the basis of a real case.

2 - Robust Grain Supply Chain Design Considering Post-Harvest Loss and Harvest Time Equilibrium

Kun An, University of Illinois, Champaign, IL, United States of America, ankun@illinois.edu, Yanfeng Ouyang

This paper presents a robust location model, where a food company maximizes its profit by optimally deploying grain processing/storage facilities, while non-cooperative and risk-averse/seeking farmers determine harvest time, shipment, storage, and market decisions under yield uncertainty. Solution methods and numerical examples are also presented.

3 - Stochastic Mixed Integer Convex Minimization Algorithm for Robust Production-Distribution Systems

Deniz Tursun, Postdoctoral Research Associate, University of Illinois Urbana Champaign, 3308 Sharp Drive, Champaign, IL, 61822, United States of America, utursu2@illinois.edu, Nagi Rakesh

Robust supply chain design and operation under uncertainty problems lead to confluence of integer and continuous variables, which call for Mixed-Integer Nonlinear Programming algorithms. We consider a comprehensive random projection algorithm for a subclass of MINLPs, where the objective and constraints are defined by convex functions and integrality restrictions are imposed on a subset of the decision variables. A stochastic convex random projection optimality algorithm for lower bound solution and a stochastic random projection feasibility algorithm for upper bound solution are used in succession converging to the solution set almost surely. We aim to solve a class of robust integrated supply chain network design problems with multiple echelons where uncertain demand leads to random constraints and objective coefficients.

4 - A Bayesian Network Model for Supplier Evaluation

Seyedmohsen Hosseini, University of Oklahoma, 202 W. Boyd St, Norman, OK, 73071, United States of America, m.hosseini@ou.edu, Kash Barker

The selection of suppliers is a multi-criteria decision making problem that includes both tangible and intangible factors. This work presents a novel Bayesian network model that embeds both qualitative and quantitative evaluation factors within a graphical framework. Emphasis is given to supplier resilience in the supplier selection problem, in addition to other supplier characteristics.

■ **WB69**

69-Room 201C, CC

ITS in Public Transportation

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Co-Chair: Alireza Khani, Assistant Professor, University of Minnesota, United States of America, akhani@umn.edu

1 - Vehicle-Sharing Network Design and its Integration with Public Transportation ServicesTianli Zhou, Massachusetts Institute of Technology, Cambridge, MA, United States of America, tzhou90@mit.edu,
Virot Chiraphadhanakul, Cynthia Barnhart, Carolina Osorio

We consider the design of a one-way vehicle sharing (VS) system, such that it is complementary with an existing public transportation system. We propose a two-stage MIP formulation to address a VS network design problem. We consider a large-scale case study of the metropolitan area of Boston. To solve the model, we decompose it and develop a cut generation method. We present numerical results for the Boston case study.

2 - A Location and Scheduling Model for a Flexible Intercity Transit Service

Andisheh Ranjbari, University of Arizona, Tucson, AZ, United States of America, aranjbari@email.arizona.edu, Mark Hickman, Yi-Chang Chiu

"Flexpress" is a high-speed intercity bus transit service that has several terminal locations in the urban area and a dynamic schedule. Travelers have the choice to board/alight the vehicle at one of the designated terminals, or pay a premium cost and ask for a door-to-door service. This presentation focuses on the mathematical model for the terminal location and scheduling problems.

3 - Transit Passenger Flow Prediction under Event Occurrences with Social Media Data

Ming Ni, SUNY Buffalo, 326 Bell Hall, University at Buffalo, Amherst, NY, 14260, United States of America, mingni@buffalo.edu, Jing Gao, Qing He

Frist, we propose a hashtag-based method to identify events near NYC subway stations based on tweets data. Second, the relationship between social activities and subway passenger flow is unveiled. Third, a convex optimization based model is developed to predict subway volume with social media data.

4 - Reliable Routing in Schedule-based Transit Networks with Stochastic Travel Times

Alireza Khani, Assistant Professor, University of Minnesota, United States of America, akhani@umn.edu, Stephen Boyles

In schedule-based transit networks where service is time-dependent and stochastic, risk-averse users try to minimize the expected travel time as well as to maximize the chance of arriving on-time. The latter objective is modeled by transfer failure probability and path algorithms are developed to find the most reliable paths.

■ **WB70**

70-Room 202A, CC

Vehicle Routing I

Contributed Session

Chair: Sadegh Mirshekarian, PhD Student, Ohio University, 285 Stocker Center, Athens, OH, 45701, United States of America, sm774113@ohio.edu

1 - Branch-and-cut Algorithms for the Time Constrained Covering Salesman Problem

Gizem Ozbaygin, PhD Candidate, Bilkent University, Department of Industrial Engineering, Ankara, Turkey, ozbaygin@bilkent.edu.tr, Hande Yaman, Oya E. Karasan

In this study, we consider the time constrained maximal covering salesman problem which is a generalization of the orienteering problem. We propose a mathematical formulation, valid inequalities and branch-and-cut algorithms for the problem. We test our approaches on several instances we generated based on some existing VRP instances and report the results of our computational study.

2 - A Fuzzy Vehicle Routing Problem with Time Windows under Driving and Working Time Restrictions

Can Celikbilek, Ohio University, Industrial & Systems Engineering, Athens, OH, United States of America, cc340609@ohio.edu, Gursel Suer

A new Fuzzy mathematical model is developed to maximize the total profit of the system while minimizing the total traveled distance. The developed mathematical model is tested considering real driving, service and working time restrictions. A single depot and multiple customers with their working time windows are considered with identical set of vehicles. The developed fuzzy mixed integer mathematical model provided promising solutions to provide insights to real industry problem.

3 - Time Dependent Vehicle Routing Problem Solving Based on Speed Profiles and Speed Drop Coefficients

Martina Ravlic, Faculty of Transport and Traffic Sciences, University of Zagreb, Vukeliceva 4, Zagreb, Croatia, mravlic@fpz.hr, Tomislav Erdelic, Tonci Caric

The vehicle routing problem in real cases can be solved by applying a TDVRP algorithm. We compared two existing methods for determining the minimum travel time in TDVRP algorithm: the first method uses speed profiles of traversed links, while the other uses speed drop coefficients on a wider road network area. We analyzed the relationship between the execution times, depending on the size of the problem, and the computed minimum travel times with measured times.

4 - A Vehicle Routing Problem with Budget and Time Constraints

Elham Kookhahi, Wichita State University, 1845 Fairmount Street, Wichita, KS, 67260, United States of America, exkookhahi@wichita.edu, Bayram Yildirim

In this paper, a mathematical model is presented for a vehicle routing problem in which a sub tour of cities can be visited to maximize the number of served customers with a limited budget and time. The problem is solved using a genetic algorithm and numerical results are presented.

5 - A Generalized Single-Depot Vehicle Routing Problem with Time Windows and Non-Identical Vehicles

Sadegh Mirshekarian, PhD Student, Ohio University, 285 Stocker Center, Athens, OH, 45701, United States of America, sm774113@ohio.edu, Gursel Suer, Can Celikbilek

A generalized variant of VRP with time windows is studied, considering vehicles different in capacity, cost and speed. Vehicles can be used for more than one route, but are subject to driving and working time constraints. A new genetic algorithm with specialized crossover and mutation operators is developed and used to solve the problem, and results are compared with a math model and with state-of-the-art. The developed GA performed well in terms of solution quality and convergence speed.

■ **WB71**

71-Room 202B, CC

Transportation Operations I

Contributed Session

Chair: Yi Liao, Southwestern University of Finance and Economics, Liutai Ave 555, School of Business Administration, Chengdu, China, yiliao@swufe.edu.cn

1 - Conflict Prevention and Detection for Autonomous and Connected Vehicles

Xin Chen, Assistant Professor, Southern Illinois University, P.O. Box 1805, Edwardsville, IL, 62034, United States of America, xchen@siue.edu, Shimon Y. Nof

An autonomous vehicle is capable of sensing its environment and navigating without human input. Conflicts between vehicles and between vehicles and transportation infrastructure are unavoidable. In this research, the authors develop a common language structure to represent domain knowledge in autonomous vehicles and apply algorithms and protocols to detect and prevent conflicts.

2 - Effective Vehicle Identification and Authentication Mechanism for Intelligent Transportation System

Joonsang Baek, Khalifa University, Al Saada St. and Muroor Rd., Abu Dhabi, United Arab Emirates, joon.baek@kustar.ac.ae, Young-ji Byon

Inspired by Internet of Things (IoT), it is possible to develop an identification mechanism for ITS, which is based on the unique vehicle identification number (VIN). Such identification mechanism would provide a certain level of privacy, which will assist traffic monitoring without compromising drivers' identities by utilizing a strong authentication mechanism based on message authentication codes.

3 - Modeling Location Diffusion, Resource Allocation and Rebalance in Car Sharing Industry-a Zipcar Exam

Wei Chen, Assistant Professor, York College of Pennsylvania,
441 Country Club Rd, York, PA, 17403, United States of America,
wchen@ycp.edu

In this study, we build two novel models to tackle three car-sharing management questions: 1). Car Station Location Selection; 2). Car Station Size problem; and 3). Car Relocation Numbers. Our models require less inputs and offer a quick analytic result to answer three operational issues. Particularly, we use Zipcar as an example to illustrate how our models work, it turns out that our models can perform well and achieve expectations.

4 - Routing Decision Strategy and Resource Allocation Planning for a Two-Echelon Rescue Delivery System

Yi Liao, Southwestern University of Finance and Economics,
Liutai Ave 555, School of Business Administration, Chengdu,
China, yiliao@swufe.edu.cn, Hanpeng Zhang

One of the most important post-catastrophe goals is the effective and efficient allocation of rescue resources. We consider the combined problem of allocating rescue resources between two main warehouses and planning their delivery strategies to several local distribution centers. We suggest three routing strategies-simple, mixed and dynamic mixed-and analyze the effects that different routing strategies have on rescue resource allocation and relief performance.

■ WB72

72-Room 203A, CC

Omni-channel Commerce and Analytics

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Dahai Xing, Research Staff Member, IBM Research,
1101 Route 134 Kitchawan Rd, Yorktown Heights, NY, 10598,
United States of America, dxing@us.ibm.com

1 - Demand Modeling in the Presence of Unobserved Lost Sales

Shivaram Subramanian, IBM Research, 1101 Kitchawan Road,
Yorktown Heights, NY, 10598, United States of America,
subshiva@us.ibm.com, Pavithra Harsha

We present an integrated optimization approach to parameter estimation and missing data imputation for calibrating discrete choice demand models where one or more choice alternatives are censored. We jointly determine the prediction parameters associated with the customer arrival rate, as well as their preferences in an assortment. We share experimental results for instances arising in a variety of industrial settings. The results achieved indicate the efficacy of the proposed methods.

2 - Big Data Solutions for Omni-channel Fulfillment Planning and Optimization

Ajay Deshpande, Research Staff Member, IBM Research, 1101
Route 134 Kitchawan Rd, Yorktown Heights, NY, 10598, United
States of America, ajayd@us.ibm.com, Yingjie Li, Dahai Xing,
Brian Quanz, Arun Hampapur, Ali Koc, Xuan Liu

Retailers look to leverage their store networks to fulfill omni-channel demand. Our research efforts focus on developing two Big Data solutions. The Network Planner provides rapid what-if analysis to find the most effective fulfillment plan. The Optimizer dynamically optimizes sourcing of online orders while balancing conflicting business goals.

3 - How Can Manufacturers Help Brick-and-mortar Stores Fight with "Showrooming"?

Dahai Xing, Research Staff Member, IBM Research,
1101 Route 134 Kitchawan Rd, Yorktown Heights, NY, 10598,
United States of America, dxing@us.ibm.com, Tieming Liu

We study a supply chain in which an online retailer free-rides a brick-and-mortar retailer's sales effort. The free riding effect reduces brick-and-mortar retailer's desired effort level, thus hurts the overall supply chain performance. We examine the selective rebate contract with price match in two scenarios: the online channel is owned by or independent of the manufacturer. We show that the contract can allocate the supply chain system profits arbitrarily between the players.

■ WB73

73-Room 203B, CC

Bayesian Data Analytics for Quality and Reliability Assurance

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Mingyang Li, Assistant Professor, University of South Florida,
4202 East Fowler Avenue, Tampa, United States of America,
mingyangli@usf.edu

1 - Density Estimation with Indirect Data

Park Chiwoo, Assistant Professor, FAMU-FSU College of
Engineering, 2525 Pottsdamer Street, Tallahassee, FL, 32310,
United States of America, cpark5@fsu.edu, Xin Li

We present a general problem of estimating a probability density of a random variable when there are only observations of other random variables that are correlated to the random of interest. The application of the approach to estimating particle size distribution with dynamic light scattering and/or small X-ray scattering data will be also presented.

2 - Bayesian Hazard Modeling of Heterogeneous Lifetime Data with an Unknown Number of Sub-populations

Mingyang Li, Assistant Professor, University of South Florida,
4202 East Fowler Avenue, Tampa, FL, United States of America,
mingyangli@usf.edu, Jian Liu

Lifetime data collected from reliability tests or field operations often exhibit heterogeneity. To quantify such heterogeneous data with an unknown number of sub-populations, a Bayesian hazard modeling approach is proposed. It features in jointly estimating model parameters and determining the number of sub-populations. Effective and efficient sampling schemes are further developed to comprehensively address the model estimation difficulty when non-conjugate priors involve.

3 - A Semi-markov Random Field Gaussian Process Models for Forecasting in Complex Systems

Zimo Wang, Texas A&M University, 3131 TAMU,
College Station, TX, United States of America,
zimowang@tamu.edu

We introduce a Semi-Markov random field approach to extend Gaussian process models for multi-step forecasting in complex systems with transient behaviors. Experimental studies indicate that forecasting approach can predict the onsets of epilepsy episodes 1 min earlier compared to other contemporary methods tested.

4 - Real-time Monitoring for Advanced Manufacturing Processes using a Novel Greedy Bayesian Method

Kaveh Bastani, Research Assistant, Virginia Tech University,
106 Durham Hall (MC 0118) 1145 Perry Str, Blacksburg, VA,
United States of America, kaveh@vt.edu, Zhenyu Kong

The objective of this work is to realize real-time monitoring of process conditions in advanced manufacturing processes. To achieve this objective we propose an approach invoking the concept of sparse representation for multiple sensor signals, and subsequently, develop a novel greedy Bayesian method (GBM) to approximate the sparse solution. We validate the effectiveness of the proposed approach in real-time monitoring of a fused filament fabrication additive manufacturing process.

■ WB74

74-Room 204A, CC

Reliability I

Contributed Session

Chair: Shufeng LI, University of Houston, Room NT0403, 4401
Wheeler, Houston, TX, 77004, United States of America, sli33@uh.edu

1 - Maintenance Policies for a Deteriorating System Subject to Non-self-announcing Failures

Onur Bakir, Associate Professor, Istanbul kemerburgaz University,
Mahmutbey Dilmenler Caddesi, No:26, Bagcilar, Istanbul, 34217,
Turkey, onur.bakir@kemerburgaz.edu.tr

We evaluate various maintenance policies for systems subject to continuous time Markovian deterioration which may result in non-selfannouncing failures. The decision maker inspects the system periodically at the decision epochs, identifies the current state; and chooses an available action. The objective is to minimize the expected long-run cost rate. We provide a numerical example to analyze the effect of various cost parameters on the optimum inspection period and policy.

2 - Stochastic Modeling and Reliability Analysis of Corroded Pipelines for Inspection Planning

Seyedeh Azadeh Miran, Research Assistant Graduate Student, University of Akron, 302 East Buchtel Avenue, ASEC405, Akron, OH, 44325, United States of America, sm214@zips.uakron.edu, Qindan Huang

Time-dependent reliability analysis of inspected defects is performed using first order reliability method based on two failure modes (small and large leaks). Time-dependent corrosion growth models are considered for the defect depth and length where growth model unknown parameters are determined using Bayesian updating through MCMC. Finally, inspection planning is proposed.

3 - Information Source Selection for Multimode Process Monitoring

Marcelo Bacher, PhD Candidate, Tel Aviv University, Ramat Aviv, Tel Aviv, Israel, mgbacher@post.tau.ac.il, Irad Ben-Gal

We present an SPC framework using Information Theoretic measurements for monitoring multi-mode systems. We aim at directly learning the data dependencies representing the modes without relying on prior information. We assume dependence among features and that the data gathered from multiple sensors generate overlapping clusters that are not necessarily Gaussian-like distributed. Comparative results with real data validate the potential use of the proposed method for monitoring such systems.

4 - Battery Life Estimation Based on Statistical Model Combined with Physical Degradation Behaviors

Shufeng Li, University of Houston, Room NT0403, 4401 Wheeler, Houston, TX, 77004, United States of America, sli33@uh.edu, Qianmei Feng, Yin Shu

Remaining useful life prediction methods have been widely applied for lithium ion batteries in the electronics and automotive industries. Statistical models based on physical degradation behaviors of lithium ion batteries have not been well established. This paper develops a statistical method to model the battery performance degradation that is induced by aging mechanism. The life distribution is estimated and case study shows the effectiveness of the proposed method.

■ WB76

76-Room 204C, CC

Simulation II

Contributed Session

Chair: Bharat Bhole, RIT, 92 Lomb Memorial Drive, Rochester, NY, 14623, United States of America, bharat.bhole@rit.edu

1 - Investigation of the Existence of AFIB Sources in Left Atria of Heart using Intracardiac Electrogram

Sharmin Mithy, Graduate Research Assistant, University of South Florida, 4202 E Fowler Ave, Tampa, FL, 33620, United States of America, sharminmithy@mail.usf.edu

This paper concentrates on a way to investigate the existence of AF sources by analyzing Intracardiac Electrogram. Intracardiac Electrogram has been recorded during catheter ablation surgeries of five patients and can be characterized by identifying different properties; i.e. cycle length, interspike interval distance, amplitude. In this paper different features has been extracted from intracardiac electrogram from different sets of patients and later analyzed to identify different patterns.

2 - A System Dynamics Approach to Study the Barriers to Primary Care Access for Socioeconomically Disadvantaged Women

Fatima Irshaidat, Binghamton University, 25 Narwood St, Johnson City, NY, 13790, United States of America, firshai1@binghamton.edu

Socioeconomically disadvantaged women have more capabilities to visit PCP after Medicaid Expansion. This study evaluates whether Medicaid expansion is actually improving access of care for these women in the poor neighborhoods & identify the actual barriers preventing those women from utilizing primary care. A systems dynamics model is created using Vensim to capture causes behind access barriers to PCP. The case of breast and cervical cancer screenings is specifically studied.

3 - Using Multi-agent-based Simulation to Model Pedestrians Behavior and Interactions

Lindsay Alvarez, Full Professor, Universidad Distrital, Carrera 7 No. 40B - 53 Piso 5, Ingenieria Industrial, Bogota, Colombia, lindsayalvarez@yahoo.com, Martha Centeno, Felipe Pacheco, Andrés Sánchez

We present a methodology to use Multi-Agent Based simulation as a tool to model pedestrians as independently thinking individuals, who move at their own speed, and may or may not abide by spatial restrictions. We have conducted fieldwork in Bogotá, developed a methodology, and built simulation models. Results indicate that these type of simulation models are effective to model pedestrian's behavior, so that it can be included in the design and construction of pedestrian's tunnels and crosswalks.

4 - A Simulation Approach for Trading Natural Gas Futures

Amine Kamali, The University of Oklahoma, 202 W. Boyd St., Room 436, Norman, OK, 73019, United States of America, amine@ou.edu, Hank Grant

This research focuses on developing a simulation framework that models the impact of speed of high-frequency traders trading natural gas futures contracts. Different scenarios are simulated and the data collected are compared to historical data. In this setting, faster traders are more profitable.

5 - The Effect of Self-selection Bias on the Effectiveness of Online Reviews

Bharat Bhole, RIT, 92 Lomb Memorial Drive, Rochester, NY, 14623, United States of America, bharat.bhole@rit.edu, Brid Hanna

It has been shown that online reviews suffer from self-selection bias. We investigate whether this bias adversely affects the effectiveness of online reviews. Effectiveness is measured by the market share of the higher quality product in a model with two products. We show that bias can improve the effectiveness of reviews. Further, in situations where it fails to do so, it is mostly when the bias is extreme to the extent that appears unlikely to be the case in reality.

■ WB77

77-Room 300, CC

Supply Chain Closed Loop II

Contributed Session

Chair: Yertai Tanai, Kent State University, Department of Management & Information S, Kent State University, Kent, OH, 44242-0001, United States of America, ytanai@kent.edu

1 - Quality and Information Coordination for False Failure Returns

Eylem Koca, Assistant Professor, Ozyegin University, Nisantepi District, Orman Street, Cekmekoy, Istanbul, 34794, Turkey, eylemkoca@gmail.com

A significant portion of consumer returns are false failures with no defects. We consider a supply chain setting with one manufacturer, who decides on the design quality, and one retailer, who decides on informational efforts, both of which affect the false failure returns, and we study supply chain coordination avenues under various scenarios regarding the re-valuation of such returns.

2 - Optimal Incentive and Production Decisions for an Integrated-forward Reverse Supply Chain

Pankaj Dutta, Associate Professor, IITBombay, SJM School of Management, Powai, Mumbai, 400076, India, pdutta@som.iitb.ac.in, Debabrata Das

This paper proposes an optimization model for an integrated forward-reverse supply chain to determine optimum incentive amount that needs to be offered to consumers on returning back a used product. Further, proposed model decides optimum manufacturing, remanufacturing and disposal quantity so that legislation criterion of minimum collection is fulfilled and overall profit of integrated system is maximized. Necessary conditions for the concavity of the proposed profit function are also derived.

3 - Coordinating Supply Chain for Consumers Returns

Yertai Tanai, Kent State University, Department of Management & Information S, Kent State University, Kent, OH, 44242-0001, United States of America, ytanai@kent.edu, Emmanuel Dechenaux, Alfred Guiffreda, Eddy Patuwo

Given the complex nature of processing returned products in a supply chain, firms have adopted the strategy of outsourcing the returns handling to third party reverse logistics providers (3PRLP). We consider a supply chain design where multiple 3PRLP's compete to process the returns. We formulate Nash equilibrium game among 3PRLP's

■ WB78

78-Room 301, CC

Natural Resources

Contributed Session

Chair: Wanshan Zhu, Associate Professor, Tsinghua University, Shunde Building 613,, Depart of Industrial Engineering, Beijing, 100084, China, zhuws@tsinghua.edu.cn

1 - A Model to Assess the Impact of Overemployment and Subsidized Fuel Price on National Oil Companies

Sergio Cabrales, Visiting Professor, Universidad de los Andes, Carrera 53A No 127 -30 apt:1204, Bogota, DC, 0111111, Colombia, s-cabral@uniandes.edu.co, Juan Banavides, Rafael Bautista

National Oil Companies (NOCs) produce 61% of worldwide oil. International Oil Companies (IOCs) maximize the expected net present value of their profits, whereas for NOCs are not necessarily the only objective. Indeed, NOCs' objectives often include non-commercial goals such as employment and fuel subsidies. We develop an optimal control model to estimate the impact of overemployment and fuel subsidies in terms of market value, production, and reinvestment.

2 - Strategic Bidding for a Virtual Power Plant: A Price-taker Robust Optimization Approach

Luis Baringo, Assistant Professor, University of Castilla-La Mancha, E.T.S.I.Industriales, Avda. Camilo Jose Cela s/n, Ciudad Real, 13071, Spain, Luis.Baringo@uclm.es, Morteza Rahimiyan

We consider an energy management system that controls a cluster of price-responsive demands, a wind-power plant and an energy storage facility that are interconnected within a small size electric energy system and that constitute a virtual power plant (VPP). We propose a two-stage robust optimization approach for the strategic bidding of this VPP in the day-ahead and the real-time markets. Uncertainties in wind-power production and market prices are represented through confidence bounds.

3 - Faustmann Revisited and Updated with Modern Operations Research Tools

Gysbert Wessels, Consultant, 3748 Bay Tree Pl, Blacksburg, VA, United States of America, wessels.gys@gmail.com

Faustmann's article published in 1849 remains an important contribution to Forestry Economics and Management. What if Faustmann had access to the current tools of OR/MS? The presentation will show how "Faustmann's Formulae" can be updated and generalized. It will be shown that Faustmann's calculations and the generalized approach give the same results under Faustmann's assumptions. Many of the assumptions can be relaxed, making the generalized approach practical to use in modern forestry.

4 - Stackelberg vs Cournot in a Natural Resource Oligopoly

Luca Colombo, Deakin University, Burwood Campus, 221 Burwood Highway, Melbourne, Australia, luca.colombo@deakin.edu.au, Paola Labrecciosa

In this paper, we compare and contrast feedback Nash and Stackelberg equilibrium strategies in a differential oligopoly game in which production requires exploitation of a common-property renewable resource. We find that the incentives for firms to take the lead are higher the higher the stock of the resource. We also find that the Cournot equilibrium can be more efficient than the Stackelberg equilibrium, both in the short-run and at the stationary equilibrium.

5 - Electricity Capacity Planning with Cross Border Exchange

Wanshan Zhu, Associate Professor, Tsinghua University, Shunde Building 613,, Depart of Industrial Engineering, Beijing, 100084, China, zhuws@tsinghua.edu.cn

This paper studies the impact of cross border maximum exchange capacity on the optimal electricity generation capacity mix. We show that models with exogenous spot prices miss the influence of capacity expansion decisions on the market, and suggests a model where spot prices are endogenous, as a function of demand and available capacity. A case study in France with the EPEX Spot prices is made.

■ WB79

79-Room 302, CC

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - FICO – Turnkey Optimization on the Cloud

Oliver Bastert, Ph.D., FICO, oliver.bastert@fico.com

In this workshop, we will demonstrate enhancements for modeling and solving linear, mixed integer and nonlinear optimization problems using the latest release of FICO® Xpress version 7.9. We will show how to rapidly turn optimization models into collaborative applications deployed on the FICO® Analytic Cloud. Also, learn how these capabilities can be combined with analytic modeling and decision rules to deliver powerful cloud-based or on-premises decision management solutions via the FICO® Decision Management Suite.

2 - IBM Academic Initiative Group - IBM Academic Initiative for Cloud...Building Next-generation Skills

IBM Academic Initiative Group

Digital transformations are requiring students, no matter what their major, understand how to leverage and build solutions on the cloud. With the new Academic Initiative for Cloud offer, faculty and students can have hands-on cloud-based experiences to propel radical ideas and innovation using IBM Watson, Internet of Things, big data, analytics, mobile and more. Join us to collaborate on best practices to empower innovation in the classroom and beyond! <http://ibm.biz/aiforcloud>.

Wednesday, 12:45pm - 2:15pm

■ WC01

01-Room 301, Marriott

Military Cognitive Analysis, Value based Acquisition and Military Recruiting Prediction Models

Sponsor: Military Applications

Sponsored Session

Chair: Mike Teter, Lt, US Army, 515 Michelson Rd, Monterey, CA, 93940, United States of America, Michael.d.teter6.mil@mail.mil

1 - Predicting Market Depth for Military Recruiting

Jon Alt, Assistant Professor, Naval Postgraduate School, Department of Operations Research, Naval Postgraduate School, Monterey, CA, 93943, United States of America, jkalt@nps.edu, Sam Buttrey

This ongoing research demonstrates the application of statistics and machine learning to identify those geographic areas that are more likely to produce military recruits. It also seeks to compare factors influencing service specific market depth. This comparison may inform the development of a common decision support framework. Practical difficulties in preparing and open source data for this purpose are discussed.

2 - Utilizing Socio-economic Factors to Evaluate Recruiting Potential for a US Army Recruiting Company

Sandra Jackson, US Army, Thayer Hall, West Point, United States of America, jackson.sandra.y@gmail.com, Nedialko Dimitrov, Jon Alt

US Army currently calculates recruiting capacity as a four year weighted average of historical data. We investigate two alternate methods for the same task — multiple linear regression (MLR) and Poisson regression (PR). Regression methods can account for the impact of economic factors on recruiting capacity, whereas weighted average methods do not. Surprisingly, we show that MLR models provide better fits than PR models, even though existing literature largely focuses on PR models.

3 - Military Modification of The Iowa Gambling Task and Wisconsin Card Sorting Task

Cardy Moten, Maj, TRADOC Analysis Center-Monterey, 700 Dyer Road, Room 183, Monterey, CA, 93943, United States of America, cmoten@nps.edu, Quinn Kennedy, Jon Alt, Peter Nesbitt

TRAC-Monterey and the Naval Postgraduate School (NPS) have developed tasks to measure military decision-making performance modeled after the Iowa Gambling and Wisconsin Card Sorting Tasks. These tasks focus on high stakes and uncertain environments particular to military decision making conditions. Thirty-four officers were tested on their levels of cognitive flexibility and reinforcement learning. This presentation will discuss task development, validation, and insights of measured components.

■ WC02

02-Room 302, Marriott

Scheduling III

Contributed Session

Chair: Pravin Tambe, Dr., RCOEM, 49, Parate Nagar, Near H.B.Estate, Sonagaon, Nagpur, MS, 440025, India, tambepp@gmail.com

1 - Hybrid Flow Shop Batch Scheduling Problem with a Bi-Criteria Objective

Rasaratnam Logendran, Professor, Oregon State University, School of Mech, Indust, and Mfg. Engr, 204 Rogers Hall, Corvallis, OR, 97331-6001, United States of America, logendrr@engr.orst.edu, Omid Shahvari

We address a batch scheduling problem in hybrid flow shops, wherein one or more stages have unrelated-parallel machines. The objective is to minimize the weighted sum of total weighted completion time and total weighted tardiness. Job release times and machine availability times are assumed to be dynamic. The performance of search algorithms, based on tabu search, is evaluated by developing a mixed-integer linear programming model in order to find the best algorithm, if any, for this problem.

2 - Flowshop Batch Processing Problem with Different Batches on Machines

Nasser Salmasi, Sharif University of Technology, Department of Industrial Engineering,, Sharif University of Technology, Tehran, Te, 11365, Iran, nsalmasi@sharif.edu, Hossein Nick Zinat Matin, Mohsen Varmazyar

We approach the multi-stage flowshop batch processing problem with minimization of makespan. Each batch on each machine has both the maximum number of jobs in each batch and the batch capacity limitations at the same time. The size of batches on machines can be different. The jobs can be assigned to different batches on different stages. We propose a general mathematical model and a metaheuristic algorithm based on particle swarm optimization (PSO) to solve the problem.

3 - Adjustable Robust Optimization for Handling Uncertainty in Process Scheduling

Nikolaos Lappas, Graduate Student, Carnegie Mellon University, DH3122, 5000 Forbes Avenue, Pittsburgh, PA, 15212, United States of America, nlappas@cmu.edu, Chrysanthos Gounaris

We develop an Adjustable Robust Optimization (ARO) framework to address uncertainty in Process Scheduling. Unlike RO, which results in a here-and-now solution, ARO results in a policy that is a function of parameter realizations. We derive the ARO counterpart, propose suitable decision-dependent uncertainty sets, and describe a cutting-plane-based solution approach. ARO results in considerably less conservative solutions, and unlike RO, can address also instances with zero-wait tasks.

4 - Robust Scheduling of Parallel Machines under Uncertainty

Selçuk Güren, Abdullah Gul University, Dept. of Industrial Engineering, Kayseri, Turkey, selcuk.goren@agu.edu.tr, Seyma Bekli

We consider stochastic scheduling of a set of jobs subject to processing time variability on identical parallel machines subject to random breakdowns. We develop a scenario-based integer-programming model that can handle small-size problems without machine breakdowns. We then propose a heuristic algorithm that can also handle large problems with machine breakdowns. Our computational experiments indicate that the performance of the proposed algorithms is promising.

5 - A Simulated Annealing Approach for Scheduling Jobs on Identical Parallel Machines

Pravin Tambe, Dr., RCOEM, 49, Parate Nagar, Near H.B.Estate, Sonagaon, Nagpur, MS, 440025, India, tambepp@gmail.com, Makarand Kulkarni

This paper presents a scheduling problem on identical parallel machines. A hybrid approach using simulated annealing combined with backward-forward heuristic is used for scheduling. The objective is to minimize the total penalty cost of jobs allocation on all the machines. Both earliness and tardiness penalties are considered. The computational experiment results for different problem sizes have been presented.

■ WC03

03-Room 303, Marriott

Inventory Management for Supply Chains I

Contributed Session

Chair: Alireza Sheikhzadeh, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, Ar, 72701, United States of America, asheikhz@uark.edu

1 - Multi-Period Dynamic Inventory Classification: Models and Applications

Dorothy Liu Yang, University of Missouri - St. Louis, 240 JCPN, One University Blvd, Saint Louis, MO, 63121, United States of America, liuyang@umsl.edu, Haitao Li

This talk presents a multi-period inventory classification model that aims to help company optimize profitability when facing nonstationary, stochastic demand. The benefits of multi-period, dynamic inventory policies over single-period, static inventory policies are examined. We offer managerial insights about how various purchasing and inventory parameters/settings impact the optimal dynamic policy and performance measures.

2 - Service-level Estimation in Inventory System Simulations with Model Uncertainty

Canan Gunes Corlu, Assistant Professor, Boston University, 808 Commonwealth Avenue, Boston, MA, 02215, United States of America, canan@bu.edu, Alp Akcay

We consider the simulation of a stochastic inventory system in the presence of input model uncertainty — the input distributions are unknown and there is only a limited amount of historical input data available for input distribution estimation. We develop an algorithm that estimates the mean service level of the inventory system accounting for the model uncertainty without making any assumptions on the form of the input model(s) that can represent the data on hand.

3 - Service Level and Contract Design with Shelf Space Dependent Demand

Peeyush Mehta, Indian Institute of Management Calcutta, NF3/4, IIM Calcutta, Kolkata, 700104, India, pmehta@iimcal.ac.in, R K Amit

We consider supply chain coordination problem when demand is influenced by the amount of inventory displayed on the shelves. First, we determine an optimal service level for shelf space dependent demand. Next, we design individually rational contracts that coordinate the supply chain when the retailer faces inventory level dependent demand.

4 - Incorporating Order Crossover Information in Service-oriented Base Stock Policy Decisions

Alan Pritchard, University of Maryland, Robert H. Smith Scholl of Business, Van Munching Hall, College Park, MD, 20742, United States of America, apritchard@rhsmith.umd.edu, Dean Chatfield

Order crossover, when orders arrive in a different sequence than the sequence in which they were placed, is a prevalent issue for modern supply chains. We utilize a hybrid discrete/continuous simulation model to investigate multiple methods of including order crossover information in the safety stock decision for an (R,S) inventory system with a service level target. Issues related to effective lead times, the normal approximation, and the appropriate protection period are investigated.

5 - Segmentation Methods for Large-scale Multi-echelon Repairable Parts Provisioning Systems

Alireza Sheikhzadeh, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, Ar, 72701, United States of America, asheikhz@uark.edu, Manuel Rossetti

Large-scale manufactured systems are an extremely crucial part of the infrastructure and worldwide competitiveness. Innovative approaches will significantly reduce the size and complexity of problems through the use of segmentation methods. In this research, grouping SKUs based on a no-backorder stocking policy (NBS) considerably reduced the size of problem with the lowest penalty cost. This procedure represents a unique segmentation model that has not been considered in the literature before.

■ WC04

04-Room 304, Marriott

Business Applications I

Contributed Session

Chair: Ravichandran Narasimhan, Professor, Indian Institute of Management Ahmedabad, Wing- 02 D, Ahmedabad, Gu, 380015, India, nravi@iimahd.ernet.in

1 - Mobile Technology and Emergency Response

Hongwei Du, Professor, California State University, 25800 Carlos Bee Blvd, Hayward, CA, 94542, United States of America, hongwei.du@csueastbay.edu, Jiming Wu

Emergency situations happen every day that requires response. We explore how mobile technology can be part of an effective strategy to manage emergency situations and the risks posed by natural hazards. This is achieved through mobile applications and technology on an individual and community level by taking advantage of the portability, ease of use, and popularity/prevalence of smartphones and tablets. The role of mobile technology in crises is critically explored in three cases studies.

2 - The Information Societies of India and China: Multivariate and Geospatial Comparison

Avijit Sarkar, Associate Professor, University of Redlands, 1200 E. Colton Avenue, Redlands, CA, 92373, United States of America, avijit_sarkar@redlands.edu, James Pick

We present comparative analysis of the information societies of the provinces of China and the states of India. The digital divide in both nations is analyzed and contrasted using multivariate and geostatistical methods. The roles of social capital and societal openness in fostering technology adoption and diffusion are discussed. Policy recommendations are presented and implications contextualized in relation to findings on telecommunications landscape in both countries.

3 - A Constraint Programming Approach for the Team Orienteering Problem with Time Windows

Ridvan Gedik, Assistant Professor, University of New Haven, 300 Boston Post Rd, West Haven, CT, 06516, United States of America, rgedik@newhaven.edu, Ashlea Milburn, Chase Rainwater, Emre Kirac

We discuss how to formulate and solve the NP-hard team orienteering problem with time windows (TOPTW) in constraint programming (CP) context by using interval variables, global constraints and domain filtering algorithms. The proposed CP model with a customized branching strategy obtains three new best solutions and proves the optimality of the three best-known solutions for the benchmark problem instances.

4 - A Canonical Model to Support the Mid Day Meal Supply Chain

Ravichandran Narasimhan, Professor, Indian Institute of Management Ahmedabad, Wing- 02 D, Ahmedabad, Gu, 380015, India, nravi@iimahd.ernet.in

In the Indian context providing Mid day meal at the primary and secondary schools is increases the enrolment and attendance. Several states having varying degree of success in implementing this. Based on the ground realities we propose a simple model to implement this scheme and discuss the implication to manage it.

■ WC05

05-Room 305, Marriott

Capitalizing on Social Media

Cluster: Social Media Analytics

Invited Session

Chair: Chris Smith, TRAC-MTRY, 28 Lupin Lane, Carmel Valley, CA, 93924, United States of America, cmsmith1@nps.edu

1 - Understanding Users' Switching Among Different Kinds of Social Media

Xiongfei Cao, USTC, Anhui province, Hefei City, Hefei, China, caoxf312@126.com

Investigating users' switching between different kinds of social media is important because it is closely related to the survival of technologies. Based on the push-pull-mooring framework, this study investigates social media users' switching behavior and mechanism. The research contents include: identify the factors affecting users' switching among different kinds of social media; elaborate the mechanism of users' switching decision.

2 - A Hawkes Process Based Dynamic Trip Attraction Model using**Open Location Based Social Network Data**

Wangsu Hu, Rutgers, the State University of New Jersey, CoRE 736, 96 Frelinghuysen Road, Piscataway, NJ, 08854, United States of America, nicholas.hu@rutgers.edu, Peter J. Jin

Location based social network (LBSN) services, such as Foursquare and Geo-tagged Twitter, allow users to "check in" to their arriving places of interests. In the proposed research, the public Foursquare check-in data published on Twitter are used. A Hawkes process based model is proposed to formulate both the actual trip arrival and LBSN checkins through a dynamic sensing and activity state transition model. The model is validated with planning data from the City of Austin Texas.

3 - Social Media and the ISIL Narrative

Rob Schroeder, Naval Postgraduate School, 526 Union St., Monterey, CA, 93940, United States of America, rcschroe@nps.edu, Sean Everton, Daniel Cunningham

The Islamic State of Iraq and Syria (ISIS) has attracted the world's attention and much of its wrath, primarily because of its rapid expansion in Iraq and Syria, its brutal treatment of religious minorities, and its beheadings of hostages from Western countries. At this point, it is unclear whether the group represents a global or a sectarian form of jihadism. Is it similar to al-Qaeda, which seeks to target the far enemy, or is it more sectarian in that it focuses on targeting what it perceives to be the near enemies of Islam? In this paper we address this debate by examining ISIS's online presence on the social media platform, Twitter, which serves as a forum for supporters to post and receive messages, images, videos, and links to websites to and from a wide-audience. The speed at which users can transmit and receive information via Twitter suggests that an analysis of ISIS-related user accounts and the key themes and concepts they disseminate can contribute to a better understanding of the group's overall narrative. We examine ISIS's online presence by extracting from Twitter the semantic networks of its most influential users. We find that a shift may be occurring in the ISIS narrative, from one that focuses on the near enemy to one that focuses on the far enemy. Ironically, this shift may have resulted from the actions of the U.S. and its Western allies.

■ WC06

06-Room 306, Marriott

Financial Institutions

Sponsor: Financial Services

Sponsored Session

Chair: Gustavo Schwenkler, Assistant Professor, Boston University, Questrom School of Business, 595 Commonwealth Ave, Boston, MA, 02215, United States of America, gas@bu.edu

1 - Asset Management Contracts and Equilibrium Prices

Andrea Buffa, Boston University, Questrom School of Business, Boston, United States of America, buffa@bu.edu, Dimitri Vayanos, Paul Woolley

We study the joint determination of fund managers' contracts and asset prices. Because of agency frictions, investors make managers' fees more sensitive to performance and benchmark performance against a market index. This exacerbates price distortions and raises the volatility of overvalued assets. Because trading against overvaluation is riskier than trading against undervaluation, agency frictions bias the aggregate market upwards, and can generate a negative risk-return relationship.

2 - Matching Capital and Labor

Jules Van Binsbergen, University of Pennsylvania, The Wharton School, Philadelphia, United States of America, julesv@wharton.upenn.edu, Jonathan Berk, Binying Liu

We establish an important role for firms by studying capital reallocation decisions of mutual fund firms. At least 30% of the value mutual fund managers add can be attributed to the firm's role in efficiently allocating capital amongst its fund managers. We find no evidence of a similar effect when a firm hires managers from another firm. We conclude that an important reason why firms exist is the private information that derives from the firm's ability to assess the skill of its employees.

3 - The Systemic Effects of Benchmarking

Gustavo Schwenkler, Assistant Professor, Boston University, Questrom School of Business, 595 Commonwealth Ave, Boston, MA, 02215, United States of America, gas@bu.edu, Diogo Duarte, Keith Lee

We show that pressure to beat a benchmark may induce institutional trading behavior that exposes retail investors to tail risk. In our model, institutions are different from a retail investor because they derive higher utility when their benchmark outperforms. This forces institutions to take on leverage to overinvest in the benchmark. Institutions execute fire sales when the benchmark experiences shocks. This behavior increases volatility, raising the tail risk exposure of the retail investor.

4 - Macroprudential Bank Capital Regulation in a Competitive Financial System

Christian Opp, University of Pennsylvania, The Wharton School, Philadelphia, United States of America, opp@wharton.upenn.edu, Markus Opp, Milton Harris

We develop a tractable general equilibrium model to analyze the effects of macroprudential bank capital regulation in an economy where firms of heterogeneous quality and risk seek financing from competitive banks and public markets. Our analysis provides an exact characterization of economy-wide capital allocation and highlights that tighter capital requirements can cause more banks to engage in value-destroying risk-shifting when banks face external financing frictions.

■ WC07

07-Room 307, Marriott

Risk Management and Financial Regulation

Cluster: Risk Management

Invited Session

Chair: Xianhua Peng, Assistant Professor, Hong Kong University of Science and Technology, Department of Mathematics, Hong Kong, Hong Kong - PRC, maxhpen@ust.hk

1 - The Level of Risk-free Rate in China

Chen Yang, National University of Singapore, Department of Mathematics, Blk S17, 10 Lower Kent Ridge Road, Singapore, 119076, Singapore, yang.chen@u.nus.edu, Min Dai, Steven Kou, Zhenfei Ye

In terms of the dual fund, an innovative structured fund capable of capturing the characteristics of both bond market and equity market, we propose an estimation of the level of China's risk-free rate under the Black-Scholes framework, and semi-model-free bounds based on minimal model specification. The level of estimation is uniformly higher than the commonly used risk-free rate proxies, which confirms the presence of a downward bias in the level of proxies as suggested by empirical studies.

2 - Bonus Caps, Deferrals and Bankers' Risk-taking

Xuchuan Yuan, Risk Management Institute, National University of Singapore, 21 Heng Mui Keng Terrace I3 Building, #04-03, Singapore, Singapore, rmiyuanx@nus.edu.sg, Jussi Keppo, Esa Jokivuolle

We model a banker's future bonuses as a series of call options on profits and show that bonus caps and deferrals reduce risk-taking. Optimal risk-taking depends on the cost of risk-taking. We calibrate the model to US banking data and show that increasing the bonus payment interval has no material impact, whereas capping the bonus to the base salary substantially reduces risk-taking. Our results suggest the bonus cap reduces risk-taking whereas bonus clawbacks in Dodd-Frank Act seem ineffective.

3 - A Dual-curve Market Model for Interest Rate Derivatives

Lixin Wu, Professor, Department of Mathematics, Hong Kong University of Science and Technology, malwu@ust.hk

After the 2007 financial crisis, the differences among the forward rates of various tenors are too significant to ignore, which necessitates multi-curve modeling. We introduce the term structure of "mean-loss rates," and adapt the LIBOR market model to the post-crisis reality of interest-rate markets by jointly modeling a forward-rate curve and a mean-loss rate curve of the same tenor. We then demonstrate how the "reshuffle premium" causes the basis spreads, a belief held by market participants.

■ WC08

08-Room 308, Marriott

Finance Theory and Empirics

Contributed Session

Chair: Wenqing Zhang, Assistant Professor, University of Minnesota Duluth, 1318 Kirby Drive, LSBE, UMD, Duluth, MN, 55812, United States of America, wqzhang@d.umn.edu

1 - Expected Commodity Returns and Pricing Models

Gonzalo Cortazar, Pontificia Universidad Católica de Chile, Vicuña Mackenna 4860, Santiago, Chile, gcortaza@ing.puc.cl, Ivo Kovacevic, Eduardo Schwartz

Commodity pricing models provide true (in addition to risk neutral) distributions which are measured with large errors. To increase reliability risk premium parameters should be obtained from other sources and we show that this can be done without losing any precision in the pricing of futures contracts. We show how the risk premium parameters can be obtained from estimations of expected futures returns and provide alternative procedures for estimating these expected futures returns.

2 - Sequential Global Sourcing Investment Decision Making under Extreme Situations

Wenqing Zhang, Assistant Professor, University of Minnesota Duluth, 1318 Kirby Drive, LSBE, UMD, Duluth, MN, 55812, United States of America, wqzhang@d.umn.edu, Prasad Padmanabhan, Chia-hsing Huang

Uncertainty plays an important role in determining a decision maker's choice when making sequential global sourcing investment decisions. This paper presents evidence that firms hiring adventurous managers may be able to generally reap dividends when faced with negative cash flows (extreme or normal) when the cost ratios are small, the investment horizons are high, and the discount rates are small.

■ WC09

09-Room 309, Marriott

Innovation and Entrepreneurship I

Contributed Session

Chair: Magali Delmas, UCLA, Anderson School of Management, Los Angeles, United States of America, delmas@ioes.ucla.edu

1 - Optimal Product Launch Times for a Small Firm in a Competitive Environment

Jacqueline Ng, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, jacquelineng2018@u.northwestern.edu, Izak Duenyas, Seyed Iravani

We consider the optimal production introduction policy for a small firm that produces a single base product that progresses through a series of product generations over time against a large rival firm. We develop a dynamic programming model to analyze the small firm's new product introduction strategy, and prove the optimality of a threshold policy. We then compare and contrast the optimal policy with the common time-pacing and event-pacing product introduction policies used in practice.

2 - A Case Study - Problem Based Learning Works to Foster the Entrepreneurial Minded Engineer

Don Reimer, College Professor, LTU, 21000 West Ten Mile Road, Southfield, United States of America, dreimer@ltu.edu, Ahad Ali

This abstract focuses tools that have successfully engaged engineering students in actively participating in learning the skills. Through the use of Problem Based Learning (PBL) as an interactive tool, engineering students are engaged. Examples of engineering students engaged in PBL will be used in case studies of a class currently being offered at LTU. The case study – Tires, Tires, Tires Everywhere will be used to demonstrate the use of PBL in the classroom.

3 - The Dynamics of Energy Conservation: Novelty and Framing Effects

Omar I. Asensio, UCLA, Institute of the Environment, Los Angeles, United States of America, omar.asensio@ucla.edu, Magali Delmas

Using a field experiment with high frequency data, we investigate dynamic consumer responses to information-based interventions designed to encourage conservation behavior in the residential electricity sector. We discuss novelty and framing effects as temporal mechanisms resulting from new consumer innovations in appliance level metering and information technologies. Our results on dynamic decision-making are based on 52 million observations at 1/30Hz for 118 residences over 8 months.

■ WC10

10-Room 310, Marriott

E-Business/Commerce I

Contributed Session

Chair: Wei Zhang, Assistant Professor, University of Hong Kong, University of Hong Kong, Hong Kong, China, zhangw.03@gmail.com

1 - How Many Crowd Workers should a Requester Hire on Amazon Mechanical Turk?

Arthur Carvalho, Assistant Professor, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, J Building, Room 35-5th Floor, Rotterdam, NA, 3038BG, Netherlands, carvalho@rsm.nl, Stanko Dimitrov, Kate Larson

We investigate the optimal number of workers a requester should hire on the crowdsourcing platform Amazon Mechanical Turk. In particular, we report the results of three studies involving different tasks and payment schemes. Surprisingly, we find that the optimal number of workers a requester should hire is around 10 to 11, no matter the underlying task and payment scheme. To derive such a result, we employ a principled analysis based on segmented linear regression.

2 - Clickstream Big Data and “Delivery Before Order Making” for Online Retailers

Haoxuan Xu, School of Management, Huazhong University of Science and Technology, 1037 Luoyu Road, Hongshan District, Wuhan, 430074, China, juwan.hsu@gmail.com, Yeming Gong, Wilco Van Den Heuvel, Albert Wagelmans, Jinlong Zhang

Our research is inspired by a leading online retailer using clickstream big data to estimate customer demand and then ship items to customers by a mode of “Delivery Before Order Making” (DBOM) operational mode. Using clickstream data to obtain advance demand information (ADI) in order quantities, we integrate the forecasting with a single-item uncapacitated dynamic lot sizing problem in a rolling-horizon environment. Using the simulated clickstream data, we evaluate the performance of DBOM mode.

3 - Estimating Seasonality of E-commerce Sales

Abhay Jha, Walmart E-Commerce, 850 Cherry, San Bruno, CA, United States of America, abhaykj@gmail.com

The assortment of items in e-commerce includes a lot of items with short life-span; hence the traditional methods of estimating seasonality per item by looking at past years' sales are not applicable here. We will formulate this problem as maximizing the penalized likelihood of a state space model, where we penalize the seasonality to have some plausible properties, and use the semantic information about items to constrain similar items to have similar seasonality.

4 - A Simulation Framework of Consumer-to-Consumer Ecommerce Business Model

Oloruntomi Joleto, University of Central Florida, 4000 Central Florida Blvd, Orlando, FL, 32816, United States of America, Tomi.Joleto@knights.ucf.edu, Luis Rabelo

In the past decade, ecommerce transformed the business models of many companies. This paper proposes a modeling and simulation framework to investigate how the actions of stakeholders in consumer-to-consumer ecommerce affect the system performance as well as the business dynamics of the model. The goal is to provide stakeholders with a decision making tool to assess the viability and performance of the consumer-to-consumer business model.

5 - Higher Prices for Larger Quantities? Non-monotonic Price-quantity Relations in B2b Markets

Wei Zhang, Assistant Professor, University of Hong Kong, University of Hong Kong, Hong Kong, China, zhangw.03@gmail.com

We study a microprocessor company that has a limited capacity and negotiates with each buyer for the price. Our analysis of their data reveals that larger purchases do not always result in bigger discounts, and we show that the non-monotonicity is rooted in how sellers value capacity. The value of residual capacity may be initially convex and then concave. Such a value function is sufficient to ensure a non-monotonic price-quantity relationship.

WC11

11-Franklin 1, Marriott

Optimization Integer Programming II

Contributed Session

Chair: Ioannis Fragkos, Post Doctoral Fellow, HEC Montreal, 3000 Chemin de la Cote-Sainte-Catherine, Montreal, Canada, ioannis.fragkos@cirrelt.ca

1 - A Computational Study of Two-Period Relaxations for Big-Bucket Lot-Sizing Problems

Ioannis Fragkos, Post Doctoral Fellow, HEC Montreal, 3000 Chemin de la Cote-Sainte-Catherine, Montreal, Canada, ioannis.fragkos@cirrelt.ca, Mahdi Doostmohammadi, Kerem Akartunali

Lot-sizing problems form the backbone of most modern production planning systems. Despite the significant advancements in optimization theory and software, most methods used in practice lead to higher-than-optimal costs. In this talk we investigate new classes of inequalities that are based on two-period relaxations. We discuss separation procedures and a branch-and-cut implementation. Computational experiments are promising, and show that the proposed inequalities derive improved lower bounds.

2 - A Small-Order-Polynomial-Sized Linear Program for the Traveling Salesman Problem with Tight Bounds

Mark Karwan, University at Buffalo, 342 Bell Hall, North Campus, Buffalo, NY, 14260, United States of America, mkarwan@buffalo.edu, Moustapha Diaby, Lei Sun

We present a polynomial-sized linear program for the n city TSP drawing upon ‘complex flow’ modeling ideas by the authors who used an $O(n^9) \times O(n^8)$ model. Here we have only $O(n^5)$ variables and $O(n^4)$ constraints. We use an assignment problem-based abstraction of tours not employing the traditional city-to-city variables of the standard TSP formulation. We solved thousands of problems with up to 26 cities using the simplex and barrier methods of CPLEX, consistently obtaining all integer solutions.

3 - A Branch and Bound Approach to the Minimum K-enclosing Ball Problem

Marta Cavaleiro, Rutgers University, 100 Rockefeller Rd., Piscataway, NJ, 08854, United States of America, marta.cavaleiro@rutgers.edu, Farid Alizadeh

The minimum k -enclosing ball problem seeks the ball with smallest radius that contains at least k of n given points. This problem is NP-hard. For the minimum enclosing ball problem (requiring the ball to contain all points) there are both primal and dual iterative algorithms that are very similar to the simplex method for LP. We incorporate these methods into a branch and bound search to solve the minimum k -enclosing ball problem. Some computational results will be presented.

4 - Cutting Circles via Piecewise Milp

Steffen Rebennack, Colorado School of Mines, 1500 Illinois Street, Golden, CO, United States of America, sreberra@mines.edu

In circle cutting, one computes an area minimizing rectangle hosting a given set of circles. These circles are not allowed to overlap. This circle cutting problem is typically formulated as a continuous NLP problem where the aforementioned nonoverlap condition make its feasible region nonconvex. We approximate these nonoverlap conditions and the bilinear objective function with piecewise linear and tailored constructs. In doing so, the resulting formulation becomes a MILP problem.

WC12

12-Franklin 2, Marriott

Optimization Stochastic III

Contributed Session

Chair: Michael Metel, PhD Student, McMaster University, 1280 Main St. West, Hamilton, ON, L8S4M4, Canada, Michael Metel <michaelmetel@gmail.com>

1 - A Bilevel Programming Model: Reduction of Dimension of the Upper Level Problem

Vyacheslav Kalashnikov, Assist. Prof., Tecnologico de Monterrey (ITESM), Campus Monterrey, 2501 Av. Eugenio Garza Sada South, Monterrey, NL, 64849, Mexico, kalash@itesm.mx, Nataliya Kalashnykova

Bilevel stochastic programming is often applied to model interaction between a Natural Gas Shipping Company and a Pipeline Operating Company. The problem is reduced to an also bilevel model but with linear constraints. However, this reduction makes the dimension of the upper level problem an unbearable burden even for the modern PC systems. The aim of this paper is a mathematical formalization of the reduction of the upper level problem's dimension without affecting the optimal solution.

2 - Optimization Problem with a Reference Utility Based Stochastic Dominance Constraint

Jian Hu, Assistant Professor, University of Michigan- Dearborn, 2340 Engineering Complex, 4901 Evergreen Rd, Dearborn, MI, 48128, United States of America, jianhu@umich.edu, Gevorg Stepanyan

We address a novel approach to relax the second order stochastic dominance, which characterizes a norm-based functional perturbation region based on a reference utility function recommended by the decision maker. This approach best represents the decision maker's individual preference. We discuss an optimization problem using this dominance constraint, and provide a solution method using Bernstein polynomial approximation.

3 - Hybrid Robust-stochastic Optimization Approach for Closed-loop Supply Chain Network Design

Esmail Keyvanshokoo, PhD Student, University of Michigan, 1205 Beal Ave., Ann Arbor, MI 48109-2117, Ann Arbor, MI, United States of America, keyvan@umich.edu, Elnaz Kabir, Sarah Ryan

Our contribution is to develop a novel hybrid robust-stochastic programming approach to simultaneously model two different types of uncertainties by including stochastic scenarios for transportation costs and polyhedral uncertainty sets for demands and returns. An accelerated stochastic Benders decomposition is proposed for solving this model. Numerical studies are performed to show the benefits of our approach.

4 - Multi-stage Stochastic Lot Sizing Problem with Nervousness Considerations

Esra Koca, Asst. Prof., Sabanci University, Department of Industrial Engineering, Istanbul, 34956, Turkey, esrakoca@gmail.com, M. Selim Akturk, Hande Yaman

We study the multi-stage stochastic lot sizing problem with controllable processing times and nervousness considerations. In multi-stage stochastic programming, one can obtain different production decisions for different scenarios and this situation may lead to lack of coordination. We formulate the problem by considering this drawback of the approach. Some mixing set structures are observed as relaxations of our formulation, and valid inequalities are developed based on these structures.

5 - Chance Constrained Optimization for Pari-mutuel Horse Race Betting

Michael Metel, PhD Student, McMaster University, 1280 Main St. West, Hamilton, ON, L8S4M4, Canada, Michael Metel, michaelmetel@gmail.com, Kai Huang, Antoine Deza

We consider the time horizon of a gambler in the optimization of horse race betting through the use of chance constrained programming. A novel approach to estimating superfecta payouts is presented using maximum likelihood estimation. A computational substantiation with historical race data found an increase in return of over 10% using the chance constrained model.

■ WC13

13-Franklin 3, Marriott

Data Driven Optimization and Applications II

Sponsor: Optimization/Optimization Under Uncertainty
Sponsored Session

Chair: Jun-ya Gotoh, Chuo university, 1-13-27 Kasuga, Bunkyo-ku, Tokyo, 112-8551, Japan, jgoto@indsys.chuo-u.ac.jp

1 - Performance Analysis of Stochastic Dynamic Programs via Information Relaxation Duality

David Brown, Duke University Fuqua School of Business, 1 Towerview Rd, Durham, NC, United States of America, dbbrown@duke.edu, Santiago Balseiro

A common technique in the analysis of stochastic systems is the use of “hindsight bounds,” in which decisions are made after uncertainties are revealed. In some applications, however, hindsight bounds may lead to very weak performance guarantees. We show how to obtain stronger guarantees by incorporating penalties that punish the use of additional information, and demonstrate the technique on several applications, including stochastic knapsack problems.

2 - A Unified Classification Algorithm Based on Accelerated Proximal Gradient Methods

Akiko Takeda, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo, 113-8656, Japan, takeda@mist.i.u-tokyo.ac.jp, Naoki Ito, Kim Chuan Toh

The goal of binary classification is to predict the class of a new sample. It is important to find suitable classification models for given datasets for good prediction performances. We design a unified model for various types of classification models and an efficient algorithm for solving the unified model, which speeds up the process of finding the best model. It is based on an accelerated proximal gradient method and performs better than specialized algorithms for specific models.

3 - Demand Clustering and Inventory Optimization for Fashion Products

Tong Wang, Associate Professor, National University of Singapore, 15 Kent Ridge Drive, Singapore, SG, 119245, Singapore, tong.wang@nus.edu.sg

We study demand estimation and inventory optimization for fashion products. Based on historical product covariates and sales, we construct Bayesian structure model to cluster products that share commonality in covariates and sales pattern. At the beginning of a new season after covariates of new products are observed, they are assigned into the clusters, and their demand distributions are estimated. Inventory decisions are made accordingly. Clustering is updated at the end of the season.

4 - Robust Empirical Optimization is Almost the Same as Mean-variance Optimization

Jun-ya Gotoh, Chuo university, 1-13-27 Kasuga, Bunkyo-ku, Tokyo, 112-8551, Japan, jgoto@indsys.chuo-u.ac.jp, Michael Kim, Andrew Lim

We consider a distributionally robust optimization (DRO) problem in which the decision maker optimizes against a worst-case distribution, where a penalty on ϕ —divergence controls the amount that the alternative can deviate from the nominal. Our main finding is that robust empirical optimization is essentially equivalent to solving an in-sample mean-variance problem, which provides insight into the mechanism by which empirical DRO achieves its “robustness.”

■ WC16

16-Franklin 6, Marriott

Game Theory IV

Contributed Session

Chair: Anastasia Nikolaeva, PhD Student, University at Buffalo, 342 Bell Hall, Amherst, NY, 14260, United States of America, aanikola@buffalo.edu

1 - Bandwagon Investment Equilibrium of a Preemption Game

Kihyung Kim, Postdoc Research Associate, Purdue University, 315 N. Grant Street, West Lafayette, In, 47907, United States of America, kihyung.kim.1@purdue.edu, Abhijit Deshmukh

Given a first mover's advantage in a competitive market, theoretical research supports the preemption strategy that invests earlier than competitors. However, empirical research shows that the preemption strategy is seldom successful, and simultaneous investments are frequently observed. This research addresses this gap by deriving the bandwagon investment equilibrium that elucidates how a firm's investment entices the competitor's investment.

2 - Contingency Inventory Reservation Across Independent Distributors

Sercan Demir, University of Miami, 1251 Memorial Drive, Department of Industrial Engineering, Coral Gables, FL, 33146, United States of America, s.demir@umiami.edu, Murat Erkoc

We study contingency inventory reservation contracts across a single supplier and multiple buyers. Buyers are distributors operating in independent markets and are subject to adverse events. They enter into contractual agreement with the supplier for carrying contingency inventory. The supplier sets the reservation terms to which the buyers respond with their reservation decisions. We investigate equilibrium reservation policies under varying probabilities and market impacts of disruptions.

3 - Vendor Competition in Remanufacturing

Debabrata Ghosh, Assistant Professor, IIM Calcutta, NAB, K-307, D.H. Road, Joka, Kolkata, WB, 700104, India, debabrata.ghosh@iimcal.ac.in, Sirish Gouda

In this paper we study a case where vendors compete during re-manufacturing for an OEM. While studies have highlighted competition between retailers under product take-back, in several emerging economies third party vendors play an interesting role in re-manufacturing. Using game theoretic set up we study the decisions of the OEM and vendors under re-manufacturing. Our study reveals interesting pricing and re-manufacturing decisions under competition.

4 - Selling Format and Contract Type in Electronic Marketplaces with Product and Retail Competition

Baixun Li, Guangdong University of Finance and Economics, 21 Chisha Road, Guangzhou, Guangzhou, 510320, China, libaixun2002qq@163.com

This paper investigates the choices of selling format and contract type of two supply chains, which compete at both manufacturer and retailer levels. We consider two kinds of selling format: agency selling format and reselling format, and two kinds of contract: wholesale price contract and revenue sharing contract. We show that the equilibrium selling format of the online retailers depend on the contract type, channel power, and competitive intensity at both manufacturer and levels.

5 - Approximating Nash Equilibria in a Two Product Two Firm Oligopoly

Anastasia Nikolaeva, PhD Student, University at Buffalo, 342 Bell Hall, Amherst, NY, 14260, United States of America, aanikola@buffalo.edu, Mark Karwan

We consider an oligopoly industry and the Cournot-Nash model with two firms competing on the basis of quantity. In our application there are two homogeneous products of interest and customers sign a one or joint product supply contract. Existing customers and a set of new customers not currently served are competed for by each firm with a goal of profit maximization. We approximate Nash Equilibria using aspects of Game Theory, Simulation and Integer Programming and present empirical results.

■ WC17

17-Franklin 7, Marriott

Optimization Network

Contributed Session

Chair: Charles Nicholson, Assistant Professor, University of Oklahoma, 202 W. Boyd St., Room 116-H, Norman, OK, 73071, United States of America, cnicholson@ou.edu

1 - 1 Refueling Location Problem on a Continuous Tree Network

Sang Jin Kweon, Ph. D. Student, The Pennsylvania State University, 232 Leonhard Building, The Pennsylvania State University, University Park, PA, 16802, United States of America, svk5333@psu.edu, Jose A. Ventura, Seong Wook Hwang

In this talk, we consider a location problem for 1-refueling station on a tree network. We aim to locate the station anywhere on the network, including along the edge. Our objective is to locate a 1-refueling station to maximize the total traffic flow covered in round trips. For this, we derive reduction properties regarding the problem size and optimality conditions. Then, we develop an exact algorithm to determine the set of optimal locations for the refueling station.

2 - Near Optimal Design of Wavelength Routed Optical Networks

Prahalad Venkateshan, Associate Professor, Indian Institute of Management, Ahmedabad, Vastrapur, Ahmedabad, India, prahalad@iimahd.ernet.in, Yogesh Agarwal

The problem of designing a wavelength routed optical transport network is considered. Valid inequalities are used to augment traditional network design formulations. The resulting network is optimal for a majority of the problem instances tested and in those cases where it is not, a trial-and-error method finds near-optimal solutions. Computational tests are reported on relatively larger problem sizes than have been reported in literature on the wavelength routing problem.

3 - Metrics of Compactness: The Benefits of a Cluster-first, Route-second Approach to the Min-max K WRPP

Oliver Lum, University of Maryland, 3103 Mathematics Building, University of Maryland, College Park, MD, 20742, United States of America, oliver@math.umd.edu, Bruce Golden, Edward Wasil, Carmine Cerrone

In practice, it is often desirable for the routes of vehicles to exhibit certain properties that are not included in the objective function. Two such properties are compactness and separation. We discuss existing metrics that attempt to capture these traits, propose a new metric that combines these intuitions into a single value, and compare computational results for route-first, and cluster-first heuristics for the Min-Max K Windy Rural Postman.

4 - Optimal Flow Analysis, Prediction and Application

Charles Nicholson, Assistant Professor, University of Oklahoma, 202 W. Boyd St., Room 116-H, Norman, OK, 73071, United States of America, cnicholson@ou.edu, Weili Zhang

The fixed charge network flow problem is a classic NP-hard problem with many applications. To the best of our knowledge, this is the first paper that employs statistical learning technique to analyze the characteristics of optimal solutions. We develop an accurate propensity model based on this analysis to predict which arcs will have positive flow in an optimal solution. This propensity score allows for multiple applications such as identification of critical components in complex networks.

■ WC18

18-Franklin 8, Marriott

Optimization Robust I

Contributed Session

Chair: Zhi Chen, Department of Decision Sciences, PhD B1-02 Biz2 Building, NUS Business School, Singapore, 117592, Singapore, chenchi@u.nus.edu

1 - Competitive Difference Analysis of One-way Trading with Limited Information

Yingjie Lan, Peking University, Guanghua School of Management, Beijing, 100871, China, ylan@pku.edu.cn, Wei Wang

We consider robust one-way trading with limited information on price as a game. Our analysis finds the best guarantee of difference from the optimal performance. We provide closed-form solution, and reveal for the first time all possible worst case scenarios. Numerical experiments show that our policy is more tolerant of information inaccuracy than Bayesian policies, and can earn higher average revenue than other robust policies while keeping a lower standard deviation.

2 - A Robust Optimization Inventory Model with Uncertain Demand and Lead Time

Mohammad Rahdar, Iowa State University, 133 University Village, Unit F, Ames, IA, 50010, United States of America, rahdar@iastate.edu, Lizhi Wang, Guiping Hu

This study aims to improve the efficiency of a supply chain system by optimizing the ordering strategy in a manufacturing facility with uncertain demand and lead-time. A robust optimization model which has tri-level structure is proposed to explicitly address the uncertainty, and make planning decisions which are robust against all scenarios. We propose an exact algorithm for the tri-level programming model and report the numerical results.

3 - An Optimal Solution to a PCA Based Multi-Response Problem

Nasser Fard, Associate Professor, Northeastern University, 334 Snell Engineering Center, 360 Huntington Avenue, Boston, MA, 02115, United States of America, n.fard@neu.edu, Huyang Xu, Yuanchen Fang

It is shown that each eigenvalue obtained from the application of PCA in multi-response optimization has a set of eigenvectors, and different eigenvectors corresponding to each eigenvalue will lead to different results. A method for determining the optimal eigenvector combination is proposed. These eigenvectors are used to calculate the multi-response performance indices, and then the optimal factor-level combination will be uniquely determined.

4 - Distributionally Robust Optimization with Semi-infinite Ambiguity Sets

Zhi CHEN, Department of Decision Sciences, PhD B1-02 Biz2 Building, NUS Business School, Singapore, 117592, Singapore, chenchi@u.nus.edu, Melvyn Sim, Xu Huan

We investigate semi-infinite ambiguity sets that involve infinite expectation constraints besides moments and support. We study the associated intractable distributionally robust optimization by considering relaxed ambiguity sets with finite constraints. Based on worst-case distribution, we demonstrate an algorithm that tightens the relaxation gradually. We present expressive examples of these ambiguity sets, and show examples where the worst-case distribution can be relatively easily verified.

5 - Robust Optimization for a Location Problem with Codependent Uncertain Constraints

Juan Carlos Espinoza Garcia, ESSEC Business School, Av Bernard Hirsch, CS 50105, Cergy-Pontoise, 95021, France, juancarlo.espinoza@essec.edu, Laurent Alfandari

We consider an uncertain problem where the same parameter is liable to variation in both constraints and objective function. We model this problem under the Gamma-Robustness paradigm adapting the framework to include codependency between the uncertain equations. We apply this model to a location problem with uncertain demands and conduct computational experiments on a housing problem.

■ WC19

19-Franklin 9, Marriott

Heuristics

Sponsor: Computing Society

Sponsored Session

Chair: Michael Hahsler, SMU, P.O. Box 750123, Dallas, TX, 75275, United States of America, mhahsler@lyle.smu.edu

1 - Heuristic Search of Good Decisions for Evaluating Soft Constraints in Integer Programs

Steve Kimbrough, University of Pennsylvania, 3730 Walnut Street, Philadelphia, PA, 19104, United States of America, kimbrough@wharton.upenn.edu, Monique Guignard-Spielberg, Frederic Murphy

Parameter sweeping seeks insight into (usually simulation) models by examining a plurality of model results obtained using a number of judiciously chosen parameter settings. We introduce decision sweeping (of optimization models), in which we collect a number of judiciously chosen decisions (feasible and infeasible settings of the decision variables) from the larger space of decisions. We focus on the resulting insights, especially with regard to integer programs with soft constraints.

2 - Ordering Objects: What Heuristic Should We Use?

Michael Hahsler, SMU, P. O. Box 750123, Dallas, TX, 75275, United States of America, mhahsler@lyle.smu.edu

Serialization, i.e., finding a suitable linear order for a set of objects given data and a merit function, is a basic combinatorial optimization problem with applications in modern data analysis. Due to the combinatorial nature of the problem, most practical problems require heuristics. We have implemented over 20 different heuristics and more than 10 merit functions. We will discuss the different methods in this presentation and compare them empirically using datasets from several problem domains.

■ WC21

21-Franklin 11, Marriott

Healthcare Capacity Planning Models

Sponsor: Health Applications

Sponsored Session

Chair: Mike Carter, University of Toronto, Mechanical & Industrial Engineering, 5 King's College Rd., Toronto, ON, M5S 3G8, Canada, mike.carter@utoronto.ca

1 - Influence of Surge Capacity Protocols on Hospital Bed Capacity Planning

Carolyn Busby, PhD Candidate, University of Toronto, Mechanical & Industrial Engineering, 5 King's College Rd., Toronto, ON, M5S 3G8, Canada, carolyn.busby@mail.utoronto.ca, Mike Carter

Management of finite hospital resources changes as hospitals near capacity. As such, we need to consider these "surge protocols" in order to accurately model bed capacity needs. Preliminary work is presented on a generalize discrete event simulation that models inpatient bed usage by medical and surgical patients, as well as off-servicing rules and surge protocols (ambulance consideration, early discharge, altered admission rates, cancellation of elective procedures etc.)

2 - Tools to Support Managing Access in the Veterans Health Administration

Renata Konrad, Worcester Polytechnic Institute, Worcester, MA, United States of America, rkonrad@wpi.edu, Sharon Johnson, Bengisu Tulu

Creating access to health services requires balancing supply and demand. A capacity cushion must be maintained, representing extra supply to absorb variability or the result is increased wait time. We describe a tool that links analysis of clinic data with actionable strategies to reduce variability in supply and demand in primary and specialty care clinics in the Veterans Health Administration. The tool is piloted in four clinics and has the potential to improve decisions surrounding access.

3 - Designing Offload Zones to Reduce Offload Delay

Peter Vanberkel, Professor, Dalhousie University, P.O. Box 15000, Halifax, Canada, Peter.VanBerkel@Dal.Ca, Richard Boucherie, Corine Laan, Alix Carter

We examine the offload zone - an area where multiple patients who arrive by ambulance can wait allowing the ambulance crew to return to service immediately. Although a reduction in offload delay was anticipated, it was observed that the offload zone is often at capacity. In this study we investigate why this is the case and use a continuous time Markov chain to evaluate interventions to prevent offload zone congestion.

4 - Analyzing Long-term Care Transition Data with a Multi-state Semi-markov Model

Hambisa Keno, PhD Candidate, Purdue University, School of Industrial Engineering, West Lafayette, IN, United States of America, hkeno@purdue.edu, Nan Kong, Steven Landry, Mark Ward, Wanzhu Tu, Chris Callahan

Capacity reconfiguration between nursing homes and home-and-community-based settings is a challenging decision for long-term care delivery. A good indicator to the capacity requirement in these facilities is length of stay. Semi-Markov models have been used to characterize patient flows in a single care facility. We extend these models to the context of multi-facility care networks. Further, we embed higher-order Markov chains to assess the impact of care pathway on the model fitting.

■ WC22

22-Franklin 12, Marriott

Learning and Queues

Sponsor: Applied Probability

Sponsored Session

Chair: Ricky Roet-Green, University of Toronto, 37 zola gate, Thornhill, L4J9A7, Canada, rgricky@gmail.com

Co-Chair: Michael Kim, University of Toronto, 5 King's College Road, Toronto, Canada, mikekim@mie.utoronto.ca

Co-Chair: Andrew Lim, National University of Singapore/Department of Decision Sciences, Mochtar Riady Building, BIZ1 08-69, 15 Kent Ridge Drive, Singapore, Singapore, andrewlim@nus.edu.sg

1 - The Armchair Decision: to Depart Towards the Queue or Not

Ricky Roet-Green, University of Toronto, 37 Zola Gate, Thornhill, L4J9A7, Canada, rgricky@gmail.com, Refael Hassin

Consider a GPS user that inspects the traffic from his armchair at home. Given the

expected delays, would she drive to the service facility? A common assumption in queueing models is that there is no time gap between observing the queue and joining it. We challenge it by allowing the queue to evolve while the customer is on her way. We show that as opposed to intuition, customers who balk when the queue is mid-congested departs towards it when it is highly congested.

2 - From Product Form Queues to Queue Decomposition: The State-dependent Mn/gn/1 Example

Opher Baron, University of Toronto, 105 St. George St, Toronto, ON, Canada, opher.baron@rotman.utoronto.ca, Hossein Abouee Mehrizi

In the analysis of Product Form compatible queueing systems we decomposed them into subsystems that can be analyzed independently of each other. Queueing decomposition (QD) was used to approximate solutions for other queueing networks. We formulate QD and discuss its implementation for exact analysis. We demonstrate QD for many systems focusing on Mn/Gn/1 where arrivals and service times are state dependent and service rates can change at arrivals and departures is analyzed.

3 - Rational Abandonment from Priority Queues: Equilibrium Strategy and Pricing Implications

Vahid Sarhangian, University of Toronto, 105 St. George Street, Toronto, ON, Canada, vahid.sarhangian11@rotman.utoronto.ca, Philipp Afeche

The literature on the economics of queues predominantly focuses on the queue-joining decisions of customers and ignores subsequent abandonment decisions. Such abandonment behavior is particularly important in priority queues, which are quite prevalent in practice. We study the equilibrium joining and abandonment behavior of utility-maximizing customers in the context of an observable two-class priority queue and identify important pricing implications.

■ WC23

23-Franklin 13, Marriott

Control of Queues

Sponsor: Applied Probability

Sponsored Session

Chair: Douglas Down, McMaster University, 1280 Main Street West, Hamilton, Canada, downd@mcmaster.ca

1 - ATM Replenishment Scheduling

Yu Zhang, UNC Chapel Hill, B04 Hanes Hall, UNC Campus, Chapel Hill, NC, 27599, United States of America, yuzhang@live.unc.edu, Vidyadhar Kulkarni

We develop an ATM replenishment policy for a bank that operates multiple ATMs with an aim to minimize the cost of stock-outs and replenishments, taking into account the economies of scale involved in replenishing multiple ATMs simultaneously. We present the structure of the optimal strategy that minimizes the long run cost per unit time and study a heuristic policy which is easy to implement.

2 - An Emergency Department Resource Allocation Model for Patients of Deteriorating Health

Mark Lewis, Professor, Cornell University, Rhodes Hall, Ithaca, NY, 14853, United States of America, mark.lewis@cornell.edu, Douglas Down, Carri Chan

We consider the allocation of medical service providers (MSPs) when patients health continues to deteriorate while waiting for service. The decision maker must balance the need to see more severely injured patients with the need to not allow those that are injured to continue to deteriorate. Conditions are provided when to prioritize each patient class.

3 - Robust Performance and Optimization of a Series Queue

Michael Veatch, Gordon College, 255 Grapevine Rd, Dept. of Mathematics, Wenham, MA, 01984, United States of America, Mike.Veatch@gordon.edu

Robust optimization (RO) is conservative, but when Central Limit Theorem uncertainty sets are used in an RO queue, the result is optimistic. We explain why, and propose a correction based on a diffusion model of a queue with general arrival and service times. For a series queue, the method is tractable for performance analysis and for optimal allocation of server capacity.

4 - Service Rate Control of an On/Off Server

Douglas Down, McMaster University, 1280 Main Street West, Hamilton, Canada, downd@mcmaster.ca, Guang Mo, Vincent Maccio

We study a server that may be turned on and off, where there is a delay to turn on the server. In addition, the service rate of the server can be chosen from a finite set. Using a cost function that involves server usage and holding costs, we discuss the following questions. Under what conditions should the server never be turned off? If it is advantageous to turn off the server, when should it be turned off? When the server is on, what speed should be chosen?

■ WC24

24-Room 401, Marriott

Constraint and Mixed Integer Programming

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Louis-Martin Rousseau, CIRRELT Ecole Polytechnique de Montréal, CP 6079 Succ Centre-Ville, Montréal, H3C3A7, Canada, louis-martin.rousseau@polymtl.ca

1 - A Constraint Programming Approach for Solving Convex Quadratically Constrained Problems

Chris Beck, University of Toronto, 5 King's College Rd, University of Toronto, Toronto, On, M5S3G8, Canada, jcb@mie.utoronto.ca, Wen-Yang Ku

Inspired by the geometric reasoning exploited in discrete ellipsoid-based search (DEBS) from the communications literature, we develop a constraint programming (CP) approach to solve problems with convex quadratic constraints. Such constraints appear in numerous applications. We strengthen the key aspects of DEBS and implement them as combination of a global constraint and variable/value ordering heuristics. Preliminary experiments on a variety of benchmark instances show promising results.

2 - Strengthening Convex Relaxations with Bound Tightening for Power Network Optimization

Pascal Van Hentenryck, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, pvanhent@umich.edu, Carleton Coffrin, Hassan Hijazi

Convexification is a fundamental technique in (mixed-integer) nonlinear optimization and many convex relaxations are parametrized by variable bounds, i.e., the tighter the bounds, the stronger the relaxations. This paper studies how bound tightening can improve convex relaxations for power network optimization. It adapts traditional constraint-programming concepts to a relaxation framework and shows how bound tightening can dramatically improve power network optimization.

3 - Improved Constraint Propagation via Lagrangian Decomposition

Andre Augusto Cire, Assistant Professor, University of Toronto Scarborough, 1265 Military Trail, Toronto, ON, M1C 1A4, Canada, acire@utsc.utoronto.ca, David Bergman, Willem-Jan Van Hove

Constraint propagation is inherently restricted to the local information that is available to each propagator. We propose to improve the communication between constraints by encoding them as decision diagrams and applying a Lagrangian Decomposition scheme, where penalty costs are incurred when the variable assignments in each constraint do not correspond to one another. We show that propagating Lagrangian cost information can help improve the quality of bounds as well as the solution time.

4 - General Bounding Mechanism for Constraint Programs

Louis-Martin Rousseau, CIRRELT Ecole Polytechnique de Montréal, CP 6079 Succ Centre-Ville, Montréal, H3C3A7, Canada, louis-martin.rousseau@polymtl.ca, Claude-guy Quimper, Hoang Minh Ha

This paper presents an approach based on ideas from Lagrangian decomposition (LD) that establishes a general bounding scheme for any CP. We provide an implementation for optimization problems that can be formulated with knapsack and regular constraints, and we give comparisons with pure CP approaches.

■ WC26

26-Room 403, Marriott

Project Management I

Contributed Session

Chair: Ted Klastorin, Professor, University of Washington, Foster School of Business, Box 353226, Seattle, WA, 98195-3226, United States of America, tedk@u.washington.edu

1 - Project Management for IT-driven Development of Disadvantaged Communities in the Developing World

Devendra Potnis, Assistant Professor, University of Tennessee at Knoxville, 1345 Circle Park Drive, Communications Bldg., Suite 451, Knoxville, TN, 37996, United States of America, dpotnis@utk.edu

Inability of researchers to collect rich data from disadvantaged communities leads to the failure of the projects aiming to develop information systems for the development of disadvantaged communities. This study demonstrates the specific ways in which researchers can contextualize project management principles to address data collection barriers by managing scope, time, cost, human resources, quality, communications, and risks related to "IT for development projects" in the developing world.

2 - On Coordinating Contracts in Decentralized Stochastic Projects

Ted Klastorin, Professor, University of Washington, Foster School of Business, Box 353226, Seattle, WA, 98195-3226, United States of America, tedk@u.washington.edu, Tony Chen, Michael Wagner

We study a decentralized project where a client organization contracts individual tasks to independent subcontractors. We show that a simple linear incentive contract coordinates the project while maximizing the expected project profit and minimizing two risk measures. We show how this contract can be implemented in both bidding and auction environments.

3 - Stochastic Resource-constrained Project Scheduling using Approximate Dynamic Programming

Haitao Li, Associate Professor, University of Missouri - St. Louis, 229 ESH, St. Louis, MO, 63121, United States of America, lihait@umsl.edu, Keith Womer

We present an effective and efficient approximate dynamic programming (ADP) algorithm for the well-known stochastic resource-constrained project scheduling problems. Our approach features a hybrid ADP framework that integrates both the rollout look-ahead policy and the look-back policy via lookup table to enhance solution performance.

4 - Resource Allocation Patterns in a Multi-project Portfolio of Engineering Projects

Vishwanath Hegde, California State University East Bay, 25800 Carlos Bee Blvd, Hayward, CA, 94542, United States of America, vish.hegde@csueastbay.edu, Zinovy Radovilsky

Using historic resource loading data in a multi-project setting, we show that resource distribution patterns can be captured by parametric regression models, which can forecast resource distribution during project lifetime using project due date and attributes. Forecast based on historical data instead of priory assumption can improve the accuracy of resource planning. This macro estimation approach can be deployed easily by project portfolio managers.

■ WC27

27-Room 404, Marriott

Multicriteria Decision Making I

Contributed Session

Chair: Sune Lauth Gadegaard, PhD fellow, Department of Economics and Business, Aarhus University, Fuglesangs Allé 4, bygning 2622, lokale 315a, Aarhus V, 8210, Denmark, sgadegaard@econ.au.dk

1 - A Multi-Objective Decision Making Model based on Uncertain Preference Sequence Information

Xiao Liu, Mr., Huazhong University of Science and Technology, No. 1037, Road Luoyu, Wuhan, 430074, China, liu_xiao@hust.edu.cn, Huimin Ma

In this paper, we put forward a multi-objective decision making model for two-sided matching based on uncertain preference sequence information. We first design a mechanism to get preference ordinal value in uncertain sequence. Then multiple optimal objectives on two-sided matching make up a mixed 0-1 integer linear programming model. At last comparing with the typical two-sided matching optimization approaches, we discuss their characteristics and performance in different evolution criteria.

2 - Preferences Modeling in Goal Programming Model through Satisfaction Functions

Belaid Aouni, Associate Dean, Qatar University, College of Business and Economics, P.O. Box 2713, Doha, Qatar, belaid.aouni@qu.edu.qa

The concept of Satisfaction Functions was developed by Martel and Aouni in 1991 to explicitly integrate the Decision-Maker's preferences within the Goal Programming Model. Through this concept several criticism of the Goal Programming model were addressed. This concept has been widely applied to different Goal Programming variants and utilized in solving several application cases. The aim of this paper is to present an analysis of different applications of this concept with a guideline.

3 - Balancing Faculty and Student Preferences in the Assignment of Students to Groups

Richard Forrester, Associate Professor Of Mathematics, Dickinson College, College and Louthier Streets, Carlisle, PA, 17013, United States of America, forrestr@dickinson.edu, Kevin Hutson

We develop a practical approach for assigning students to groups where the goal is to create diversity within the groups while considering the preferences of the students. A motivating application is the assignment of students to seminars. Faculty want seminars that are balanced with regards to gender and ethnicity, while students want to be assigned to one of their higher ranked seminars. Our model is a multi-objective convex quadratic program that can be solved using a standard solver.

4 - P-center and P-dispersion Problems: A Bi-criteria Analysis

Golbarg Kazemi Tutunchi, North Carolina State University,
1916 Trexler Ct, Raleigh, NC, 27606, United States of America,
gkazemi@ncsu.edu, Yahya Fathi

We consider the p-center and the p-dispersion problems in the context of a bi-criteria location analysis. We discuss a mathematical programming approach to obtain a non-dominated point with respect to these two objectives, and an exact method to obtain the corresponding non-dominated frontier. Through a computational experiment we demonstrate the effectiveness of this approach for different instances of the problem.

5 - A Cut and Branch Approach for a Class of Bi-Objective Combinatorial Optimization Problems

Sune Lauth Gadegaard, PhD fellow, Department of Economics and Business, Aarhus University, Fuglesangs Allé 4, Bygning 2622, lokale 315a, Aarhus V, 8210, Denmark,
sgadegaard@econ.au.dk, Matthias Ehrgott

In this talk we discuss a cut and branch approach for bi-objective optimization problems with integer outcome vectors. The approach improves the LP-relaxation by adding cuts at each extreme point of the efficient frontier of the LP-relaxation. After improving the LP-relaxation, we propose a branch and bound algorithm which alternately branches in objective space and in decision space. Experimental results for the single source capacitated facility location problem is reported.

WC28

28-Room 405, Marriott

Optimization Stochastic V

Contributed Session

Chair: Yasaman Kazemi, North Dakota State University, NDSU Dept. 2880, P.O. Box 6050, Fargo, ND, 58108, United States of America,
yasaman.kazemi@ndsu.edu

1 - Multistage Stochastic Programming under Endogenous and Exogenous Uncertainties

Robert M. Apap, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America,
rapap@andrew.cmu.edu, Ignacio E. Grossmann

We address the modeling and solution of mixed-integer linear multistage stochastic programming problems involving endogenous and exogenous uncertain parameters. We propose a composite scenario tree that contains both types of parameters. We then present new theoretical model-reduction properties to drastically reduce the number of non-anticipativity constraints. Lagrangean decomposition and a sequential scenario decomposition heuristic are used to solve large-scale instances.

2 - Stochastic Optimization of Downstream Petroleum Supply Chain under Uncertainties

Yasaman Kazemi, North Dakota State University, NDSU Dept. 2880, P.O. Box 6050, Fargo, ND, 58108, United States of America,
yasaman.kazemi@ndsu.edu, Joseph Szmerekovsky

An integrated multi-product multi-echelon and multi-mode supply chain design is studied in the downstream petroleum supply chain under the risk of facility disruptions. Two-stage stochastic model is proposed to minimize the expected total costs by optimizing the strategic and tactical decisions and selecting appropriate mitigation strategies. In addition, Geographic Information System (GIS) is used to locate facilities, obtain realistic transportation data, and to visualize the process.

3 - Risk-averse Wind Power Investment through Unified Stochastic and Robust Optimization

Kun Zhao, Department of Industrial and Systems Engineering
The University of Florida, FL, United States of America,
zhaokunzk@ufl.edu, Yongpei Guan

A unified stochastic and robust optimization approach is proposed for the wind power investment problems. Two models are developed: a short-term risk-averse wind power investment problem for market participants, and a long-term simultaneous wind power and transmission investment problem for vertically integrated utilities. By reformulation, tractable formulations can be obtained and solved in finite time. Computational results are shown for the effectiveness of our proposed model and solution approaches.

WC29

29-Room 406, Marriott

Decision Analytics Applications in the Media Industry

Sponsor: Analytics

Sponsored Session

Chair: J. Antonio Carbajal, Sr Operations Research Analyst,
Turner Broadcasting System, Inc., 1050 Techwood Dr., Atlanta, GA,
United States of America, Antonio.Carbajal@turner.com

1 - Commercial Time Management Applications in the Media Industry

J. Antonio Carbajal, Sr Operations Research Analyst, Turner
Broadcasting System, Inc., 1050 Techwood Dr., Atlanta, GA,
United States of America, Antonio.Carbajal@turner.com,
W. Chaar

Advertisement-based networks face the challenge of optimally allocating their commercial time capacity to meet audience levels guaranteed to their advertisers. This presentation introduces two systems that support this objective: 1) A spot scheduling engine that maximizes deal delivery while honoring several placement constraints and 2) A make-goods allocation engine that maximizes the liability inventory value and meets advertiser requirements of selling title mix and weekly unit distribution.

2 - Competitive Audience Estimation

W. Chaar, Analytics, Data & Decision Sciences, VP, 106 N Denton Rd, 210, Dallas, TX, 75019, United States of America,
wscemail2002@yahoo.com, J. Antonio Carbajal, Peter Williams

A consumer choice modeling approach is developed and used to model audience behavior across competing media contents. The methodology demonstrates the capability of the approach to generate accurate predictive results of audiences.

3 - Television Programming Optimization in the 24-hour Cable Network Environment

Peter Williams, Sr. Operations Research Analyst, Turner
Broadcasting System, Inc., 1050 Techwood Dr., Atlanta, GA,
30308, United States of America, peter.williams@turner.com,
W. Chaar, J. Antonio Carbajal

A cable network programmer's main objective is to create program schedules that attract viewers. The mix of available programs and various scheduling constraints introduce complexity to organizing a 24-hour program schedule. With Nielsen data, the authors develop a model to predict ratings using features of a program schedule. Using this model, TV program scheduling is formulated as an optimization problem with the objective of maximizing ratings given program airtime constraints.

WC30

30-Room 407, Marriott

Information Systems II

Contributed Session

Chair: Harris Kyriakou, Stevens Institute of Technology, 1 Castle Point on Hudson, School of Business 642, Hoboken, NJ, 07030,
United States of America, ckyriako@stevens.edu

1 - Cooperate to Dominate?: Empirical Analysis of Cooperation Decisions on Technological Innovation

Ashish Kumar Jha, Doctoral Student, Indian Institute of
Management Calcutta, Diamond Harbor Road, Joka, Kolkata,
WB, 700104, India, ashishkj11@iimcal.ac.in, Indranil Bose

We analyze the importance of cooperation factors and cooperation partners for product and process innovation for Chinese firms. We also test the relationship between product and process innovation which leads to confirmation of our hypothesis that continuous process innovation has a rub off effect on product innovation and product innovation increases but vice versa is not true. We arrive at the conclusions based on analysis of innovation data of over 900 Chinese firms.

2 - Commercial Companies' Open Source Strategies – When Should Competitive Companies Support the Same Operation

Ying Liu, Xi'an Jiaotong University, No.28 Xianning Road,
Beilin District, Xi'an, China, liuyingleyna@stu.xjtu.edu.cn

Nowadays many firms have been involved with open source software through various ways, such as contributing code and providing support to open source community. They do this for profit, mostly through complementary product or service. How much effort should they put into open source project and does their competitor's contribution affect their behavior? How would they design additive product? Does free-riding problem really hurt and which kind of license can mitigate it?

3 - The Impact of Digital Natives on B2B Purchasing Decisions

Haris Krijestorac, PhD Student, Information Systems, University of Texas at Austin, 3106 Speedway, Apt. B203, Austin, Tx, 78705, United States of America, haris.krijestorac@utexas.edu

Our study seeks to better understand how businesses buys from businesses in a marketplace with increasingly digitally oriented decision makers. We analyze how 'Digital Natives' and 'Digital Immigrants' differ when influencing purchasing decisions in a business-to-business (B2B) context. To this end, we are surveying purchase decision makers at B2B companies. The results of our survey can help B2B companies better understand their target market, and refine their approach to marketing and sales.

4 - Improving The Persuasive Effectiveness of Anti-piracy Educational Campaign Messages

Bong Keun Jeong, Assistant Professor, Metropolitan State University of Denver, Campus Box 45, P.O. Box 173362, Denver, CO, 80217, United States of America, bjeong@msudenver.edu, Tom Yoon

Prior literature suggests that anti-piracy educational campaign is an effective way to dissuade users from downloading illegal contents. However, most comments and opinions on public campaigns are against what they seek to achieve. The objective of this study is to explore ways to improve the effectiveness of anti-piracy campaigns. We examine the impact of message frame, issue involvement, risk perception, and message evidence on the persuasive effectiveness of anti-piracy campaign messages.

5 - Collective Innovation in 3D Printing: Novelty, Reuse and Their Interplay

Harris Kyriakou, Stevens Institute of Technology, 1 Castle Point on Hudson, School of Business 642, Hoboken, NJ, 07030, United States of America, ckyriako@stevens.edu, Jeffrey V. Nickerson

We present an empirical fitness landscape of open hardware designs and examine how (i) digital artifact reuse, (ii) novelty and (iii) their interaction affect the success of open innovation endeavors. We use mixed research methods to draw insights about how members of open innovation communities build upon preexisting work and collaborate to create something new. A theory of search in the design space is used to explain how these seemingly contradicting forces affect innovation.

■ WC31

31-Room 408, Marriott

Data-driven Operations Management of Energy Systems

Sponsor: Data Mining

Sponsored Session

Chair: Adrian Albert, Senior Data Scientist, C3 Energy, 1300 Seaport Blvd, Suite 500, Redwood City, CA, 94063, United States of America, adrian.albert@c3energy.com

1 - Data-Driven Structural Health Monitoring of Large-Scale Power Grids

Adrian Albert, Senior Data Scientist, C3 Energy, 1300 Seaport Blvd, Suite 500, Redwood City, CA, 94063, United States of America, adrian.albert@c3energy.com

Physical asset failure on power grids leads to costly loss-of-service. In the past, energy utilities have only performed maintenance retroactively. Yet new sensing and data processing allow for a near real-time picture of network state. However in practice the sensors used to detect faults often malfunction. Here we describe a system for predicting faults on certain asset types. We also develop a model for optimizing sensor replacement as to ensure desired operation profiles.

2 - Simulating Annual Variation in Load, Wind, and Solar by Representative Hour Selection

John Bistline, Technical Lead And Project Manager, Electric Power Research Institute, 3420 Hillview Avenue, Palo Alto, CA, 94305, United States of America, jbistline@epri.com

The spatial and temporal variability of renewables have important economic implications for investment and system operation. This talk describes a method for selecting representative hours to preserve key distributional requirements for regional load, wind, and solar time series with a two orders of magnitude reduction in dimensionality. We discuss the implementation of this procedure in the US-REGEN model and compare impacts on energy system decisions with more common approaches.

3 - C3 Cyberphysics: An Operating System for the Smart Grid

Mehdi Massoumy, Senior Data Scientist, C3 Energy, 1300 Seaport Blvd, Suite 500, Redwood City, CA, 94063, United States of America, mehdi.maasoumy@c3energy.com

We propose an operating system that aggregates data from disparate data sources across the smart grid value chain, applies analytics on the data, and makes

optimal decisions for the operation of the system. The proposed operating system in real-time analyzes the requirements of the supply side, and requirements of the demand and performs optimal operation of the system while taking into account the constraints of all the components of the grid.

4 - Data-Driven Management of Large, Distributed Energy Systems – The Case of Residential Solar Networks

Amir Kavousian, Data Scientist, Sunrun Inc., 747 Anderson St, San Francisco, CA, 94110, United States of America, amirk@alummi.stanford.edu

This talk presents the data-driven operation of one of the largest residential solar fleets in the US. I demonstrate how advanced statistical methods are deployed to proactively identify operational issues and their root causes. The data-driven insights are fed back into operations, customer relations management, sales, marketing, product, and design teams. In particular, I explain a novel method to estimate the long-term, gradual decrease in solar systems productivity, known as degradation.

■ WC32

32-Room 409, Marriott

Data Mining Methodology

Contributed Session

Chair: Xuelei Ni, Associate Professor, Kennesaw State University, 365 Cobb Ave, Suite 209, MD# 1601, Kennesaw, GA, 30144, United States of America, xni2@kennesaw.edu

1 - Multivariate Statistical Analysis in NPD: Customization of a Sustainable Product

Istefani Paula, Professor, UFRGS, Osvaldo Aranha street 99, Porto Alegre, 90035190, Brazil, istefani@producao.ufrgs.br, Manoel Silveira, Angela Marx, Ana Facchini, Márcia Elisa Echeveste

The aim of this poster is to present an approach to identify clusters of consumers using Chi squared Automatic Interaction Detector. Based on the clusters formed it is possible to find different segments and to associate requirements demanded by them what allows the customization by means of product derivation. The method contributes to the Requirements Management area illustrated in the development of an eco friendly household cleaning product.

2 - Change Detection using Local Amplitude and Phase Synchronization in Complex Dynamical Systems

Ashif Sikandar Iquebal, Texas A and M University, 4501 College Main St, Apt. 1002, Bryan, TX, 77801, United States of America, ashif_22@tamu.edu, Satish Bukkapatnam

We propose a novel technique to detect changes in dynamical systems using local phase and amplitude synchronization among its constituent signals, generated using a non-parametric time scale decomposition method. We identify a set of components that is likely to capture the information about dynamical changes of interest using a maximum mutual agreement concept. Finally, a statistic is defined that can be employed to detect changes in complex systems where other methods fail.

3 - Between-Participants' Discourse Bias in Comments Classification: Adjusting Tf-idf

Inbal Yahav, Lecturer, Bar Ilan Business School, Bar Ilan University, Ramat Gan, Is, 52900, Israel, inbal.yahav@biu.ac.il, David Schwartz

Text mining has gained great momentum in recent years. A leading research branch in this regard is the field of comment classification. An essential pre-step in comment classification is words processing, commonly achieved by using the tf-idf formula. This work reveals, analyses and correct the bias introduced by between-participants' discourse to tf-idf. We show that ignoring this bias can manifest in a non-robust method at best, and can lead to an entirely wrong conclusion at worst.

4 - High-Dimensional Semi-Supervised Learning via a Fusion-Refinement Procedure

Xuelei Ni, Associate Professor, Kennesaw State University, 365 Cobb Ave, Suite 209, MD# 1601, Kennesaw, GA, 30144, United States of America, xni2@kennesaw.edu, Xiaoming Huo, Zhikun Lei, Renfu Li

This paper develops a sufficient dimension reduction (SDR) approach for the high-dimensional semi-supervised learning (SSL) problem. We first modify the fusion-refinement procedure, an SDR technique, to extract the essential features for a lower-dimensional representation, then apply an SSL algorithm in the lower-dimensional feature space to tackle the SSL problem. Numerical experiments demonstrated the effectiveness of the new technique.

■ WC33

33-Room 410, Marriott

Health Care Operations Management

Sponsor: Health Applications

Sponsored Session

Chair: Amin Khademi, Assistant Professor, Clemson University, 130-D Freeman Hall, Clemson University, Clemson, SC, 29634, United States of America, khademi@clemson.edu

1 - Improving Outpatient Scheduling through Patient Complexity and Integer Programming

Eva Lee, Georgia Institute of Technology, eva.lee@gatech.edu,
Prashant Tailor, ptailor3@gatech.edu

This work is joint with Emory Brain Center. We develop a clinical tool that classifies and schedules patients based off a patient complexity metric. The goal is to maximize the number of patients seen and increase providers and patient satisfaction. A classification model is first used to predict patient complexity, severity and type of follow-up appointment. This information is then used within the MIP scheduling model.

2 - Classifying Heterogeneous Tumor Subtypes via Matrix Factorization and Mixed-integer Programming

Andrew Trapp, Assistant Professor, Worcester Polytechnic Institute, 100 Institute Rd., Worcester, MA, 01609, United States of America, atrapp@wpi.edu, Patrick Flaherty

We consider tumor subtype classification via regularized mixed-membership matrix factorization, where one factor matrix has a limited number of non-zero entries, and the other has simplex constraints. This provides a mixed-membership representation for each column of the original matrix with sparse mixing components. We transform the original and NP-hard biconvex optimization problem into a mixed-integer linear program, and discuss exact and approximate solution approaches.

3 - Prediction of Operating Room End Time using Regression Modeling

Robert Allen, Clemson University, 130 Freeman Hall, Clemson, SC, United States of America, rallen3@g.clemson.edu,
Kevin Taaffe

The decision to let staff go home or bring more staff in depends on the ability of the nurse manager to predict when certain rooms will be finished for the day. We explore several different methods of enhancing the nurse's predictive capability by using hospital process flow data to build several models aimed at predicting the OR end time. We compare varying predictive models such as a simple offset and regression modeling to better predict the room end offsets as they occur during the day.

■ WC34

34-Room 411, Marriott

Joint Session HAS/Analytics: Unleashing the Potential of Big Data using Visualization in Health Care Delivery

Sponsor: Health Applications

Sponsored Session

Chair: Mustafa Ozkaynak, Assistant Professor, University of Colorado, 13120 E 19th Ave, Aurora, CO, 80045, United States of America, mustafa.ozkaynak@ucdenver.edu

1 - Understanding Adherence and Prescription Patterns using Large Scale Claims Data

Margret Bjarnadottir, Assistant Professor of Management Science and Statistics, Robert H. Smith School of Business, University of Maryland, 4324 Van Munching Hall, College Park, MD, 20742, United States of America, margret@rhsmith.umd.edu,
Sana Malik, Catherine Plaisant, Tanisha Gooden,
Eberechukwu Onukwughu

Traditionally, studies have measured medication adherence using summary statistics. However, advanced computing capabilities and novel visual analytics tools now allow us to move beyond the traditional reporting of "average adherence" to analyze longitudinal adherence patterns. Utilizing EventFlow, a novel discrete event sequence visualization software, we investigate patterns of prescription fills and illustrate the use of visual analytics tools in summarizing large scale claims data.

2 - Visualizing Differences in Patient Use of an EHR Patient Portal Informed by Clickstream Data

Sharon Johnson, Associate Professor, Worcester Polytechnic Institute, Foisie School of Business, 100 Institute Road, Worcester, MA, 01609, United States of America, sharon@wpi.edu,
Farhan Mushtaq, Bengisu Tulu, Diane Strong, John Trudel,
Lawrence Garber

In this paper, we explore patient usage behavior of a patient portal by analyzing patterns of use in clickstream data combined with data on demographics and health system utilization. Directed and undirected mining techniques were used to explore the data and to visualize specific patterns. This type of analysis can be used to improve processes for engaging patients through a patient portal, as well as to enhance the portal interface to support different user needs.

3 - Visualization of Care Delivery to Asthma Patients in Pediatric Emergency Departments

Mustafa Ozkaynak, Assistant Professor, University of Colorado, 13120 E 19th Ave, Aurora, CO, 80045, United States of America, mustafa.ozkaynak@ucdenver.edu, Marion Sills

We used Eventflow (an interactive visualization tool) to examine the temporal relationship between care delivery activities for asthma patients in an academic pediatric emergency department and its four satellite clinics. Time-stamped event logs from Electronic Health Records were processed and workflow patterns in each of the five settings for different acuity level and arrival mode were highlighted. Findings can inform systematic organizational interventions that will improve quality of care.

4 - Healthcare Process Discovery and Visualization

Rahul Basole, Associate Professor, Georgia Institute of Technology, 85 Fifth Street NW, Atlanta, GA, 30332, United States of America, basole@gatech.edu, Mayank Gupta, Mark Braunstein, Polo Chau, Hyunwoo Park, Robert Pienta, Brian Kahng, Vikas Kumar, Nicoleta Serban, Michael Thompson

Healthcare processes are complex activities that span organizational, spatial, and temporal boundaries. Systemic insights are consequently difficult to achieve. Our research develops a data-driven methodology, fusing systems modeling, data mining, and visualization, to identify, describe, and visualize healthcare processes. We illustrate our methodology with a case study in pediatric healthcare.

■ WC35

35-Room 412, Marriott

Global Issues I

Contributed Session

Chair: Satish Nargundkar, Associate Professor, Georgia State University, 35 Broad St., Suite 827, Atlanta, GA, 30302, United States of America, snargundkar@gmail.com

1 - Creative Destruction through Online Education:

What Industry and Students Can Teach Academics

Andrei Villarroel, Professor, Swiss Entrepreneurship Institute, 4 Chemin du Musee, Fribourg, Switzerland, andreiv@mit.edu

Our research spans 54 countries, 44 industries, unveiling the value of a new generation of online education organizations from HEI professors, industry practitioners, and current students. Amongst respondents with first-hand experience with MOOC education, they find it superior to traditional education in 14 out of 15 dimensions long-believed better served by the traditional campus-based education model.

2 - Orientation Determination of Hotel Buildings using 3-d GIS for Maximum Rental Revenue

Young-ji Byon, Assistant Professor, Khalifa University, Al Saada St. and Muroor Rd., Abu Dhabi, 127788, United Arab Emirates, youngji.byon@kustar.ac.ae, Joonsang Baek, Chung-suk Cho

Hotel room rates are strongly related to the quality of scenery from the rooms. In Dubai and Abu Dhabi, great number of new hotel constructions are being planned. By utilizing the 3-D elevation model in GIS, it is possible to quantifiably determine the optimal direction of the hotel buildings before the constructions begin, that would maximize the scenic views of the hotels and hence also the room rental revenue.

3 - Healthcare Analytics Data and Insights on Patient Satisfaction

Satish Nargundkar, Associate Professor, Georgia State University, 35 Broad St., Suite 827, Atlanta, GA, 30302, United States of America, snargundkar@gmail.com, Subhashish Samaddar

The lack of patient satisfaction data across the hospital system limits the ability of researchers to investigate the customer service elements of the patient experience. In this paper we collect and organize hospital-level patient satisfaction data over a six year period from multiple websites, and make it available to the research community. We identify research opportunities in healthcare quality analytics. We analyze the data to offer some insights on patient satisfaction across the U.S.

■ **WC36**

36-Room 413, Marriott

Modeling Disease Transmissions Using Contact Networks

Sponsor: Public Sector OR

Sponsored Session

Chair: Chaitra Gopalappa, University of Massachusetts, 160 Governors Drive, University of Massachusetts, Amherst, MA, 01003, United States of America, chaitrag@umass.edu

1 - Understanding Feedback Between Behavioral Interventions and Disease Evolution

Kaja Abbas, Assistant Professor, Virginia Tech, Dept. of Vet Med, Blacksburg VA, United States of America, kaja.abbas@vt.edu,
Achla Marathe, Samarth Swarup, Achla Marathe,
Samarth Swarup

Disease evolution and behavioral responses to outbreaks are interrelated through a complicated feedback process. Just like the disease, individuals' perceptions and behaviors continuously evolve resulting in self-guided behavioral adaptations. Some of these adaptations dynamically change the social contact network, which in turn affects the opportunities for transmission of the disease. This research will describe the computational methods that account for these feedback.

2 - Spread on Dynamic Networks: Calibration and Forward Reachable Sets

Benjamin Armbruster, Northwestern University, 2514 Sheridan Rd, Evanston, IL, United States of America, armbrusterb@gmail.com

We discuss various topics about spread on networks including (1) calibrating the network dynamics of a detailed agent-based model of HIV spread and (2) the notion of a forward reachable set, an extension of connectivity or reach to dynamic networks, specifically, the set of all nodes that could have been infected/reached in a certain time. We derive simple analytic results on its growth.

3 - Network Modeling of HIV

Chaitra Gopalappa, University of Massachusetts, 160 Governors Drive, University of Massachusetts, Amherst, MA, 01003, United States of America, chaitrag@umass.edu

Very few models in the literature on HIV consider partnership networks, specifically partnership concurrency, for simulating transmissions. We evaluate the differences in estimated new infections with and without inclusion of concurrency by modeling sexual behavior among the different risk groups in the US.

4 - Impact of a Potential Human-to-Human Transmittable H7N9 Pandemic Outbreak in the U.S.

Walter Silva Sotillo, PhD Student, University of South Florida and Pontificia Universidad Catolica del Peru, 4202 E. Fowler Ave, Av. Universitaria 1801, Lima Peru, Tampa, FL, 33620, United States of America, silvasotillo@mail.usf.edu, Tapas K. Das

From March 2013 until March 2015, WHO reported more than 640 cases (with 35% fatality) of H7N9 flu, most from the mainland of China. There are some cases reported on February 2015 that cannot be excluded from a potential human-to-human transmission scenario. We use data from recent reports and an Agent-based simulation model to predict a potential impact of H7N9 pandemic outbreak in the U.S.

■ **WC37**

37-Room 414, Marriott

Health Care Strategy and Policy I

Contributed Session

Chair: Jie Song, Peking University, Room 512, Fangzheng Building, Beijing, China, songjie@coe.pku.edu.cn

1 - A Manufacturer's View of the United States Healthcare System

Kurt Masten, Drexel University, Gerri C Lebow Hall, 3220 Market Street, Philadelphia, PA, 19104, United States of America, kam478@drexel.edu

The traditional and idealistic vision of a doctor making a house call to a sick patient is not representative of how the process actually works. This research takes a novel approach to modeling the healthcare system from a parts manufacturing perspective that questions the typical assumptions of healthcare as a service and the patient as the customer. Potential improvements are considered based on JIT, lean, and other established manufacturing practices.

2 - Feedback of Standardized Clinical Process on Patient Satisfaction

Yunsik Choi, PhD Candidate, Clemson University, 100 Sirrine Hall, Clemson, SC, 29634-1305, United States of America, yunsikc@clemson.edu, Aleda Roth, Lawrence Fredendall

To better understand the standardized clinical process that support or inhibit front-line nurses' patient care, this study identifies positive (e.g., task time reduction & problem identification) and negative feedback (e.g., use of shortcuts, perceived workload intensity) driven by the standardized process that affect patient satisfaction.

3 - Supporting Health Policy through Modeling and Microsimulation

Steven Cohen, Vice President, DSDS, Research Triangle Institute, 3040 East Cornwallis Road, Research Triangle Park, NC, 27709, United States of America, scohen@ahrq.gov

There is a growing demand for timely, accurate and precise estimates of health care parameters at the national and sub-national levels in concert with data resources to inform policy and practice. Critical measures include health insurance coverage, health care utilization, and expenditures. This presentation will focus on issues of data quality and the statistical integrity of modeling efforts.

4 - Is the Public-private Partnership Healthcare Program Socially Beneficial?

Jie Song, Peking University, Room 512, Fangzheng Building, Beijing, China, songjie@coe.pku.edu.cn, Jianpei Wen, Frank Youhua Chen, Yimin Yu

Motivated by the long indirect waiting time in Hong Kong's public hospitals, a Public-Private Partnership (PPP) program was proposed for certain elective surgeries, which consists of a government subsidy and a threshold number for the waitlist. We propose a novel queuing model incorporating choice behavior of heterogeneous time-sensitive customers through MNL. The customer equilibrium joining behavior shows how the mechanism affects the overall social welfare in the PPP system.

■ **WC38**

38-Room 415, Marriott

Optimization Heuristic Programming

Contributed Session

Chair: Jin Qin, Doctoral Student, Huazhong University of Science & Technology, 1037 Luoyu Road, Wuhan, China, Wuhan, China, qinjinhu@163.com

1 - Regression Based Relaxation Solution Approach for Fixed Charge Network Flow Problem

Weili Zhang, Graduate Research Assistant, University of Oklahoma, 829 E Lindsey St, Norman, OK, 73071, United States of America, weili.zhang-1@ou.edu, Charles Nicholson

In this paper, a novel solution approach to the fixed charge network flow (FCNF) problem named regression based relaxation (RBR) is developed. RBR employs the probability of arc usage to form a new linear programming problem. Through rigorous testing, RBR outperforms linear programming relaxation and relaxation induced neighborhood search regardless of the complexity of the problem. In addition, the improvement of integrating RBR in the exact solver is robust for large FCNF problems.

2 - Travelling Salesman with Multiple Means of Transportation and Switching Cost

Qiwen Wang, Peking University, Guanghua School of Management, Beijing, 100871, China, wqw@gsm.pku.edu.cn, Yingjie Lan

We study a modified travelling salesman problem (TSP), where there are multiple transportation means (e.g., by aircraft, train, or car) between cities and there is a cost of switching from one means of transportation to another in a city. Not all transportation means are available between some cities. We provide an integer programming formulation, and design specialized heuristics to solve the problem.

3 - New Robust Efficiency Measures for Knapsack Problems

Christopher Wishon, PhD Candidate, Arizona State University, 633 W. Southern Ave, #1195, Tempe, AZ, 85282, United States of America, cwishon@asu.edu, J. Rene Villalobos

New efficiency measures have been developed for solving all multi-constraint knapsack problem variants. Using these measures, three solution heuristics are presented for solving the multi-demand, multi-dimensional knapsack problem: fixed-core reduction, genetic algorithm, and kernel search. Test cases have been solved using these heuristics demonstrating that the measures can be used to identify the same or better solutions than commercial software in a shorter time in a majority of cases.

4 - An Efficient VNS Heuristic for the Pickup and Delivery Traveling Salesman Problem with FIFO

Jin Qin, Doctoral Student, Huazhong University of Science & Technology, 1037 Luoyu Road, Wuhan, China, Wuhan, China, qinjinhu@gmail.com, Qinghua Wu, Xianhao Xu

In this paper, we present a variable neighborhood search(VNS) algorithm to solve a variant of the traveling salesman problem with pickup and delivery(TSPDP), named the TSPDP with first-in-first-out loading (TSPPDF). The VNS heuristic cooperate with a Simulated Annealing(SA) and two Tabu Search(TS) to solve this problem. Numerical experiment results show that the proposed heuristic produces better solutions than do the previous methods in relatively short computing times.

5 - Heuristic Methods for Automotive Stamping Scheduling

Sayak Roychowdhury, PhD Student, The Ohio State University, 1971 Neil Avenue, Columbus, Oh, 43210, United States of America, roychowdhury.6@osu.edu, Theodore Allen

A major automotive manufacturer plans parts to be made by a large stamping machine on a seven day basis to conform to an overall vehicle schedule. The problem involves setups, part and die set families, storage constraints, and the possibility of downstream process starvation. Multiple heuristics are compared in terms of solution quality and computational speed.

■ WC39

39-Room 100, CC

Operations Management and Marketing Interface

Cluster: Operations/Marketing Interface

Invited Session

Chair: Shuya Yin, University of California, Irvine, Merage School of Business, Irvine, United States of America, shuya.yin@uci.edu

1 - Impact of Media Substitution and Synergy in Media Planning Decisions for A New Product Introduction

Vahideh Abedi, Assistant Professor, California State University Fullerton, Fullerton, CA, United States of America, vabedi@exchange.fullerton.edu, Dmitry Krass, Oded Berman

Substitutive and synergic interactions between multiple marketing media can significantly influence media planning strategies of firms. However, the existing literature focuses on only one of these two types of interactions. We show that most typically channel interactions are both substitutive and synergistic at the same time in the context of a new product introduction. We derive several insights on the implications of this co-existence and its influence on the firm's media planning decisions.

2 - Balanced or Unbalanced Market Structure? An Upstream Supplier's Perspective

Yuhong He, Assistant Professor, California State University, Fullerton, Fullerton, United States of America, yuhe@fullerton.edu, Shuya Yin, Saibal Ray

Upstream suppliers often need to decide whether or not to reply on dominant retailers in the market place when they sell through the downstream partners. We propose an economic model to gain some understanding of the basic trade-offs involved in such decision making processes.

3 - Setting the Optimal Pledge and Target in Crowdfunding Campaigns

Rachel Chen, Associate Professor, rachen@ucdavis.edu, Esther Gal-or, Paolo Roma

Crowdfunding campaigns (of consumer products) allow the entrepreneur to raise funds from the crowd, and, if succeeded, sends a positive signal to the VC about how the product is likely to be received by consumers. If the campaign fails, however, the entrepreneur will have great difficulty getting funded by the VC. This paper examines the entrepreneur's decision in setting the pledge and the target in crowdfunding campaigns.

4 - A Generalized Model on Forecasting Repeat Sales

Yibo Zhou, Ruixia Shi

We propose a stochastic model to forecast customers' repeat purchasing. We extend the traditional mixture distribution model (negative binomial distribution) to the general situation, which fully captures customers' heterogeneity. The generalization is made possible through using the Gaussian quadrature. The model retains the elegance of NBD framework and can be easily implemented. Our results show that the proposed method outperforms the traditional forecast methods.

■ WC40

40- Room 101, CC

Operations Management/Marketing Interface II

Contributed Session

Chair: Prateek Raj, PhD Student, Department of Management Science and Innovation, UCL, Gower Street, London, WC1E 6BT, United Kingdom, p.raj.12@ucl.ac.uk

1 - Context Dependent Preferences and Bundling Strategy

Qianbo Yin, CUHK, Room 941, CYT, CUHK, HK, HK, Hong Kong - PRC, qianboyin@gmail.com, Sean Zhou

The bundling literature explains pure components strategy and pure bundling strategy are optimal in perfectly and imperfectly competitive industries, respectively. However, when consumers respond to distinct product portfolios and exhibit context-dependent preferences, the optimal bundling strategy may change. This paper finds this consumer behavior boosts the introduction of the bundle and mixed bundling strategy is optimal under certain conditions.

2 - Dominant Retailer's Strategic Response to Efficient Fringe Retailers

Zhong Chen, PhD Student, The Chinese University of HongKong, Room 943, Cheng Yu Tung Building,, The Chinese University of HongKong, N.T., HongKong, Hong Kong - PRC, zhongchen@baf.cuhk.edu.hk, Ehsan Bolandifar

Dominant retailers like Walmart has the power to negotiate their suppliers to get more favourable contract terms while fringe retailers lack such market power. Industry evidences indicates that fringe retailers are becoming more efficient in their operations which puts pressure on dominant retailers to become even more aggressive in their procurement contracts. We present a model to study strategic response of a dominant retailer to such improvement in operational efficiency of fringe retailers.

3 - Licensing Contracts in Conspicuous Markets

Prateek Raj, PhD Student, Department of Management Science and Innovation, UCL, Gower Street, London, WC1E 6BT, United Kingdom, p.raj.12@ucl.ac.uk, Kenan Arifoglu

We study licensing decision of a brand-owning firm that sells its primary product to conspicuous customers, who value the brand exclusivity, and also licenses its brand name to a licensing firm. We compare fixed-fee and royalty contracts, and develop a mixed contract that improves the profit and coordinates the system.

■ WC41

41-Room 102A, CC

Healthcare Operations

Sponsor: Manufacturing & Service Oper
Mgmt/Healthcare Operations
Sponsored Session

Chair: Van-Anh Truong, Columbia University, 500 West 120th St, New York, NY, 10027, United States of America, vt2196@columbia.edu

1 - Online Advance Admission Scheduling for Services, with Customer Preferences

Xinshang Wang, Columbia University, 500 West 120th St, New York, NY, 10027, United States of America, xw2230@columbia.edu, Van-Anh Truong

We study web and mobile applications that are used to schedule advance service, from medical appointments to restaurant reservations. We give the first online, data-driven algorithms with performance guarantees for these problems. We show that the average performance of our algorithms is bounded by 1/2 times that of an optimal algorithm. We test the empirical performance of our algorithms by using data from a department within a major academic hospital system in New York City.

2 - Service Encounters in Outpatient Clinics

Michele Samorani, Assistant Professor, University of Alberta, 3-20F Business Building,, University of Alberta, Edmonton, AB, T6G 2R6, Canada, samorani@ualberta.ca, Dan Zhang

The appointment scheduling literature typically focuses on "individual appointments" which may end with a no-show, a cancellation, or a patient arrival. However, cancellations and no-shows are often followed (possibly with some time lag) by rebooking another individual appointment, until the patient finally sees the doctor. We empirically study such sequences of individual appointments, which we call service encounters, and discuss the implications of our findings on capacity planning.

3 - Adaptive Robust Optimization of Surgery and Downstream Capacity Planning

Saba Neyshabouri, PhD Student, George Mason University,
SEOR Department, Engr Bldg, Rm 2100, MS, Fairfax, VA, 22030,
United States of America, sneyshab@gmu.edu, Bjorn Berg

We propose a novel robust optimization formulation to address the uncertainty in surgery duration and length-of-stay (LOS) in the downstream unit. The structure of the problem is analyzed in order to adapt a column-and-constraint generation method to find the optimal solution to the formulation. The methodology presented can be used in other important applications such as resource-constrained project scheduling under activity duration uncertainty and inventory management.

4 - Multi-class, Multi-resource Advance Scheduling with No-shows, Cancellations and Overbooking

Mahshid Parizi, University of Washington, Industrial & Systems
Engineering, University of Washington Box 352650, Seattle,
United States of America, msalemp@uw.edu, Archis Ghatge

We study a scheduling problem where arriving stochastic demand of heterogeneous job-types is booked into the booking horizon or is rejected. The effect of cancellations, no shows and overbooking is included. Scheduling decisions must respect multiple resource constraints. We formulate an MDP model and provide an approximate dynamic programming algorithm rooted in Lagrangian relaxation, value function approximation and constraint generation. The resulting policies are compared with a myopic one.

■ WC43

43-Room 103A, CC

Innovative Pricing Strategies

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Pnina Feldman, UC Berkeley Haas School of Business, 2220
Piedmont Ave, Berkeley, CA, 94720, United States of America,
feldman@haas.berkeley.edu

1 - Unbundling of Ancillary Service: How Does Price Discrimination of Main Service Matter?

Yao Cui, Cornell University, 401N Sage Hall, Ithaca, United States
of America, yao.cui@cornell.edu, Izak Duenyas, Ozge Sahin

We consider a setting where the firm sells a main service (e.g., air travel) and an ancillary service (e.g., baggage delivery) to multiple consumer segments (e.g., business travelers and leisure travelers). We study how the firm's ability to charge discriminatory main service prices affects its decision of whether to unbundle the ancillary service from the main service and charge separate prices.

2 - Dynamic Pricing in the Presence of Social Learning and Strategic Consumers

Yiangos Papanastasiou, Haas School of Business, UC Berkeley,
Berkeley, CA, 94720, United States of America,
yiangos@haas.berkeley.edu, Nicos Savva

When a product of unknown quality is first introduced, consumers may choose to strategically delay their purchasing decisions in order to learn from the reviews of their peers (social learning). This paper investigates how the presence of social learning affects the strategic interaction between a dynamic-pricing monopolist and a forward-looking consumer population.

3 - Innovative Dynamic Pricing: The Potential Benefits of Early-purchase Reward Programs

Yossi Aviv, Professor, Washington University, 1 Brookings Drive,
St. Louis, MO, 63130, United States of America, aviv@wustl.edu,
Mike Wei

The management science literature has studied on the implications of strategic consumer behavior on the effectiveness of dynamic pricing strategies. Possible ways to mitigate the adverse effect of strategic consumer behavior include price commitment, inter-temporal price matching, and capacity rationing. In this work, we propose a scientific model to theoretically examine the optimal structure and effectiveness of an early-purchase reward program as a mechanism for mitigating strategic behavior.

4 - The Operational Advantages of Threshold Discounting Offers

Simone Marinesi, Wharton, 562 Jon M. Huntsman Hall, 3730
Walnut St, Philadelphia, PA, 19104, United States of America,
marinesi@wharton.upenn.edu

Inspired by Groupon, this study examines how Threshold-Discounting strategies—the idea to offer a discounted service to customers conditional on enough customers subscribing to the offer—can significantly boost operational performance and profit by improving capacity utilization. However, when offered through powerful intermediaries, such offers can be much less effective and even harmful. Surprisingly, in this context, we show that customer strategic behavior is beneficial to the firm.

■ WC44

44-Room 103B, CC

Contemporary Challenges in Pricing and Revenue Management: Repetitive Purchases and Loss Aversion

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Necati Tereyagoglu, Assistant Professor of Operations
Management, Scheller College of Business, Georgia Institute of
Technology, 800 W Peachtree St NW, Suite 4424, Atlanta, GA, 30308,
United States of America, Necati.Tereyagoglu@scheller.gatech.edu

1 - Optimal Pricing of Access and Secondary Goods with Repeat Purchases: Evidence from Online Grocery

Ricard Gil, Associate Professor, ricard.gil@jhu.edu,
Evsen Korkmaz, Ozge Sahin

We investigate optimal pricing strategies for an online grocery retailer who derives its profits from delivery fees and grocery sales. We derive testable theoretical implications that we take to data using a unique dataset detailing transaction information from an online grocery retailer in a Western European country. We find that firms may increase profits by implementing alternative and simpler pricing strategies that combine second and third degree price discrimination schemes.

2 - Loss Aversion and the Uniform Pricing Puzzle for Vertically Differentiated Products

Javad Nasiry, Assistant Professor, Hong Kong University of
Science and Technology, ISOM, LSK Building, HKUST, Hong
Kong, Hong Kong - PRC, nasiry@ust.hk, Pascal Courty

The uniform pricing puzzle states that a monopolist sells high and low quality products at the same price despite the fact that quality is perfectly observable and that there are no significant costs of adjusting prices. We resolve the puzzle by accounting for consumer loss aversion in monetary and consumption utilities and by assuming that the reference point is endogenously set as part of a “personal equilibrium” and includes only past purchases of products of the same quality.

3 - Service Pricing with Loss Averse Customers

Liu Yang, Tsinghua University, School of Economics and
Management, Tsinghua university, Beijing, 100084, China,
yangliu@sem.tsinghua.edu.cn, Pengfei Guo, Yulan Wang

We consider a service system in which customers are loss averse towards both price and delay attributes. We first study customers' equilibrium queueing strategies. We find that, in contrast to the traditional case in which loss aversion is not considered, there could exist three equilibrium strategies. We then study the optimal pricing problem for a monopoly server. We show that loss aversion polarizes queues, making long queues even longer and short queues even shorter.

4 - Multi-Attribute Loss Aversion and Reference Dependence: Evidence from Performing Arts Industry

Necati Tereyagoglu, Assistant Professor of Operations
Management, Scheller College of Business, Georgia Institute of
Technology, 800 W Peachtree St. NW, Suite 4424,
Atlanta, GA, 30308, United States of America,
Necati.Tereyagoglu@scheller.gatech.edu, Peter Fader,
Senthil Veeraraghavan

We hypothesize that not only the price but also the observed sales for a seating area determines the utility of a customer from buying a ticket for a show in this industry. We test the reference effects for both prices and sales using customer level transaction data from an orchestra in the US, and show that patron decisions are driven by the position of the seating alternatives relative to price and sales expectations. We find that the revenue effects of referencing are significant.

■ WC45

45-Room 103C, CC

Sustainability II

Contributed Session

Chair: Xu Chang-yan, Shanghai Maritime University, 1550 Haigang
Avenue, Shanghai, 201306, China, silu369@126.com

1 - Including Regeneration Possibilities to Increase Water Reuse in Scheduling Multipurpose Batch Plants

Renzo Akkerman, Technische Universität München, TUM School
of Management, Arcisstr 21, München, 80333, Germany,
renzo.akkerman@tum.de, Pulluru Sai Jishna

Scheduling of multipurpose batch process plants has recently started integrating water reuse objectives, also including water regeneration processes. Including regeneration possibilities significantly alters the flexibility of schedules that are

already constrained on the use of water. This study aims to examine the impact of including regeneration possibilities on the flexibility of scheduling procedures and focuses on trade-offs between cost-optimal and water-efficient production schedules.

2 - A Layer Analysis Framework to Investigate the CO2 Sinks in the U.S. Manufacturing Supply Chain Network

Gokhan Egilmez, University of New Haven, Mechanical and Industrial Engineering, East Haven, CT, 06512, United States of America, gegilmez@newhaven.edu, Mohammad Aslam

In this study, U.S. manufacturing industries and related supply chains are analyzed from life cycle perspective considering layers in the supply chain. The focus of the analysis is greenhouse gas (GHG) emissions which are represented with CO2 equivalent metric. Input output-based life cycle assessment models are developed and layer analysis is conducted for 6 supply chain layers: onsite, second, third, fourth, fifth tier suppliers and rest of the supply chain.

3 - Promoting Fair Trade Products

Seung Jae Park, Assistant Professor, Texas A&M University-Central Texas, 1001 Leadership Place, Killeen, TX, 76549, United States of America, s.park@tamuct.edu

The study considers how to promote fair trade products. We show that competition between firms increases the usage of fair trade certified raw materials. We also show that if a fair trade organization can decide the maximum margin from fair trade products, then it will increase the usage of fair trade certified raw materials and increase each manufacturer's total profit compared to those without consideration of the maximum margin decision.

4 - Effect of Carbon Emission Regulations on the Supply Chain with Two Substitutable Products

Xu Chang-yan, Shanghai Maritime University, 1550 Haigang Avenue, Shanghai, 201306, China, silu369@126.com, Wang Chuan-xu, Rongbing Huang

We examine a decision problem for one retailer and one manufacturer under the influence of carbon tax policy set by the government. The manufacturer produces two partially substitutable products with different carbon emissions. The two-stage game theoretical model under three different carbon tax policies is investigated. The impact of carbon tax and green subsidy on the profits of the manufacture, the retailer, and the supply chain is analyzed.

WC46

46-Room 104A, CC

Sustainability and New Business Models

Sponsor: Manufacturing & Service Oper Mgmt/Service Operations
Sponsored Session

Chair: Karan Girotra, Associate Professor, INSEAD, Boulevard de Constance, Fontainebleau, 77300, France, Karan.Girotra@insead.edu

Co-Chair: Serguei Netessine, Professor, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, Serguei.Netessine@insead.edu

1 - Algorithms and Computational Results for the (CITI) Bike-sharing System

David Shmoys, Cornell University, School of ORIE, Rhodes Hall, Ithaca, NY, 14853, United States of America, david.shmoys@cornell.edu, Eoin O'Mahony, Ola Svensson, Shane Henderson

Bike-sharing systems are becoming increasingly prevalent in urban environments. Users imbalance the system by creating demand in an asymmetric pattern; this necessitates intervention to restore balance and facilitate future use. Pre-balancing the system in preparation for usage requires placement of the available bikes at stations to minimize the expected rush-hour outage minutes. We present algorithmic approaches for pre-balancing and both mid-rush hour and overnight rebalancing operations.

2 - The Implications of the Auto Manufacturer's Involvement in the Car Sharing Business

Ioannis Bellas, Assistant Professor, George Mason University-ISOM Area, Enterprise Hall, 4400 University Drive, MS 5F4, Fairfax, VA, 22030, United States of America, ibellos@gmu.edu, Mark Ferguson, Beril Toktay

We study the auto manufacturer's choice regarding whether to offer a car sharing business model in conjunction with the traditional sales channel. We determine the efficiency of the vehicles offered and we characterize the economic and environmental implications.

3 - Bike-share Systems: Empirical Models of Business Models

Karan Girotra, Associate Professor, INSEAD, Boulevard de Constance, Fontainebleau, 77300, France, Karan.Girotra@insead.edu, Ashish Kabra, Elena Belavina

This talk illustrates the use of big-data to capture consumer behavior in Bike-share systems. We then use the estimated patterns of customer to propose system improvements and redesigns.

WC47

47-Room 104B, CC

Incentive Issues in Sustainable Operations

Sponsor: Manufacturing & Service Oper Mgmt/Sustainable Operations
Sponsored Session

Chair: Luyi Gui, Assistant Professor, UC Irvine, United States of America, luyig@exchange.uci.edu

1 - Impact of Certification Programs on Waste Recovery

Gokce Esenduran, esenduran.1@osu.edu, Yen-Ting Lin, Wenli Xiao

R2 and E-stewards are two main certification programs for recyclers. The latter is stricter and costlier to implement; however when customers are "green", it would also result in higher product returns. In order to understand which certification is more profitable to adopt under what conditions, we model the competition between recyclers considering the consumers' and collectors' decisions as well. We also identify the impact of certification's stringency on the total recycling amount.

2 - The Joint Impact of Public Awareness Campaigns and System Infrastructure on E-Waste Collection

Wenyi Chen, Postdoc, McGill University, 1001 Rue Sherbrooke Ouest, Montreal, QC, H3A 1G5, Canada, wenyi.chen@mail.mcgill.ca, Jianmai Shi, Vedat Verter

We present a dynamic formulation for the joint design of the collection center network and the campaign strategy for a monopolistic non-profit organization. We use a Nerlove-Arrow-type advertising model to capture the "carryover effect" in the consumers' environmental awareness and a continuous approach to incorporate the impact of the collection center locations. A case study based on the British Columbia Stewardship Program in Canada is presented.

3 - Impact Analysis of Recyclability and Reusability on Greenhouse Gas Emissions and Related Cost

Hailong Cui, University of Southern California, Marshall School of Business, Bridge Hall B5, Los Angeles, CA, 90089, United States of America, Hailong.Cui.2019@marshall.usc.edu, Greys Sosis

We build supply chain models to evaluate the impact of recyclability and reusability on the emissions through the products' life cycle and derive conditions that lead to reduction in the long-run average emissions. We then investigate the cost of recycling and emissions imposed on the supply chain and on the society to understand optimal decisions for centralized and decentralized cases. We compare outcomes obtained when recycling is run by the government and when it is done by the manufacturer.

WC48

48-Room 105A, CC

Revenue Management Pricing I

Contributed Session

Chair: Fredrik Odegaard, Ivey Business School, Western University, 1255 Western Road, London, ON, N6G 0N1, Canada, fodegaard@ivey.uwo.ca

1 - Dynamic Pricing to Maximize Profits in Multiproduct and Multioutlet Channel Systems

Markus Bergmeier, Research Assistant, University of Passau / Chair of Marketing and Services, Innstr. 27, Passau, 94032, Germany, markus.bergmeier@uni-passau.de, Dirk Totzek

To date, operations research approaches have played a minor role in the field of managing multiple online and offline distribution channels. We develop an optimization model that captures heterogeneous customer characteristics over time and enables companies to choose profit-maximizing prices for each product, distribution channel, intermediary, consumer group, and period. We test this model using data from different industries and show that it leads to higher profits and optimal coordination.

2 - Dynamic Pricing with Bogo Promotion in Revenue Management

Sunggyun Park, Doctoral Program, KAIST, 291 Daehak-ro
Yuseong, Daejeon, Korea, Republic of, sunggyun@kaist.ac.kr,
Kyoung-kuk Kim, Chi Guhn Lee

We consider a dynamic pricing problem when a seller sells a single product in a finite horizon. We particularly focus on the widely adopted promotional schemes “buy one get one free” and “50% off” and study the optimal strategic choices of the seller. Analytical results together with numerical experiments are presented to help us obtain managerial insights. Additional numerical results for a generalized model are provided so as to examine the effectiveness of promotional schemes.

3 - Estimation from Competitor Data

Möge Tekin, Universitat Pompeu Fabra, Ramon Trias Fargas, 27,
Barcelona, Spain, muge.tekin@upf.edu, Kalyan Talluri

Competitor price information is available as a data stream in many industries. Also, in the hotel industry some providers reveal competitor occupancy rates. While this information is very closely monitored by hotel managers, it has not been fully exploited by revenue management systems. We exploit this marginal information to answer a question of great interest to pricing managers: How much should I price above (or below) the competitor's price?

4 - Revenue Bounds for Bundling Strategies under Dependent Valuations

Fredrik Odegaard, Ivey Business School, Western University,
1255 Western Road, London, ON, N6G 0N1, Canada,
fodegaard@ivey.uwo.ca, Mihai Banciu, Alia Stanciu

Digital goods such as radio streaming, television channels or e-journals are frequently bundled in packages of large sizes. Moreover, most of these bundles incorporate goods that have dependent valuations, which makes the associated revenue optimization problem hard to solve analytically. In this paper, we derive tight bounds for the seller's revenue function and show the existence of an optimal maximin pricing strategy.

■ WC49

49-Room 105B, CC

Incentive and Compensation Schemes in Supply Chains

Sponsor: Manufacturing & Service Operations Management
Mgmt/Supply Chain
Sponsored Session

Chair: Sandra Transchel, Kuehne Logistics University, Grosse
Grasbrook 17, Hamburg, Germany, Sandra.Transchel@the-klu.org

1 - You Get What You Pay For: CEO Compensation and the Inventory Rhombus

Kristoph Ullrich, Köhne Logistics University - KLU,
Grosse Grasbrook 17, Hamburg, 22297, Germany,
Kristoph.Ullrich@the-klu.org

This article seeks and finds empirical evidence of a relationship between CEO compensation and inventory investments in multiple direct and indirect ways. I identify the dominant of the competing hypotheses that emerge from OM theory: CEOs whose compensation is more dependent on the stock price follow less risky strategies and invest less in inventories. CEOs whose compensation is more dependent on the stock price volatility follow more risky strategies and have higher inventory investments.

2 - Contract Design in Processing Trade under Information Asymmetry

Paolo Letizia, Assistant Professor of Business Analytics, University
of Tennessee, 223 Stokley Management Center, 916 Volunteer
Boulevard, Knoxville, TN, 37996, United States of America,
pletizia@utk.edu, Long Gao

Processing companies have repeatedly wrestled on the question whether they should control or delegate the quality of their products to foreign producers. We study this important question when there is a gap of expertise in the production processes between the processing company and its producer. We find that although quality delegation involves a control loss, it allows the producer to leverage on his superior expertise resulting in a flexibility gain.

3 - Salesforce Compensation under Inventory Rationing

Sandra Transchel, Kuehne Logistics University, Grosse Grasbrook
17, Hamburg, Germany, Sandra.Transchel@the-klu.org,
Kristoph Ullrich, Ruud Teunter, Jasper Veldman

We study sales quota-based compensation schemes of two sales agents who can exert effort to stochastically increase demand. Both agents satisfy demand from the same inventory, which is ordered by the firm before demand uncertainty is revealed. As actual demand and exerted sales effort are unobservable by the firm, both agents decide on their effort level based on sale quota bonus contract, inventory level, and allocation policy, which are designed by the firm to maximize the expected profit.

4 - Cultural Attitudes Towards Contract Design in Supply Chain Exchanges

Dina Ribbink, Assistant Professor, Western University,
1255 Western Rd, London, ON, Canada, dribbink@ivey.ca,
Yun Shin Lee, Stephanie Eckerd

The purpose of this study is to investigate the impact of national culture on the design and effectiveness of bonus and penalty incentive contracts. We conduct laboratory experiments in Canada, China, and the Republic of Korea, and evaluate buyers' contract design decisions and suppliers' responses.

■ WC50

50-Room 106A, CC

Non-Profit Operations Management

Sponsor: Manufacturing & Service Operations Management
Sponsored Session

Chair: Sripad Devalkar, Assistant Professor, Indian School of Business,
Gachibowli, Hyderabad, 500032, India, sripad_devalkar@isb.edu

Co-Chair: Karthik V. Natarajan, Assistant Professor, University of
Minnesota, 321 19th Avenue South, 3-150, Minneapolis, MN,
United States of America, knataraj@umn.edu

1 - Understanding and Improving Global Health Supply Chains: An Analysis of Global Supply Chain D

Ananth Iyer, Susan Bulkeley Butler Chair In Operations
Management, Purdue University, Purdue University,
West Lafayette, IN, United States of America, aiyer@purdue.edu,
Gemma Berenguer

We focus on data from USAID which provides all shipments across the supply chain in 2011-2012. We built statistical and mathematical programming models to understand the logic of the flows, explore the impact of changes in mode mix and changes in supply chain structure and explore the impact of lead times, transshipment etc. Our goal is to enable an understanding of the cost and service level impact on the operation of the supply chain.

2 - Effect of Armed Conflicts on Humanitarian Operations

Alfonso Pedraza-Martinez, Assistant Professor, Indiana University,
1309 E 10th Street, Bloomington, IN, 47405, United States of
America, alpedraz@indiana.edu, Andres Jola-sanchez,
Kurt Bretthauer, Rodrigo Britto

We study an important but widely neglected topic in humanitarian operations: armed conflicts. Specifically, we analyze the effect of man-made disasters (armed conflicts) on the operational performance of rural hospitals and investigate what is the effect of conflicts on: (i) the efficiency of rural hospitals? (ii) the total factor productivity of rural hospitals? and (iii) patient satisfaction? We use panel data from 163 public rural hospitals in Colombia during the period 2007-2011.

3 - Payment for Results: Signaling Efficiency in Non-profit Operations

Milind Sohoni, Associate Professor Of Operations Management
And Sr. Associate Dean Of Programs, Indian School of Business,
Gachibowli, Indian School of Business, Gachibowli, Hyderabad,
PL, 500032, India, milind_sohoni@isb.edu, Sripad Devalkar

We consider the problem of a NPO raising funds for projects. Donors care about the end benefits but are uncertain about the NPO's efficiency. We compare the performance of traditional fund raising, where donors contribute before implementation, with an emerging form of ‘payment for results’ wherein the NPO implements a project and then seeks contribution. We highlight conditions when the ‘payment for results’ option dominates. Our results suggest important implications for regulators too.

4 - Dynamic Programming to Reduce Environmental Impacts of Food Waste at Campus Dining Services

Esma Birisci, Student, University Of Missouri, 246 Engineering
Building West, Columbia, MO, 65211, United States of America,
esmaibirisci@mail.missouri.edu, Ronald McGarvey,
Christine Costello

This research incorporates environmental impacts of food wastage into a cost-minimizing stochastic inventory model of campus dining service operations. We use Life Cycle Analysis estimates to account for broader environmental costs of wasted food, focusing on how optimal food production and ordering decisions can reduce storage losses and over preparation losses.

■ WC51

51-Room 106B, CC

Consolidation and Asymptotics in Inventory

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Stefanus Jasin, Stephen M. Ross School of Business, University of Michigan, Ann Arbor, United States of America, sjasin@umich.eduCo-Chair: Linwei Xin, Assistant Professor, University of Illinois at Urbana-Champaign, 104 S. Mathews Ave., Urbana, IL, 61801, United States of America, lxin@illinois.edu**1 - Centralized and Decentralized Warehouse Logistics Collaboration**Shiman Ding, UC Berkeley, IEOR Dept., Berkeley, CA, 94720-1777, United States of America, shiman@berkeley.edu, Philip Kaminsky

An emerging paradigm for logistics collaboration in the grocery industry centers on large third-party warehouses that multiple suppliers use as warehouses or mixing centers, and from which multiple retailers order mixed-product truckloads. We explore centralized and decentralized strategies for operating shared warehouses, and characterize the loss due to decentralized operation.

2 - Shipment Consolidation for Online RetailersLai Wei, Stephen M. Ross School of Business, 701 Tappen Ave, Ann Arbor, MI, 48109, United States of America, laiwei@umich.edu, Roman Kapuscinski, Stefanus Jasin

The online retailers have a significant flexibility how to satisfy multiple orders for customers. An existing order can be strategically delayed to combine with future orders, such that a single shipping cost can be incurred for multiple orders. But delaying the shipment increases the shipping cost itself, as shorter remaining time requires expedited shipping. We characterize the structure of the optimal policy and use such insights to construct easily implementable near-optimal heuristics.

3 - Asymptotic Optimality of Tailored Base-Surge Policies in Dual-Sourcing Inventory SystemsLinwei Xin, Assistant Professor, University of Illinois at Urbana-Champaign, 104 S. Mathews Ave., Urbana, IL, 61801, United States of America, lxin@illinois.edu, David Goldberg

Dual-sourcing inventory systems are notoriously difficult to optimize. Recently, so-called Tailored Base-Surge policies have been analyzed in Allon and Van Mieghem (2010) and Janakiraman et al. (2014). Although numerical results have suggested that such policies perform well as the lead time difference grows large, providing a theoretical foundation for this phenomenon has remained a major open problem. In this talk, we resolve this open problem by proving asymptotic optimality of such policies.

4 - Replenishment Policies in Assemble-to-order Inventory Systems with Non-identical Lead TimesMartin I Reiman, Bell Labs, 600 Mountain Ave., Murray Hill, NJ, 07974, United States of America, martyreiman@gmail.com, Haohua Wan, Qiong Wang

In Assemble-to-Order systems, the use of one component often depends on the availability of others. Thus ordering decisions for components with shorter lead times should be coordinated with decisions made at earlier times for those with longer lead times. The independent base stock policy does not have this feature and we will assess the impact of this deficiency on the inventory cost. We will also explore alternative policies that improve an asymptotic-optimality criterion.

■ WC52

52-Room 107A, CC

Retail Management III

Contributed Session

Chair: Amir Ghiasi, PhD Student, University of South Florida, Department of Civil and Environmental Engineering, 4202 E. Fowler Avenue, Tampa FL 33620, United States of America, amirghiasi@mail.usf.edu**1 - The Prepack Optimization: A Case Study of a Korean Fashion Retailer**Shin Woong Sung, KAIST, 291 Daehak-ro, Yuseong-gu, Daejeon, Korea, Republic of, sw.sung@kaist.ac.kr, Young Jae Jang

This study considers a real-world inventory packing and distribution problem called "PrePack Optimization Problem (POP)" at the largest outdoor-fashion retailer in Korea, KOLON SPORT (K/S). We formulate a mathematical programming model for POP and propose a solution approach which can be efficiently utilized at K/S. The field experiments, conducted for two seasons, revealed that the approach remarkably improved the inventory stability.

2 - Socio-demographic Characteristic Associated with the Location of Organic and Local Food StoresAmir Ghiasi, PhD Student, University of South Florida, Department of Civil and Environmental Engineering, 4202 E. Fowler Avenue, Tampa, FL, 33620, United States of America, amirghiasi@mail.usf.edu, Guangqing Chi, Chuo Li, Xiaopeng Li

In this study, physical accessibility to organic and local food is examined relative to socio-demographic factors in New Orleans, LA. Linear and spatial regression models are adopted to investigate how the socio-demographic variables correlate with the distance of driving, biking, or walking to the stores. Results show that accessibility to organic food stores is more in denser areas and areas with more African-Americans, Hispanics and more educated people.

■ WC53

53-Room 107B, CC

Behavioral Issues in Supply Chains Regarding Quality and Competition

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Yinghao Zhang, Assistant Professor, Salisbury University, 1101 Camden Avenue, Salisbury, MD, 21801, United States of America, YXZhang@salisbury.eduCo-Chair: Diana Wu, University of Kansas, Lawrence, United States of America, dianawu@ku.edu**1 - The Decision to Recall: A Behavioral Investigation in the Medical Device Industry**George Ball, PhD Candidate, University of Minnesota, 321 19th Ave. S, Minneapolis, MN, 55455, United States of America, ball0197@umn.edu, Karen Donohue, Rachna Shah

Using a unique managerial subject pool with significant experience in product recall decision-making, this study identifies factors that impel medical device industry managers to decide to recall. We then incorporate a well-established Cognitive Reflection Test (CRT) to highlight sources of individual heterogeneity among recall decision-makers. The results of this study inform decision-making literature and may be able to improve the product recall decision-making process.

2 - Should Suppliers Bear the Qualification Costs?**Theory and Experiments**Wei Chen, Assistant Professor, The University of Kansas, 1450 Jayhawk Blvd, Lawrence, KS, 66045, United States of America, wei.chen@ku.edu, Milind Dawande, Ganesh Janakiraman, Elena Katok

A firm needs to source from a fixed-size pool of yet-to-be qualified suppliers for an indivisible contract. The contract can only be awarded to a supplier who passes a costly qualification test. Using the theory of optimal auction design and lab experiments, we investigate the following questions: Should suppliers bear the qualification costs in mechanisms that are optimal for the buyer? If suppliers are asked to bear these costs, should the buyer reimburse them in any way?

3 - Social Comparison and Pull-to-Center in Newsvendor ContestsValery Pavlov, The University of Auckland, Private Bag 92019, Auckland, New Zealand, v.pavlov@auckland.ac.nz, Nagesh Gavirneni, Tony Lin

We study a game of two newsvendors competing for a fixed bonus. Its most prominent feature is that the game is non-transitive (similar to Rock-Paper-Scissors), and the best-response is almost always "to order a quantity a bit closer to the mean than the competitor's". We test our model predictions experimentally and (i) find that a pull-to-center dynamics can emerge due to social comparison, and, (ii) find that friendship may be ineffective in mitigating competitive effects of social comparison.

4 - Perceived Versus Actual Value of Product Substitution FlexibilityBrent Moritz, Assistant Professor, Supply Chain Management, Pennsylvania State University, 469 Business Bldg., University Park, PA, 16802, United States of America, bmoritz@psu.edu, Saurabh Bansal

Using behavioral decision-making experiments for inventory of substitutable products, we investigate how decision-makers perform when estimating the value of operational flexibility of product substitution. Subjects consistently overestimated the monetary value of product substitution, and this is related to behavioral biases when estimating the conjunctive probability of substitution. We demonstrate a probability decomposition-based approach to mitigate this overestimation.

■ WC54

54-Room 108A, CC

Service Science I

Contributed Session

Chair: Oleg Pavlov, Associate Professor Of Economics And System Dynamics, WPI, SSPS, 100 Institute Rd., Worcester, MA, 01609, United States of America, opavlov@wpi.edu

1 - Demand Management and Optimal Workforce Scheduling in Professional Service Firms

Vincent Hargaden, University College Dublin, Engineering & Materials Science Centre, Belfield, Dublin 4, Ireland, vincent.hargaden@ucd.ie, Jennifer Ryan, Amir Azaron

We analyse the workforce planning process in professional services firms from a demand management perspective. Taking a project network approach, we develop a multi-objective optimization model, which minimizes both the total direct costs of project staff and the maximum delay from the scheduled durations across all projects. The result is a better utilization of the firm's workforce, while maintaining customer satisfaction.

2 - Strategies for Planning the ICT Convergence-based PSS Value Chain in Manufacturing Companies

Hosun Rhim, Professor Of Logistics, Service, And Operations Management, Korea University Business School, Anam-dong, Seongbuk-gu, 136-701, Seoul, Korea, Republic of, hrhim@korea.ac.kr, Yong Yoon

The ICT convergence-based Product Service Systems (PSS) is a migration strategy to be adopted for the manufacturers in the PSS business model planning stage. The structured process and the critical factors in that stage will be investigated. The analytic hierarchy process (AHP) has been implemented to organize and analyze a series of decisions.

3 - Exploiting Learning in Call Center Routing Decisions

Tom Robbins, Associate Professor, East Carolina University, College of Business, 3212 Bate Building, Greenville, NC, 27858, United States of America, robbinst@ecu.edu

We explore a call center environment where agents increase their productivity over time, but eventually quit. We consider a routing policy that attempts to exploit this situation and improve long-term call center performance. We examine policies where calls are routed to the most experienced agents when the call center is busy, to facilitate efficiency, and to the least experienced agent when the call center is slow, to facilitate learning.

4 - Education as a Service System

Oleg Pavlov, Associate Professor Of Economics And System Dynamics, WPI, SSPS, 100 Institute Rd., Worcester, MA, 01609, United States of America, opavlov@wpi.edu, Frank Hoy

Service science is an emerging discipline rooted in system science. Applied to education, the service science methodology views universities and academic programs as service systems that go through life-cycles. We study entrepreneurship education programs that are gaining in popularity, yet are notoriously difficult to build up and sustain. We describe them as educational service systems, review different program deployment models and identify factors that lead to their success or failure.

■ WC55

55-Room 108B, CC

Decision Analysis II

Contributed Session

Chair: Yudhi Ahuja, Associate Professor, San Jose State University, One Washington Square, San Jose, CA, 95192, United States of America, yudhi.ahuja@sjsu.edu

1 - Social Norms and Identity Dependent Preferences

Daphne Chang, School of Information, University of Michigan, 105 S. State Street, 3336 North Quad, Ann Arbor, United States of America, daphnec@umich.edu, Erin Krupka, Roy Chen

In our paper, we test the impact of norms on social identity driven choice by using a 2 (identity prime) x 2 (frame) x 2 (choice or norms) experimental design to separately and directly elicit empirical measures of identity dependent norms for eleven different redistribution situations. We demonstrate that including identity dependent norms improves our ability to predict behavior. Further, we estimate a key structural parameter of the social identity model identity dependent norm sensitivity.

2 - Combining Forecast Quantiles – A Numerical Investigation

Chen (mavis) Wang, Assistant Professor, Tsinghua University, Shunde Bldg. S609, Beijing, 100084, China, chenwang@tsinghua.edu.cn, Shu Huang, Vicki Bier

We review statistical methods for combining forecast quantiles from multiple experts, including equal weighting aggregation (by finding the average quantile, average probability, median quantile, or median probability), and performance-based weighting aggregation. We also propose a Bayesian quantile regression model to estimate location and precision biases and a more flexible Bayesian nonparametric model. We compare them using both simulation and a large dataset on expert opinion by Cooke.

3 - Approximate Representation for Time Series and its Application to Efficient State Estimation

Jianjun Lu, Associate Professor, China Agricultural University, No. 17, Qinghuadong Road, Haidian Distri, Beijing, 100083, China, ljjun@cau.edu.cn

We propose an approximate representation of multivariate time series by using the representative time series called latent time series based on covariance structure analysis where correlation among observed time series is utilized. The dynamic factor analysis for multivariate time series is extended. To avoid the whole estimation of state variable to each nonlinear system, we apply Particle Filters only for latent time series, and for another observed time series we use these estimated states.

4 - Forecasting Trends of Immigration to United States of America

Yudhi Ahuja, Associate Professor, San Jose State University, One Washington Square, San Jose, CA, 95192, United States of America, yudhi.ahuja@sjsu.edu

This paper deals with immigration statistics to United States of America from all over the globe. The future trends of immigrants have been estimated and their distributions over various States worked out. The paper concludes with implications of immigration on the economy, employment, education and social benefits.

5 - Integrated Fuzzy Approach for Analyzing Risk Analysis in Product Recovery System

Dr Jitender Madaan, Professor, Dept Of Management Studies, Indian Institute of Technology Delhi, Hauz Khas, New Delhi, 110016, India, jmadaan@iitd@gmail.com, Divya Chaoudhry

Paper proposes a novel methodology based on fuzzy set theory and evidential reasoning algorithm for quantifying the risks to capture the uncertainties of recovery system operations. It has practical implications for the organizations involved in product recovery to guide strategy formulation for the pro-active mitigation of risks. Moreover, paper would provide insights to the managers for enhancing the robustness of recovery systems along with better management of disruptions.

■ WC56

56-Room 109A, CC

Manufacturing I

Contributed Session

Chair: Felix Papier, Associate Professor, ESSEC Business School, Avenue Bernard Hirsch, Cergy, 95021, France, papier@essec.edu

1 - Managing Product Variety through Developing Vanilla Boxes using Hierarchical Clustering

Pooya Daie, Concordia University, 1455 De Maisonneuve Blvd. W., Montreal, QC, H3G 1M8, Canada, Pooyadaie@gmail.com, Simon Li

This paper focuses on implementing mass customization through development of semi-finished vanilla boxes to reduce supply chain cost. The challenge is that the possible number of vanilla boxes grows dramatically with increase in number of product variants. In solution, the basic information of product variety is captured in a matrix format, specifying the component requirements for each product variant. Then, hierarchical clustering is applied over the components with the considerations of demands.

2 - Tailor Made: Make-to-order Decisions at the Bottom of the Apparel Supply Chain

Suri Gurumurthi, Visiting Asst. Professor, HKUST, Clearwater Bay, Kowloon, HK, Hong Kong - PRC, imsuri@ust.hk

I discuss make-to-order strategies considered by apparel component suppliers at the bottom of the supply chain. The prevalent models for make-to-order decisions focus on decision-makers at the upper tiers of supply chains. I discuss make-to-order decisions at lower tier decision-makers who are subject to extremes of demand variability, but that also compete with very slim margins.

3 - Optimal Assembly Planning to Manage Manufacturing and Supply Chain Complexity Due to Product Variety

Jeonghan Ko, University of Michigan and Ajou University,
1205 Beal Ave., Ann Arbor, MI, United States of America,
jeonghan@umich.edu, Heng Kuang, Ehsan Nazarian

The complexity due to product variety has been an important issue for manufacturing and supply chains. Assembly planning determines the manufacturing process sequence and logistics, and plays a crucial role in minimizing such complexity. We propose a new complexity measure of assembly plans, verify the index through manufacturing and supply chain models, and provide a strategy for improved assembly plans. Our result illustrates the advantages of delayed differentiation and balanced planning.

4 - How Much Efficiency Is Enough?

Mohammad Ali Asudegi, University of Tennessee, 525 John D.
Tickle Engineering Building., 851 Neyland Dr, Knoxville, TN,
37996, United States of America, aliasudegi@gmail.com,
Rupy Sawhney

For many years the focus of many companies has been on efficiency metrics while other metrics have been ignored to gain higher efficiency. To define an optimal level of efficiency in a facility the interaction between efficiency and all other metrics should be studied. In this study, a framework is offered to define optimal level of efficiency considering other financial and non financial metrics for a better use of available resources.

5 - Managing Electricity Peak Loads in Make-to-Stock Manufacturing Lines

Felix Papier, Associate Professor, ESSEC Business School, Avenue
Bernard Hirsch, Cergy, 95021, France, papier@essec.edu

Our research is motivated by new manufacturing systems that smoothen electricity consumption to avoid expensive and carbon-emission-intensive peak loads. We study the control of stochastic make-to-stock manufacturing lines in the presence of peak loads. We show that standard methods in manufacturing research are not effective in this setting and we develop a new control policy. We derive analytic properties of the control policy for 2 workstations and develop a heuristic for more workstations.

WC57

57-Room 109B, CC

Power System Design and Optimization

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Amir Mousavian, Assistant Professor, Clarkson University, 8
Clarkson Avenue, Potsdam, NY, 13699-5790, United States of America,
amir@clarkson.edu

1 - Optimizing Primary Response in Preventive Security-constrained Optimal Power Flow

Hrvoje Pandzic, Faculty of Electrical Engineering and Computing
University of Zagreb, Unska 3, Zagreb, Croatia,
Hrvoje.Pandzic@fer.hr, Pierre Henneaux, Yuri Dvorkin,
Daniel Kirschen

Preventive Security-Constrained (PSC) Optimal Power Flow (OPF) dispatches controllable generators at minimum cost while ensuring that operating constraints on generation and transmission assets are respected during both the pre- and post-contingency states without relying on post-contingency redispatch. A new PSCOPF model that optimizes the droop coefficients of the synchronized generators will be described.

2 - Optimal Resilient Distribution Grid Design using a 3-phase Unbalanced AC Power Flow

Russell Bent, Los Alamos National Laboratory, P.O. Box 1663, Los
Alamos, NM, 87545, United States of America, rbent@lanl.gov,
Emre Yamangil, Harsha Nagarajan, Scott Backhaus

Modern society is critically dependent on the services provided by power systems. Here we discuss an optimal electrical distribution grid design problem that improves the resiliency of such systems. To improve tractability, we introduce two ways of approximating the 3-phase AC power flow equations and L-shaped infeasibility cuts. Our experiments show that, unless the network impedance profile is unrealistically modified, our algorithms remain tractable and the solutions provide good results.

3 - Dispatchability Maximized Energy and Reserve Dispatch

Wei Wei, Tsinghua University, 3-211, West Main Building,
Tsinghua Univ, Beijing, 100084, China,
wei-wei04@mails.tsinghua.edu.cn, Shengwei Mei, Jianhui Wang

The dispatchability of the affine policy based energy and reserve dispatch (AF-ERD) is shown to be a polytope. The mathematical model of AF-RED is proposed. An efficient SOCP based algorithm is developed to solve the proposed model. The

generalized Gauss inequality is adopted to evaluate the probability of infeasible real-time dispatch in the absence of the exact probability distribution of wind power.

4 - Optimal Energy Scheduling in a Microgrid Including Electric Vehicle Parking Lots

Ebrahim Mortaz, Auburn University, Auburn University, Auburn,
AL, 36849, United States of America, ezm0012@auburn.edu,
Jorge Valenzuela

Microgrids are small-scale versions of the current bulk power grids. Microgrids allow customers to participate in energy trading and demand response programs. In this presentation, we consider scheduling electric power in a microgrid that includes thermal generators, renewable energy, and a parking lot with electric vehicles. We propose a mathematical programming model that minimizes the total expected operation cost. Results confirm that the proposed energy scheduling reduces generation costs.

WC58

58-Room 110A, CC

Optimal Power Flow in Electric Power Systems II

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Andy Sun, Assistant Professor, Georgia Institute of Technology,
755 Ferst Drive, Atlanta, GA, 30332, United States of America,
andy.sun@isye.gatech.edu

1 - Power Markets with Real and Reactive Power Based off a Sequential Linear Approximation to the ACOPF

Paula Lipka, Graduate Student Researcher, University of
California, Berkeley, 4141 Etcheverry Hall, Berkeley, CA, 94720,
United States of America, plipka@berkeley.edu, Shmuel Oren

This work shows how to use a successive linear program that solves the ACOPF to run a real-time power market. It discusses how to calculate load payments, generation rents, congestion rents, and flowgate prices and how these items are different from the DC terms due to voltage and reactive power. It compares market outcomes under these new settings to those from a DCOPF approach with several examples.

2 - Impact of ACOPF Constraints on Security-constrained Unit Commitment

Anya Castillo, Federal Energy Regulatory Commission,
888 1st Street NE, Washington DC, United States of America,
anya.castillo@ferc.gov, Richard O'Neill, Carl Laird,
Jean-Paul Watson, Cesar Silva Monroy

We propose a unit commitment formulation with alternating current optimal power flow (ACOPF) constraints and solve the problem as a mixed-integer sequential linear program. This approach accounts for voltage requirements and enables the commitment of units for reactive power compensation in addition to economically satisfying the real power balancing requirements. We compare our results to unit commitment approaches that either ignore network effects or approximate lossless power flows.

3 - First Order Loss Approximation for LMP Calculation

Brent Eldridge, Operations Research Analyst, Federal Energy
Regulatory Commission, 888 First St. NE, Washington, DC,
United States of America, breldridge@gmail.com, Richard O'Neill,
Any Castillo

The following paper discusses an improvement method for estimating line losses when solving a DC optimal power flow (DCOPF) with endogenous line loss estimation. We present a DCOPF model and propose a method called First Order Improvement of Losses, or FOIL, which uses only linear constraints and does not require additional solutions to AC power flow equations. We compare FOIL to the initial solution and to results using successive linearization.

4 - Robust Feasibility and Stability Analysis in Power Flow Problems

Krishnamurthy Dvijotham, California Institute of Technology,
Pasadena, CA, United States of America, dvij@caltech.edu

Recent research has shown that convex relaxations often find provably optimal solutions of ACOPF problems. However, they do not provide guarantees of feasibility and dynamic stability in the presence of uncertainty (contingencies, stochastic generation, load etc.). In this work, we develop efficient algorithms to certify stability and feasibility of power flow solutions under various forms of uncertainty. The certificates cover practical operating conditions for several test cases.

■ WC59

59-Room 110B, CC

Strategy/Strategic Planning II

Contributed Session

Chair: Karim Farhat, Stanford University, 475 Via Ortega, Huang Engineering Center 245A, Stanford, CA, 94305, United States of America, kfarhat@stanford.edu

1 - Product Spacing and The Quest for Survival: Organizational Learning in New Markets

Josué Reynoso, PhD Student, Rensselaer Polytechnic Institute, 124 Ferry Street, Apt. 203, Troy, NY, 12180, United States of America, reynoj5@rpi.edu

In new product markets, entrants make choices about the characteristics of their products. Given the technological and market uncertainties, learning plays a key role on the success of product strategies. While product differentiation is related to faster learning, diffusion dynamics provide incentives to introduce products in the vicinity of what is already in the market. Product-level data is used to analyze this tension as well as pre-entry experience and order-of-entry effects.

2 - Is it Worth Trusting Your Manager?

Elena Kulchina, Assistant Professor, Duke University, Fuqua School of Business, 100 Fuqua Drive, Durham, NC, 27708, United States of America, Elena.Kulchina@duke.edu

Researchers have long been interested in the role of top managers in organizations. The research, however, has paid little attention to the social aspects of the relationships between managers and owners. We focus on one such social aspect: the asymmetry of trust between an owner and a manager. We demonstrate that under-trusted managers are associated with lower firm performance. Conversely, equal trust and over-trust have no negative association with the performance of firms with hired managers.

3 - A Theoretical Synthesis of Research on Strategy Implementation Effectiveness

Alex Tawse, PhD Candidate in Management, University of Houston - Bauer College of Business, 4800 Calhoun Road, Houston, TX, 77004, United States of America, awtawse@uh.edu, Pooya Tabesh

Strategy implementation (SI) is a critical component of organizational performance. Despite extensive efforts by researchers to define and develop factors that determine effective SI, a comprehensive framework of SI has yet to be developed. Through the synthesis of existing research, we propose a model that defines the process of SI, summarizes tools that promote SI effectiveness, and outlines three conditions for successful SI: coordination, commitment, and capability.

4 - Can Divestiture Foster Parent-firm's Innovation? Proactiveness, Experiences and Relative Size

Kyungsuk Lee, Seoul National University Business School, 599 Gwanak-ro, Gwanak-gu, Seoul, 151-916, Korea, Republic of, kxl5060@snu.ac.kr, Dong-kee Rhee, Taewoo Roh

We investigate the impact of post-divestitures on innovative activities at firm-level. This study integrated research on knowledge-based view and organizational inertia and encompassed the model of financial distress in order to evaluate firm's proactive-ness. Our findings contribute to understandings of how proactive divestiture can reinforce knowledge capacity, distant from previous studies that regarded divestiture as a reactive action vis-à-vis financial pressure.

5 - Quantifying Competitive Strategy: Decision Analytic Modeling of Five-forces Framework

Karim Farhat, Stanford University, 475 Via Ortega, Huang Engineering Center 245A, Stanford, CA, 94305, United States of America, kfarhat@stanford.edu

We present a decision-analysis model of Porter's Five-Forces framework, with a case-study in the solar PV industry. While capable of generating valuable insights, the Five-Forces have been mostly assessed qualitatively. This model quantifies the five competitive forces, and it accounts for market uncertainties as well as value-chain decisions. Thus, the model provides executives with a practical and robust methodology to evaluate future profitability and strategically position their business.

■ WC60

60-Room 111A, CC

Flexible Manufacturing Systems

Contributed Session

Chair: Hakan Gultekin, TOBB University of Economics and Technology, Sogutozu Cad No:43 Sogutozu, Ankara, Turkey, hgultekin@etu.edu.tr

1 - The Optimization of Agile Multi-Product Production Systems through Markov Decision Process

Yuan Feng, Tsinghua University, Department of Automation, Tsinghua University, Beijing, 100084, China, fengyuan1216@gmail.com, Wenhui Fan

In order to optimize the work-in-process (WIP) level in multi-product production systems, Markov Decision Process is used to obtain the optimal workforce scheduling policy, which dynamically allocates the cross-trained workforce according to the system state. The results from simulation experiments show that the WIP level of the optimal policy based on MDP is significantly lower than the WIP levels under Longest Queue, Shortest Queue, Longest Time, Shortest Time and Cyclic Policies in any case.

2 - Modeling and Analysis of a Flexible Manufacturing Cell with Three Machines and a Robot

Mehmet Savsar, Professor, Kuwait University, College of Engineering, P.O. Box 5969, Safat, 13060, Kuwait, mehmet.savsar@ku.edu.kw

This paper presents a stochastic model for analysis of a Flexible Manufacturing Cell (FMC) consisting of three flexible machines, one robot, and a pallet. Batch of parts are conveyed into and out of the cell by the pallet, while the robot loads and unloads the parts. The stochastic model is used to determine system performance measures, including production rate of the cell and utilization of the system components under different operational conditions.

3 - Cell Formation in under Uncertain Demand and Processing Times: A Stochastic Genetic Algorithm (SGA)

Samrat Singh, Research Assistant, North Dakota State University, 1263 17th Avenue North, Unit 20 University Village, Fargo, ND, 58102, United States of America, samrat.singhnepal@gmail.com, Gokhan Egilmez

This study addresses the stochastic cell formation problem with a newly proposed stochastic genetic algorithm (SGA) approach considering stochastic demand and processing times, thus capacity requirements. Statistical analysis was employed to convert the uncertain demand and processing times into stochastic capacity requirements. The stochastic nonlinear mathematical model (SNMM) and the newly proposed SGA approaches are compared on 10, 20 and 30-product problems.

4 - Balancing Dual Gripper Robotic Cells

Hakan Gultekin, TOBB University of Economics and Technology, Sogutozu Cad No:43 Sogutozu, Ankara, Turkey, hgultekin@etu.edu.tr, Betul Coban, Vahid Eghbal Akhlahi

We consider a production line consisting of a number of machines and a dual-gripper robot. Each of the identical parts has a number of. The problem is to assign these operations to the machines satisfying the precedence constraints and to determine the robot activity sequence that jointly maximize the throughput rate. We develop both a mathematical programming formulation and a heuristic algorithm for this complex problem. The performance of the heuristic is tested through computational study.

5 - A Mathematical Model for Perishable Products with Price- and Displayed-stock-dependent Demand

Erhun Kundakcioglu, Ozyegin University, Faculty of Engineering, Istanbul, Turkey, erhun.kundakcioglu@ozyegin.edu.tr, Arda Yenipazarli, Mehmet Onal

In this study, we introduce a single store multi-product order quantity model incorporating product assortment, pricing and space-allocation decisions for perishable products. We assume that the demand rate of a product depends on the selling price and the on-display stock level of that item as well as other products in the assortment. A heuristic method is developed to solve this complex problem and the results are discussed with computational experiments to validate the proposed approach.

■ WC61

61-Room 111B, CC

Optimization under Uncertainty: Integration of Intermittent and Demand Side Resources in Electric Power Systems

Sponsor: ENRE – Environment I – Environment and Sustainability
Sponsored Session

Chair: Lindsay Anderson, Assistant Professor, Cornell University,
316 Riley Robb Hall, Ithaca, NY, 14853, United States of America,
landerson@cornell.edu

1 - Chance-constrained Optimal Power Flow with Uncertain Reserves

Johanna Mathieu, Assistant Professor, University of Michigan,
1301 Beal Ave, Ann Arbor, MI, 48109, United States of America,
jlmath@umich.edu, Bowen Li, Siqian Shen, Yiling Zhang

Electric loads can be controlled to help the power grid balance supply and demand, but the amount of reserves available from these resources is uncertain. We investigate optimization methods to dispatch power systems with uncertain reserves. Specifically, we formulate a chance-constrained optimal power flow problem and solve it using various scenario-based and analytical methods. We run experimental studies and compare the performance and computational complexity across the cases.

2 - Strategic Price Bidding in Electricity Markets with Only Renewables

Josh Taylor, Assistant Professor, University of Toronto, 10 King's
College Rd., SF 1021C, Toronto, ON, M5S3G4, Canada,
josh.taylor@utoronto.ca, Johanna Mathieu

Renewables have low marginal-to-fixed costs ratios. In a power system with only renewables, the standard marginal-cost pricing mechanism would simply lead to all prices being equal to zero, which would be unsatisfactory. Motivated by other high-fixed, low-marginal cost industries like software and digital media, we analyze an extension of Bertrand-Edgeworth competition in which renewable producers with random capacities compete through a single, non-physical price to fulfill a random demand.

3 - Optimal Development of Wind Farm with Energy Storage in Micro-grid Community

Qing Li, PhD Candidate, Rutgers University, 96 Frelinghuysen
Road, CoRE Building, Room 201, Piscataway, NJ, 08854, United
States of America, ql78@scarletmail.rutgers.edu, Honggang Wang

Wind power has been widely used in micro-grids for local community energy consumptions. While it is clean, sustainable and low operational cost, wind power availability is highly fluctuant. A practical solution to maintain sufficiency is using energy storage. We develop computational models and optimization methods for optimal development and management of wind farm with energy storage. Two-stage optimization framework is proposed to seek and improve the optimal number and placement of turbines.

4 - Social Effects in the Diffusion of Solar Panels: A Dynamic Discrete Choice Approach

Sebastian Souyris, PhD Candidate, The University of Texas at
Austin, 2110 Speedway Stop B6500, Austin, TX, 78712, United
States of America, sebastian.souyris@utexas.edu, Jason A. Duan,
Anant Balakrishnan, Varun Rai

We study the diffusion of residential solar panels by assuming looking forward households. We propose a dynamic discrete choice model, where the households estimate the return on investment and are influenced by previous spatio-temporal distributed adopters. We project the dynamics of the market; thereby, giving insights about where the developers should focus their customer acquisition efforts and what schedule of incentives would be more efficient to stimulate adoption.

■ WC62

62-Room 112A, CC

Distributed Energy Generation

Cluster: Energy Systems: Design, Operation, Reliability and Maintenance

Invited Session

Chair: Alexandra Newman, Professor, Colorado School of Mines,
Mechanical Engineering, Golden, CO, 80401, United States of America,
anewman@mines.edu

1 - Optimizing A Renewable, Hybrid Distributed Energy Generation System

Gavin Goodall, PhD Student, Colorado School of Mines,
Golden, CO, 80401, United States of America,
ggoodall@mymail.mines.edu

We formulate a mixed integer linear program to select renewable technologies such as wind and solar, and conventional technologies such as diesel generators and batteries, to minimize system costs subject to operational, load, and spinning reserve constraints. We use statistical models to generate realizations of load, solar irradiance and wind speed. Solutions from our optimization model prescribe both a procurement and a dispatch strategy for these realizations, with additional realistic data.

2 - Robust Unit Commitment Problem with Valid Inequalities and Computational Study

Wei Wang, PhD Student, University of South Florida, 4202
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weiw@mail.usf.edu, Bo Zeng

In order to improve the computational performance of robust unit commitment problem, we study the polyhedron of unit commitment problem, derive some valid inequalities and incorporate them into robust formulation. Preliminary computational results will be presented to evaluate their impact.

3 - Integration of Demand Dynamics and Investment Decisions on Distributed Energy Resources

Farbod Farzan, Rutgers University, 96 Frelinghuysen Road,
Piscataway, Ne, 08901, United States of America,
farbod_farzan@yahoo.com, Farnaz Farzan, Mohsen Jafari

We coupled investment decisions on distributed generation(DG) with demand side management(DSM). An adaptive model is used for load calculations on a premise that expected dynamical effects due to DSM strategies cannot be captured by forecast models. To demonstrate the effect of coupling of DG investment decisions and DSM, three scenarios(S) are presented. SI is used for benchmarking. Load patterns for PEVs are introduced in SII. SIII is an extended version of SII, where smart devices are adopted

4 - Multi-objective Optimization of Grid-connected Decentralized Energy Systems

Ayşe Kocaman, Assistant Professor, Bilkent University, Bilkent
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selin.kocaman@bilkent.edu.tr, Ozlem Karsu

Along with the transition from fossil fuel based centralized energy systems to decentralized renewable energy systems, decision makers will have to make a choice between using two types of electricity, one of which is less expensive but also associated with high CO2 emissions and the other is clean but more costly. Here, we develop a decision support system that decides on the scales of energy production facilities to be used in the process of moving towards decentralized energy systems.

■ WC63

63-Room 112B, CC

Operations Management V

Contributed Session

Chair: Ahmed Ghoniem, Isenberg School of Management, UMass
Amherst, 121 Presidents Dr., Amherst, MA, 01002, United States of
America, aghoniem@isenberg.umass.edu

1 - Performance of Office-based Versus Home-based Call Center Agents: Evidence from Three Industries In

Hyojeong Kim, University of Oregon, 2050 Goodpasture Pl,
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America, hyojeongkim.uoregon@gmail.com, Nagesh Murthy

We examine the performance of call center agents that work from office vis-à-vis those that work from home. The home-based workers achieve significantly higher call productivity without any loss of call service quality. These differences are accentuated by task complexity and call routing clarity perceived by the agents.

2 - The Research on Modularization Order-picking Policy Based on Combination Forecasting

Shuiyin Zhou, Associate Professor, Huazhong University of
Science and Technology, NO. 1037, Luoyu Road, Wuhan,
430074, China, abigale_lm@sina.com, Miao Li

Modularization order-picking policy was proposed to improve the response speed of orders and reduce the cost. The method of determining modules and the process of order-picking were described in detail and mathematic optimal model was established in the article, then algorithms were used to solve the problem. What is more, combination forecasting method was used to get the final module set. The results showed that the policy could improve the efficiency of order-picking effectively.

3 - Optimizing The Online Sellers' Shipping Strategy and Return Service Charge Jointly

Huijun Hou, University of Science and Technology of China,
No.96, Jinzhai Road, Hefei, 230026, China,
hjhou90@mail.ustc.edu.cn, Xiangyu Meng

Our work develops a theoretical model to optimize the sellers' shipping strategy of free shipping or not and return service charge jointly when no-reason return are admitted. The results imply that the sellers should adjust their shipping strategy and return service charge according to the market environment. Data experiments show that the joint optimal decisions could improve the sellers' profit and keep it more stable with the change of the price effectively.

4 - Optimal Routing for Multi-channel Call Centers with Idling Times during the Service Process

Oualid Jouini, Associate Professor, Ecole Centrale Paris, LGI,
Grande Voie des Vignes, Chateauf-Malabry, 92290, France,
oualid.jouini@ecp.fr, Ger Koole, Benjamin Legros

We consider a call center with inbound and outbound jobs. The inbound service is characterized by three successive stages where the second one is a break (idle time for the agent). This leads to a new opportunity to efficiently split the agent time between inbounds and outbounds. We focus on the optimization of the outbound job routing to agents. We prove for the optimal policy that all the time there is at least a systematic treatment of outbounds, either during the break, or between two calls.

5 - Lodging Capacity Analytics for the Qatar 2022 Fifa World Cup

Ahmed Ghoniem, Isenberg School of Management, UMass
Amherst, 121 Presidents Dr., Amherst, MA, 01002, United States
of America, aghoniem@isenberg.umass.edu, Agha Iqbal Ali

Capacity analytics is important for small countries, such as Qatar, that host the FIFA World Cup. We develop an Analytics-Optimization framework that assesses the lodging preparedness of the host country under an array of likely scenarios.

■ WC64

64-Room 113A, CC

Strategic Decision Making

Sponsor: Decision Analysis

Sponsored Session

Chair: Wenxin Xu, Illinois University, United States of America,
wxu9@illinois.edu

Co-Chair: Youngsoo Kim, University of Illinois at Urbana-Champaign,
ykim180@illinois.edu

1 - Strategic Decisions for Bringing Innovation to Market in Presence of Spillover Risks

Yunke Mai, Duke University, Durham, NC,
United States of America, yunke.mai@duke.edu, Sasa Pecek

We study optimal sourcing strategies of a technology innovator facing a manufacturer who is also a competitor in the product end market. The competing manufacturer has its own inferior product which could be improved through technology spillover, should a contract with the innovator be secured. We characterize the equilibria and analyze comparative statics in several variants of this supply chain/innovation management game.

2 - Decision Analysis using Holistic Component as Opposed to Conventional Attribute Driven Methodology

Subhabrata Bapi Sen, Adjunct Faculty, Sillberman College of
Business, 32 Rolling Hill Dr, Chatham, NJ, 07928,
United States of America, bapi45@fdu.edu

The holistic approach - 5 stage skill acquisition model that differentiate "knowing how" from "knowing that" is better than multi-attribute decision analysis (MDA) supported by AI which uses decomposition. This truly reflect the decision making as an inscrutable business, a mysterious blending of careful analysis, intuition, and the wisdom and judgement distilled from experience that takes us away from limited rationality to a-rational domain which limit un mindful use of MDA in social policy.

3 - The Impact of Spillover in R and D Competition

Wenxin Xu, Illinois University, United States of
America, wxu9@illinois.edu, Jovan Grahovac, Dharma Kwon

Why are some firms willing to disclose their intellectual properties to their competitors while others are not? To answer this, we investigate a game theoretic duopoly model to examine the impact of spillover on R&D investment strategies when the R&D completion times are uncertain. We find that spillover may or may not hurt the more efficient firm. We identify the conditions under which the more efficient firm benefits from spillover.

4 - Investment in Shared Supplier under Spillover, Uncertainty, and Competition

Youngsoo Kim, University of Illinois at Urbana-Champaign,
Urbana, IL, United States of America, ykim180@illinois.edu,
Anupam Agrawal, Dharma Kwon, Suresh Muthulingam

We consider two competing buyers who can invest into their common supplier under spillover and uncertainty. One firm's investment could be spilled to the other through the shared supplier. Moreover, return on investment is unknown to the buyers though it can be learned based on the supplier's performance. Modeling as real option game, we find two equilibria, one of which has been rarely studied in literature, and we characterize the conditions under which the investment is hastened or delayed.

■ WC65

65-Room 113B, CC

Intelligent Transportation Systems

Contributed Session

Chair: Xiaoyun Zhao, PhD Student, Dalarna University, Sweden,
Högskolan Dalarna, 79188 Falun, Falun, 79188, Sweden, xzh@du.se

1 - Nonparametric, Heterogeneous Demand for Autonomous Electric Vehicles

Ricardo Daziano, Assistant Professor, Cornell University,
305 Hollister Hall, Ithaca, NY, 14853, United States of America,
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In this paper we use data about vehicle preferences, and automation awareness and attitudes. A sample of 1,260 respondents answered a discrete choice experiment especially designed for this study. Several models were estimated, including a semi-parametric random parameter logit (with assumption-free heterogeneity distributions that are a mixture of normals). Estimation of the Gaussian mixture model was implemented in R using the maximum simulated likelihood estimator with analytical gradients.

2 - Deployment and Utilization of Plug-in Electric Vehicles in Round-trip Carsharing Systems

Stephen Zoepf, MIT, 1039 Massachusetts Ave., #302, Cambridge,
MA, 02138, United States of America, szoepf@mac.com,
Alexandre Jacquillat

Plug-in Electric Vehicles (PEVs) can reduce gasoline consumption but are also constrained by range limitations and recharging requirements. We address the problem of PEV utilization in a round-trip carsharing system by optimizing and simulating the assignment of trips to vehicles. We use these results to inform the deployment of PEVs in the carsharing fleet. We find that PEV deployment and utilization can reduce gasoline consumption significantly and improve carsharing operators' profitability.

3 - Connected Vehicle V2i(vehicle-to-infrastructure) Based Microscopic Dynamic Merge Coordination System

Xiaowen Jiang, Ph.d Fellow, Rutgers, The State University of New
Jersey, #736 CORE Building Busch Campus, 96 Frelinghuysen
Rd, Piscataway, NJ, 08854, United States of America,
xiaowen.jiang@rutgers.edu, Peter J. Jin

This paper proposes a connected vehicle V2I (Vehicle-to-Infrastructure) based dynamic merge coordination system. The system assumes DSRC Road-side Unit (RSU) can obtain full vehicle trajectories through radar sensors and will coordinate all DSRC-equipped thru and ramp vehicles. Each ramp vehicle is paired and synchronized with a targeted gap on the through lane. The putative following (PF) vehicle of the gap will be advised to yield and maintain enough gap to allow smooth merging.

4 - Framework for Standalone Application Development for Traffic Management in Ad Hoc Networks

Sayyid Vaqar, KFUPM, P.O. Box 983, Dhahran, 312600,
Saudi Arabia, savaqar@kfupm.edu.sa

Road traffic condition awareness is an important tool in traffic management in intelligent transportation systems. We propose a framework to develop standalone application to be run on participating node in the network that can process information collected from neighboring nodes to predict driving condition down the road. The nodes can communicate with each other for gathering data but processing and decision making is done individually.

5 - On Processing and Evaluating GPS Based Traffic Data

Xiaoyun Zhao, PhD Student, Dalarna University, Sweden,
Högskolan Dalarna, 79188 Falun, Falun, 79188, Sweden,
xzh@du.se, Kenneth Carling, Johan Håkansson

This paper aims to evaluate the reliability of GPS based traffic data to reveal the neglected but susceptible measurement error. We assess the reliability of the data on geographical positioning, speed and altitude for three types of vehicles: bike, car and bus with a randomized experiment. We outline a general procedure for data processing considering no standard software packages or procedures are available in former studies.

■ WC66

66-Room 113C, CC

Airline Operations

Sponsor: Aviation Applications

Sponsored Session

Chair: Cheng-lung Wu, Senior Lecturer, UNSW Australia, School of Aviation, UNSW Australia, Kensington, NS, 2052, Australia, c.l.wu@unsw.edu.au

1 - Enhanced Delay Propagation Tree Model with Bayesian Network for Modelling Flight Delay Propagation

Cheng-lung Wu, Senior Lecturer, UNSW Australia, School of Aviation, UNSW Australia, Kensington, NS, 2052, Australia, c.l.wu@unsw.edu.au, Weiwei Wu

This paper developed an enhanced Delay Propagation Tree model with Bayesian Network (DPT-BN) to model delay propagation and interdependencies between flights. Results showed that flights have non-homogeneous delay propagation with non-IID delay profiles. The DPT-BN model was used to infer posterior delay profiles with different delay scenarios. We also demonstrated how robust airline scheduling methodologies can benefit from this probability-based delay model.

2 - Integer Programming Based Pairing Generation with Deviation Penalty in Airline Crew Recovery

Hyunsuk Lee, Ph.d Student, McCombs School of Business, The University of Texas at Austin, 2110 Speedway Stop B6500, CBA 5.202, Austin, TX, 78712, United States of America, hyunsuk.lee@utexas.edu, Douglas Fearing

In this paper, we will explore how to model airline scheduling problems (flight/crew scheduling and recovery), and apply IP based pairing generation technique to crew recovery with deviation penalty. In particular, we will control IP based pairing generator by restricting the number of different flights in new pairing. Such a study should hopefully give insights to minimizing deviations from original schedule.

3 - U.S. Commercial Aviation Demand Forecasting with a Panel Data: The Role of Individual Heterogeneity

Mei Liu, Economist, FAA, 6712 Tildenwood Lane, Rockville, MD, 20852, United States of America, chia-mei.liu@faa.gov, Dipasis Bhadra

Studies in aviation demand forecasting have long relied on time series approaches, ignoring the individual heterogeneity in a panel data. Heterogeneity is most evident in the U.S. aviation sector where network effect is prevalent. This paper identifies the route-specific effects from 2000 through 2010 and takes it forward to perform a 4-year-ahead forecasting. We evaluate whether the inclusion of individual heterogeneity reduces forecast errors.

■ WC67

67-Room 201A, CC

Risk in Freight Transport and Logistics

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Choungryeol Lee, Purdue University, United States of America, lee1210@purdue.edu

1 - Downside Risk Analysis for Planning Intermodal Facility Investments

Irina Benedyk, United States of America, birina@purdue.edu, Hong Zheng, Yuntao Guo, Srinivas Peeta, Ananth Iyer

We apply Down Side Risk analysis to plan intermodal facility investment decisions. The model accounts for factors such as the future global commodity flow changes and demand uncertainty. Experiment results show that tighter downside risk constraints lead to the inland intermodal facilities being preferred for investment compared to the ports. They also suggest that low downside risk values increase the total cost but reduce its variation.

2 - Procuring and Transporting Commodities: Hedging against Price, Demand and Freight Rate Risk with Options

Arum Chockalingam, Assistant Professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, 5612AZ, Netherlands, A.Chockalingam@tue.nl, Taimaz Soltani, Jan Fransoo

We consider a firm that procures and transports a commodity via ocean freight to its production plant where the commodity is converted to a final product to meet customer demand. Transportation of commodities via ocean freight has increased significantly in recent years leading to increasing volatility in the cost of freight transportation. We study how a firm can reduce its procurement and transportation costs using options on procuring the commodity and freight space in a newsvendor setting.

3 - Risk Management Strategies in Transportation Capacity Decisions: An Analytical Approach

Jiho Yoon, Michigan State University, N468 North Business Complex, Michigan State University, East Lansing, MI, 48824-1121, United States of America, yoon@broad.msu.edu, Hakan Yildiz, Sri Talluri

In recent years, access to freight transportation capacity has become a constant issue in the minds of logistics managers due to capacity shortages. In a buyer-seller relationship, reliable, timely, and cost-effective access to transportation is critical to the success of such partnerships. Given this, guaranteed capacity contracts with 3PLs may be appealing to shippers to increase their access to capacity and respond effectively to customer requirements. With this new opportunity, 3PLs must focus on approaches that can assist them in analyzing their options as they promise guaranteed capacity to shippers when faced with uncertain demand and related risks in transportation. In this paper, we analytically analyze three capacity-based risk mitigation strategies and the mixed use of these individual strategies using industry based data to provide insights on which strategy is preferable to the 3PL and under what conditions. We posit that the selection of a strategy is contingent on several conditions faced by both the shipper and the carrier. Although our approach is analytical in nature, it has a high degree of practical utility in that a 3PL can utilize our decision models to effectively analyze and visualize the trade-offs between the different strategies by considering appropriate cost and demand data.

4 - Freight Option-Based Mechanism for Multiple Carrier Collaborative Less-Than-Truckload Logistics

Choungryeol Lee, Purdue University, United States of America, lee1210@purdue.edu, Srinivas Peeta

We propose option-based mechanisms for LTL carrier-to-carrier collaboration to alleviate operational and financial risks resulting from stochastic demand in the operational horizon. It aims to enhance the utilization of fleet capacity and reduce the induced costs of handling demand variability. Numerical experiments illustrate the feasibility and provide useful insights of implementing option-based multiple carrier collaborative LTL logistics.

■ WC68

68-Room 201B, CC

Traffic Control

Sponsor: Transportation, Science and Logistics

Sponsored Session

Chair: Indrajit Chatterjee, University of Minnesota, Twin Cities, 500 Pillsbury Drive SE, Minneapolis, mn, 55455, United States of America, chat0123@umn.edu

1 - Computationally Efficient Algorithms for the Calibration of High-resolution Stochastic Traffic Simulators

Chao Zhang, Massachusetts Institute of Technology, 77 Massachusetts Ave, Cambridge, MA, 02139, United States of America, chaoz@mit.edu, Carolina Osorio, Gunnar Flütterüd

This work formulates the calibration problem as a simulation-based optimization (SO) problem which is addressed by the metamodel approach. The metamodel combines information from both the simulator and an analytical traffic model that relates the calibration parameters to the simulation-based objective function. The performance of the proposed approach has been tested on a toy network and is currently being evaluated on a large-scale metropolitan network in Berlin, Germany.

2 - Decentralized Traffic Assignment for Multi-level Modeling

Ehsan Jafari, University of Texas at Austin, Austin, TX, United States of America, ejafari@utexas.edu, Stephen Boyles

Statewide planning model is used for planning projects that will have implications on transportation across the entire state. At the same time, medium-sized cities have their own planning model. The process of updating these models in a way that maintains consistency between them is laborious and time-consuming. In this research, a decentralized bi-level modeling approach, based on the concept of network contraction, is proposed to address these issues.

3 - A Simulation-based Optimization Algorithm for Traffic Responsive Control

Linsen Chong, Massachusetts Institute of Technology, Cambridge, MA, United States of America, linsenc@mit.edu, Carolina Osorio

We propose a simulation-based optimization (SO) framework to address generally constrained urban traffic responsive control problems. We develop a tractable dynamic traffic model that is inspired from traffic flow theory, transient queueing theory and is parameterized by time-dependent sensor data. We illustrate the performance of the proposed method through a large-scale urban traffic case study.

4 - Potential Effectiveness of Liability Rules and Automated Vehicles in Reducing Rear-ending Crashes

Indrajit Chatterjee, University of Minnesota, Twin Cities,
500 Pillsbury Drive SE, Minneapolis, MN, 55455,
United States of America, chat0123@umn.edu, Gary Davis

This research focuses on understanding the behavior of drivers involved in rear-ending crashes on congested freeways, and using this understanding to evaluate (a) the safety implications of changes in liability policies where individual drivers are penalized based on degree of causal contribution to the crash and (b) the safety implications of mixtures of human-operated and automated vehicles in the future traffic streams.

■ WC69

69-Room 201C, CC

Innovative Data Sources in Transportation

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Xianyuan Zhan, PhD Candidate, Purdue University, 550 Stadium Mall Drive, School of Civil Engineering, West Lafayette, IN, 47906, United States of America, zhanxianyuan@purdue.edu

1 - Spatial-temporal Traffic Pattern Identification in a Large-Scale Urban Network

Zhenhua Zhang, The University at Buffalo, NY,
United States of America, zhenhuaz@buffalo.edu, Qing He,
Jizhan Gou, Xiaoling Li

We employ the dictionary-based compression method to identify the regional traffic pattern within a large-scale urban network and aim to quantify the traffic pattern fluctuations from different time and space perspectives. Studies unveil characteristics of the geographic pattern distribution, time-of-day pattern fluctuations and the day-to-day pattern differences etc. It can even quantify the influences of the large municipal works on its surrounding traffic.

2 - A Bayesian Mixture Model for Short-term Average Link Travel Time Estimation using Large-scale Limited Information Trip-based Data

Xianyuan Zhan, PhD Candidate, Purdue University, 550 Stadium Mall Drive, School of Civil Engineering, West Lafayette, IN, 47906, United States of America, zhanxianyuan@purdue.edu, Chao Yang, Satish V. Ukkusuri

This paper develops a Bayesian mixture model to estimate the urban link travel times utilizing large-scale limited trip-based data without trajectory information. The model estimates the mean and variance of the average link travel times. A transition model is also introduced as an informative prior to capture the temporal and spatial dependencies of link travel times. An efficient solution approach based on expectation-optimization (EM) algorithm is proposed to solve the problem. The model is tested using a large-scale taxi trip data from New York City.

3 - Exploring Behavior during Hurricane Sandy

Arif Mohaimin Sadri, Purdue University, 149 Arnold Drive,
Apt 12, West Lafayette, IN, 47906, United States of America,
asadri@purdue.edu, Satish V. Ukkusuri

Individuals, being subjected to different personal constraints and environments, may want to evacuate or not during a major hurricane. Evacuation decision can also be influenced by the social network partners. In this study, data has been obtained by interviewing individuals from high storm surge areas of New York and New Jersey. Individuals' social network information were obtained by using an ego-centric approach. A mixed logit model is developed to explain the effects of individual, household and social network characteristics on evacuation decision making.

4 - Temporal-Spatial Domain Trajectory Matching Algorithm

Ali Arian, Graduate Research Assistant, The University of Arizona, 1209 E. Second Street, Room 206A-1, Tucson, AZ, 85721, United States of America, arian@email.arizona.edu, Yi-Chang Chiu

This talk presents a Longest Common Sequence (LCS) based algorithm to compare and match two distinct trajectories for degree similarity based on temporal-spatial domain information matching. Applications of the presented algorithm in passive multi-person carpool matching and day-to-day route set building are presented.

■ WC70

70-Room 202A, CC

Vehicle Routing II

Contributed Session

Chair: Jiahong Zhao, School of Business, Guangzhou University, NO.230, Guangzhou Daxuecheng Waihuanxilu, Guangzhou, China

1 - An Optimization-Based Heuristic for the School Bus Problems with Regret Minimization

Mehmet Ivgin, Lecturer, Turkish Military Academy,
Devlet Mahallesi Kara Harp Okulu Caddesi, Ankara, Turkey,
mivgin@kho.edu.tr, Elif Rabia Karadeniz

We present in this study an application of the School Bus problem in practice. Based on an integer programming formulation of the School Bus problem, we implemented a heuristic using column generation to solve a real-life instance provided by a public school in Ankara. Our results show that our approach yields a big improvement in terms of customer satisfaction when compared to the previously used scheduling approaches.

2 - A Simulated Annealing Approach to Solve Large-Scale VRP: An Application at GE Appliances & Lighting

Ehsan Khodabandeh, University of Louisville, Speed School of Engineering, Department of Industrial Engineering,
Louisville, KY, 40292, United States of America,
ehsan.khodabandeh@louisville.edu, Sunderesh Heragu,
Lihui Bai, Gerald Evans

A simulated annealing approach with a network shrinking heuristic is considered to solve a vehicle routing problem with time windows where routes have limited duration. The objective is to minimize traveled time and total number of vehicles required. Implementation of this algorithm for solving large-scale problems has positively impacted GE Appliances & Lighting's operation by reducing delivery time from three to two days and by reducing the number of required trucks by half in some instances.

3 - A Branch-and-Price-and-Cut Algorithm for the Generalized Vehicle Routing Problem

Mohammad Reihaneh, Isenberg school of management,
University of Massachusetts Amherst, 121 Presidents Dr.,
Amherst, MA, 01002, United States of America,
mreihaneh@som.umass.edu, Ahmed Ghoniem

We examine the Generalized Vehicle Routing Problem, a VRP variant where customers are partitioned into mutually exclusive clusters, each with a specific demand. We propose a branch-and-price-and-cut algorithm that takes advantage of the characteristics of the problem and treats a GVRP instance with n customers and m clusters nearly as a VRP instance with m customers. Our computational study reports encouraging results.

4 - Rail Freight Service Design with Consideration of Consolidation and Heterogenous Demand

Xiao Lin, PhD Candidate, Tsinghua University, Beijing, China,
lin-x12@mails.tsinghua.edu.cn, Tianhu Deng, Simin Huang

Rail carriers are forced to serve more time-sensitive customers in nowadays China. To serve the new market the China Railway Company need to provide faster transportation service and design differentiated service products. For a consolidation carrier like the rail, faster service means less stops, which further results in less consolidation of freight. This study provides a differentiated service design model that maximize revenue for consolidation carriers facing heterogeneous demand. In solving this problem, we proposed two heuristic methods which can solve the problem of real size and compared its performance with lagrangian relaxation method.

5 - A Multi-Depot Vehicle-Routing Model for the Explosive Waste Recycling

Jiahong Zhao, School of Business, Guangzhou University, No. 230 in Daxuecheng Waihuanxilu, Guangzhou, Guangdong, 510006, China, zhaojiahong1@126.com

The explosive waste recycling is a significant concern because it has immense impacts on economy and safety during its transportation among multiple depots. We develop a multi-depot vehicle-routing model with the minimizations of cost and risk. It is formulated through the two-commodity flow formulation, and characterized by simultaneously planning tours, vehicle acquisitions and return-trips. To solve this model, a modified lexicographic weighted Tchebycheff method is also proposed.

■ WC71

71-Room 202B, CC

Transportation Operations II

Contributed Session

Chair: Ioannis Akrotirianakis, Siemens Corporate Technology,
750 College Road, Princeton, NJ, United States of America,
ioannis.akrotirianakis@siemens.com

1 - Optimization of Area Traffic Control: A Binary Mixed Integer Linear Programming Approach

Zhao Zhang, Researcher Assistant, Tsinghua University,
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This paper proposes a model aims at optimizing area traffic control. We use network total delay as the objective in the model. In this research, cell transmission model is used to discretize research time into many intervals and signal coordination, lane settings, phase, start of green and green split can be optimized simultaneously. The model is linear in nature and can be solved by standard branch and bound algorithm.

2 - A Finite Sampling Approach for MPEC

Wenjing Song, Pennsylvania State University, 628B Oakwood
Ave, State College, PA, 16803, United States of America,
wus145@psu.edu, Terry Friesz, Hongcheng Liu, Tao Yao

We study mathematical program with equilibrium constraints (MPEC) from equilibrium network design problems. We consider the scenario where the equilibrium constraint has a non-closed-form operator, and propose a finite sampling approximation with a tunable error bound. Under some regularity conditions, the approach allows MPEC to be solvable by gradient-based local schemes to an approximate KKT solution with bounded infeasibility. The approach is applied to a congestion toll pricing problem.

3 - Travel Time Transmission Model for Network Loading at Merging, Diverging Segments, and Intersections

Peter J. Jin, Assistant Professor, Rutgers, The State University of
New Jersey, CoRE 613, 96 Frelinghuysen Rd, Piscataway, NJ,
08854, United States of America, peter.j.jin@rutgers.edu,
Stephen Boyles, Wangsu Hu

The research presents an enhanced travel time transmission model (TTM) based dynamic network loading (DNL) model for freeway merging, diverging segment and signalized intersections. The study further evaluates the capability of TTM in formulating node delay. A network adapted from field flow, signal and network data of the US-1 at Far West Interchange in Austin TX is used. The modeling results are compared with the output of a CTM (Cell Transmission Model) based DNL model.

4 - Vehicle (Lagrangian)-space Freeway Traffic State Estimation: A Lagrangian Kalman Filter Approach

Han Yang, PhD, Tongji University, Cao'an Road 4800, Shanghai,
China, yanghan900121@163.com, Peter J. Jin

Lagrangian coordinates has shown the potential numerical benefits in modeling mobile sensor data. A new Kalman filter based Lagrangian-space traffic state estimation model is proposed based on the Travel Time Transmission Model (TTM). The model is calibrated and evaluated by using a simulation model calibrated with field data on IH-894 in Milwaukee, Wisconsin and compared with a CTM-based Kalman filter estimator on space-time coordinates under different sampling rates of probe vehicles.

5 - Vehicle Routing for the Radiopharmaceutical Industry

Ioannis Akrotirianakis, Siemens Corporate Technology,
750 College Road, Princeton, NJ, United States of America,
ioannis.akrotirianakis@siemens.com, Amit Chakraborty

We develop a model for the distribution of radiopharmaceuticals. Our aim is to serve many medical imaging centers within a pre-specified time interval at minimum transportation cost. The model ensures all orders arrive at the centers before the patients enter the PET scanners. It also takes into consideration the availability and capacity of the transportation vehicles. The efficiency of the model is supported by computational results demonstrating substantial savings in transportation costs.

■ WC73

73-Room 203B, CC

Data Analytics for Reliability Evaluation and Maintenance Optimization II

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Eunshin Byon, Assistant Professor, University of Michigan,
1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America,
ebyon@umich.edu

Co-Chair: Qingyu Yang, Assistant Professor, Wayne State University,
4815 4th street, Room 2167, Detroit, MI, 48202,
United States of America, qyang@wayne.edu

1 - Reliability Approximation for k-out-of-n Pairs:**G Balanced Systems**

Elsayed Elsayed, Rutgers University, 96 Frelinghuysen Road,
CoRE Building, Room 201, Piscataway, NJ, 08854, United States
of America, elsayed@rci.rutgers.edu, Dingguo Hua

Many applications can be modeled as k-out-of-n pairs: G Balanced systems. When there are a large number of units in such systems, it is very tedious and impossible to enumerate the complete set of successful events to obtain the exact function of its reliability. We provide an approach to obtain approximation for the reliability of such systems. We validate the approximation by comparing its results with systems with a small number of units and through the simulation of larger systems.

2 - A Wiener Process Model for Heterogeneous Degradations Based on Kriging

Nan Chen, National University of Singapore, isecn@nus.edu.sg,
Eunshin Byon

Wiener process plays a crucial role in degradation modeling and condition based maintenance for critical assets. This paper proposes a Wiener process model based on Kriging to provide a flexible way to account for heterogeneous degradation patterns commonly observed due to observable or unobservable factors. It includes conventional random effects model and covariate model as special cases, and offers efficient computation. Numerical studies have been conducted to demonstrate the performance.

3 - Condition-based Joint Maintenance Optimization for a Large-scale Homogeneous Population

Young Myoung Ko, Assistant Professor, Pohang University of
Science and Technology, 77, Cheongam-ro, Nam-Gu,
Pohang, Gyeongbuk, 790-784, Korea, Republic of,
youngko@postech.ac.kr, Eunshin Byon

We develop a cost-effective maintenance strategy for systems consisting of homogeneous units. When a large number of units operate in a system, translating the stochastic degradation processes of individual units into system-level information remains a significant challenge. We use the asymptotic distribution for characterizing the system-level condition and analytically derive the threshold values that trigger maintenance operations. The results are verified through numerical experiments.

4 - Uncertainty Analysis for Importance Sampling Estimators with Stochastic Simulations

Youngjun Choe, PhD Candidate, University of Michigan, 1205
Beal Avenue, Ann Arbor, MI, 48109, United States of America,
yjchoe@umich.edu, Eunshin Byon

Stochastic simulations are widely used to model real-world stochastic systems and to evaluate the system reliability. Yet, the reliability evaluation can take significant computational resources as the simulator becomes more realistic. To speed up the computer experiments, our prior study proposed new importance sampling estimators. This study establishes the central limit theorems for the estimators and constructs asymptotically valid confidence intervals.

■ WC74

74-Room 204A, CC

Reliability II

Contributed Session

Chair: Yin Shu, University of Houston, E206 Engineering Bldg.2, Houston, TX, 77204, United States of America, yinshulx@gmail.com

1 - Detecting Entropy Increase in Categorical Data using Maximum Entropy Distribution

Devashish Das, Research Assistant, University of Wisconsin, Madis, 124 North Breeze Terrace Apt. E, Madison, WI, 53726, United States of America, ddas3@wisc.edu, Shiyu Zhou

In work, we propose a statistical monitoring method to detect the increase of entropy in categorical data. First, we propose a distribution estimation method to approximate the probability distribution of the observed categorical data. Then we use this procedure to estimate the non-parametric, maximum entropy distribution of an observed data sample and use it for statistical monitoring.

2 - A Conditioned-Based Maintenance Policy for a Two-Component System

Ameneh Forouzandeh Shahraki, NDSU, 1220, 10th St. N, #101, Fargo, ND, United States of America, ameneh.forouzandehsh@ndsu.edu, Om Yadav

This paper proposes an optimal conditioned-based maintenance policy for a two-unit deteriorating system with economic dependency. Each unit is monitored by remaining useful life based-inspection policy and is maintained by corrective, perfect or imperfect maintenance actions. We propose a general maintenance decision framework to select optimal maintenance actions and to optimize the grouping of maintenance actions for both components at the same time.

3 - Optimal Decision Making for Systems with Multifunctional Components

Yiwen Xu, University of Arizona, RM111, 1127 E. James E. Rogers Way, Tucson, AZ, United States of America, yiwen.xu6@gmail.com, Haitao Liao

We studied systems with multifunctional components. The goal is to make an optimal decision to maximize the system reliability when a failure occurs. Properties and numerical studies are included.

4 - Non-Gaussian Ornstein-Uhlenbeck Processes in Degradation-based Reliability Analysis

Yin Shu, University of Houston, E206 Engineering Bldg.2, Houston, TX, 77204, United States of America, yinshulx@gmail.com, Qianmei Feng, Hao Liu, Edward Kao

We use non-Gaussian Ornstein-Uhlenbeck (OU) processes to model the evolution of degradation with random jumps. The superiority of our models stems from their flexibility in modeling stylized features of degradation data series such as nonlinearity, jumps fluctuation, asymmetry, and heavy tails. Based on Fokker-Planck equations, we derive explicit results for reliability characteristics represented by Levy measures. Our models are applicable for analyzing a great deal of degradation phenomenon.

5 - A Flexible Random Effects Zero-inflated Model for the Study of Copper Hillocks Growth

Guilin Li, National University of Singapore, #07-17 Blk E1, Engineering Drive 2, NUS, Singapore, 117576, Singapore, guilin_li@u.nus.edu, Szu Hui Ng, Daniel Chua, Royston Tan

An experiment was conducted to measure the metal layer shorts in integrated circuits caused by copper hillocks to improve the process. Two features of the collected short counts are identified: excessive zeros and multi-level variations. A zero-inflated model with flexible random effects was proposed. Statistical inference procedures are also developed.

■ WC76

76-Room 204C, CC

Simulation III

Contributed Session

Chair: Ni Xia, School of Management, Huazhong University of Science and Technology, No.1037, LuoYu Road, Hongshan District, Wuhan, 430074, China, xntx128390@163.com

1 - Exact Efficient Simulation of Stochastic Differential Equations

Apaar Sadhwani, PhD Student, Stanford University, 212L, Huang Engineering Center, 475 Via Ortega, Stanford, Ca, 94305, United States of America, apaars@stanford.edu, Kay Giesecke

We present practical techniques to improve the efficiency of exact simulation of SDEs. Our proposed acceptance-rejection algorithm is an order of magnitude faster than existing methods and alleviates the problem of sample paths hitting unreachable boundaries. To achieve this speedup, we develop a novel method for

simulating hitting time of Brownian Meander to a fixed boundary. Numerical experiments show that our method performs 10-15x faster than current methods.

2 - Modeling and Simulation of Automotive Assembly Line

Ahad Ali, Associate Professor, Lawrence Technological University, 21000 West Ten Mile Road, Canton, MI, 48188, United States of America, aali@ltu.edu, Don Reimer

This paper provides methods to create a valid representation of a automotive assembly using modeling and simulation. Various performance analysis are presented with statistical validation. The use of the mean steady state 90% confidence interval was used to measure job per hour for the simulation model to the current system. DOE and RSM will be used and analyzed.

3 - Promoting Loose Coupling in Simulation Models: The Service Broker Approach

Sunil Kothari, Researcher, Hewlett-Packard, 1501 Page Mill Road, Bldg 2U, Palo Alto, CA, 94304, United States of America, sunil.kothari@hp.com, Jun Zeng, Gary Dispoto, Francisco Oblea

Many simulation models are not designed for reuse since the development of reusable models can take significant investment in time and effort since they have to be abstracted over all possible use cases. We illustrate the service broker architecture in the context of industrial printing domain. The service broker architecture ensures that the resources are loosely coupled to demand. We highlight two case studies to show our approach.

4 - Maximal On-time Delivery by Soft-pegging in Wafer Fab under Consideration of Hierarchical Mes

Joon Young Lee, ASU ME, 850 S. McAllister Ave., Tempe, AZ, 85287, United States of America, joon.lee@asu.edu

Under given hierarchical production planning and control of the MES, assignment policy (soft-pegging) is considered in order to maximize customer service level in semiconductor wafer fabrication processes. A wafer fab is modeled and several input scenarios were experimented to see the effects of the policy. On-time delivery is maximized in equilibrium state at a diversification point by proper assignment policy.

5 - Knowledge Evolution in a Dynamic R&d Team from the Perspective of Task Performance

Ni Xia, Mr., School of Management, Huazhong University of Science and Technology, No.1037, LuoYu Road, Hongshan District, Wuhan, 430074, China, xntx128390@163.com

We leverage learning by doing to establish a model of knowledge evolution in a R&D team, and simulate the effects of strength of team dynamics, task load, task complexity. Simulation results indicate that dynamic strength has greater damage to group knowledge than individual knowledge. It not only destroys group knowledge, but also benefit knowledge recovery. We also find low task load benefits knowledge restore but harms knowledge increase, while task complexity cannot take significant effects.

■ WC77

77-Room 300, CC

Supply Chain Competition I

Contributed Session

Chair: Ziteng Wang, Department of Industrial and Systems Engineering, North Carolina State University, 111 Lampe Dr., Daniels 443, Raleigh, NC, 27695, United States of America, zwang23@ncsu.edu

1 - Price and Quantity Competition in Mixed Market with a Common Retailer

Jian Liu, Dr., Hohai University, Focheng West Road No.8, Business School, Hohai University, Nanjing, JS, 211100, China, liujane1124@126.com, Sun Li, Huimin Wang

This paper investigates the public supplier and the private supplier's equilibrium pricing and quantity decisions in mixed market. Through comparing these equilibrium results under different game, we find that under Cournot competition, the whole market is in prison's dilemma. Under Bertrand competition, the market equilibrium exists when the product differentiation is lower, where the public supplier is leader and the private one is follower.

2 - Real-time Demand Forecasting in a 3-stage Fast-fashion Retail Supply Chain

Sanchoy Das, Professor, New Jersey Institute of Technology, University Heights, Newark, NJ, 07102, United States of America, das@njit.edu, Jingran Zhang

Demand forecasting is a critical issue as a premise of supply positioning in a fast fashion supply chain. This paper is focused on a fast fashion retailer that sells a single product in a finite selling season, with demand uncertainty and stage switching. Products are sold in three sequential stages, regular, clearance and outlet. We derive the demand forecast by a modified exponential-weighted moving average.

3 - Organizational Structure of A Global Supply Chain in the Presence of a Gray Market

Bosung Kim, Ph.D Student, KAIST(Korea Advanced Institute of Science and Technology), 85 Hoegiro, Dongdaemun-Gu, Seoul, Korea, Republic of, kim-bs@business.kaist.ac.kr, Kun Soo Park

We consider the organizational structure of a multinational firm (MNF) that distributes its product to low-price and high-price markets. MNF competes with the gray marketer with parallel import. We analyze the impact of information asymmetry and consumers' valuation difference in the choice of organizational structure.

4 - Does Transshipment Benefit Newsvendors under Limited Supply?

Ziteng Wang, Department of Industrial and Systems Engineering, North Carolina State University, 111 Lampe Dr., Daniels 443, Raleigh, NC, 27695, United States of America, zzwang23@ncsu.edu, Shu-chen Fang

In a supply chain consisting of one supplier and two newsvendor-type retailers, inventory transshipment after demand realization can benefit both newsvendors. When the supply capacity is limited, however, we find that one of the newsvendors may be hurt. Insights are discussed and a coordinating mechanism is designed.

■ WC78

78-Room 301, CC

Auctions/Mechanism Design

Contributed Session

Chair: Su Xiu Xu, The University of Hong Kong, LG108, Composite Building, HKU, Hong Kong, 999077, Hong Kong - PRC, xusuxiu@gmail.com

1 - Pro-competitive Rationing in Multi-unit Auctions

Par Holmberg, Associate Professor, Research Institute of Industrial Organization, Box 55665, Stockholm, SE10215, Sweden, par.holmberg@ifn.se

In multi-unit auctions, rationing rules break ties between multiple marginal bids. The standard approach is to ration marginal bids proportionally. This paper shows how bidding can be made more competitive if the rationing rule depends on the clearing price and gives increasing priority to bidders with a small volume of marginal bids at clearing prices closer to the reservation price. This can have almost the same effect on the competitiveness of bids as a doubling of the number of bidders.

2 - Modeling Electricity Coalition Payoff Disaggregation: A Multi-Agent Framework

Abbas Ehsanfar, Stevens Institute of Technology, Babbio 516, 6th & River St., Stevens Institute of Tech., Hoboken, NJ, 07030, United States of America, aehsanfa@stevens.edu, Babak Heydari

We formulate the electricity consumer and producer coalition in the electricity market. The cooperation is formulated according to the functionality of electricity day-ahead and real-time wholesale markets and a mathematical model is proposed to disaggregate the cooperative payoff among consumers. A multi-agent approach is applied to create a competitive realistic environment for participants.

3 - An Empirical Study on Recyclers' Valuation of Plastic Bottle Recycling in Auctions in Japan

Kazuaki Okubo, Saitama University, 255 Shimo-Okubo, Sakura-ku, Saitama, Japan, okubo@dp.civil.saitama-u.ac.jp

In Japan, electronic bidding is conducted on contracts for recycling polyethylene terephthalate bottles in municipality-based auctions. Recyclers and municipalities are spatially distributed and recyclers can bid in certain municipalities. Predicted bottle amounts at auctions often differ from post-contract amounts. We use a structural model and data from these auctions to empirically examine the impact of recyclers' distance from municipalities, and of amount differences, on their valuations.

4 - Social Welfare in Repeated Task Allocation in Transportation

Qing Chuan Ye, Erasmus University Rotterdam, Burg. Oudlaan 50, Rotterdam, Netherlands, ye@ese.eur.nl, Yingqian Zhang

We investigate the social welfare and behaviour of agents in repeated task allocation problems in transportation by looking at social welfare throughout the system, and the role behaviour plays in the system and agents' willingness to participate. We make use of two task allocation mechanisms, one only considering optimality in terms of costs and the other considering optimality in terms of primarily fairness and secondarily costs. Fairness incentivizes agents to keep participating.

5 - Intermodal Transportation Auctions for B2b E-commerce Logistics with Transaction Costs

Su Xiu Xu, The University of Hong Kong, LG108, Composite Building, Hong Kong, 999077, Hong Kong - PRC, xusuxiu@gmail.com, Meng Cheng, George Q. Huang

We propose efficient intermodal transportation auctions for the B2B e-commerce logistics problem (ELP). This paper is the first to consider transaction costs into auctions. The shipper (a B2B e-commerce platform) bears transaction costs while goods sellers or buyers pay 3PLs' intermodal services. Total logistics chain cost is minimized. Incorporating transaction costs leads to considerable cost saving for the shipper and logistics chain, as well as higher profitability for the group of 3PLs.

■ WC79

79-Room 302, CC

Software Demonstrations

Invited Session

Introduction to Risk and Decision Analysis using Palisade @RISK and The Decision Tools Suite, Jose Raul Castro, author

This event is designed to provide an entry-level introduction into probabilistic analysis and will show how Monte Carlo simulation, decision trees, and optimization can be applied to your everyday business analyses. If you build models in Excel then Palisade solutions can almost certainly help you to make more informed decisions, right from your desktop. The webinar will explore some of the ways in which organizations are applying Palisade tools. From oil and gas, insurance and finance to healthcare, defense and construction, the DecisionTools Suite improves decision making at many of the world's most successful companies.

Wednesday, 2:45pm - 4:15pm

■ WD01

01-Room 301, Marriott

Operations Research in Military Medicine and Healthcare

Sponsor: Military Applications

Sponsored Session

Chair: Nathaniel Bastian, Pennsylvania State University, 362 Leonhard Building, University Park, PA, 16823, United States of America, nathaniel.bastian@fulbrightmail.org

1 - Medical Evacuation from The Battlefield under Uncertainty

Miguel Lejeune, Associate Professor, The George Washington University, 2201 G Street, NW, Fungar Hall, Suite 415, Washington, DC, 20052, United States of America, mlejeune@gwu.edu, Francois Margot

We propose stochastic optimization models that maximize the number of CAT A high-priority casualties transported to a medical center within one hour. Uncertainty stems from the difficulty to reach the casualty locations and the load of the air ambulances. We derive MINLP reformulations and propose algorithmic methods.

2 - Evaluating The Impact of Hospital Efficiency on Wellness in The Military Health System

Eric Swenson, Pennsylvania State University, University Park, PA, United States of America, es187@psu.edu, Nathaniel Bastian, Hyojung Kang, Lawrence Fulton, Paul Griffin

Like all healthcare delivery systems, the U.S. military health system strives to achieve top preventative care and population health outcomes for its members while operating at an efficient performance level. This work uses DEA, SFA, and panel regression to investigate the relationship between hospital efficiency and wellness over time within the military health system. Comparisons are made using 128 military hospitals and clinics in the Army, Navy and Air Force from 2011 - 2013.

3 - Optimizing Military Medevac Dispatching: A Multi-objective Markov Decision Process Model

Benjamin Grannan, Virginia Military Institute, Lexington, VA,
United States of America, grannanbc@vmi.edu, Nathaniel
Bastian, Lawrence Fulton, Mort Webster, Paul Griffin

We present an infinite horizon Multi-Objective Markov Decision Process model to optimize sequential resource allocation decision-making in the military medical evacuation of wartime casualties, which consists of identifying how many/which air assets to dispatch in response to a casualty event and which mobile hospital to transport the patients to. These sequential decisions are complicated due to uncertain casualty demand, distinguishable mobile hospitals, and multiple conflicting objectives.

4 - Stochastic Multi-objective Auto-optimization for Resource Allocation Decision-making

Nathaniel Bastian, Pennsylvania State University, 362 Leonhard
Building, University Park, PA, 16823, United States of America,
nathaniel.bastian@fulbrightmail.org, Lawrence Fulton, Benjamin
Grannan, Tahir Ekin, Hyojung Kang, Paul Griffin

The military health system is a large, centrally-funded and controlled health system that is challenged to provide healthcare delivery and health services at certain quality and workload levels with a fixed amount of input resources. We present a stochastic multi-objective auto-optimization model to help health system decision-makers automatically re-allocate input resources across hospitals for difference levels of resource uncertainty as to optimize overall system performance.

■ WD02

02-Room 302, Marriott

Scheduling IV

Contributed Session

Chair: Hossein Soroush, Professor, Kuwait University, Dept. of Stat. & Opns. Res., POB 5969, Safat, 13060, Kuwait, h.soroush@ku.edu.kw

1 - Heuristics for Scheduling Parallel Machines to Minimize Weighted Squared Tardiness

Jeffrey Schaller, Professor, Eastern Connecticut State University,
83 Windham St., Department of Business Administration,
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schallerj@easternct.edu, Jorge Valente

This paper considers a problem in which there is a set of jobs to be sequenced on identical parallel machines. Each job has a weight and the objective is to sequence the jobs to minimize total weighted squared tardiness. Several heuristics are presented and are tested on randomly generated problems of various numbers of jobs, numbers of machines, due date tightness and due date ranges. The results show that some heuristics find good solutions in a minimal amount of processing time.

2 - Investigation of Algorithms for No-Wait Flowshops

Ali Allahverdi, Professor, Kuwait University, P.O. Box 5969,
Safat, Kuwait, ali.allahverdi@ku.edu.kw

The m-machine no-wait flowshop scheduling problem of minimizing total completion time is addressed where makespan is constrained to be less than a certain value and where setup times are considered as separate from processing times. Several new algorithms are proposed and shown to be efficient.

3 - Synchronized Scheduling in Hybrid Flowshop with Dynamic Customer Order Arrivals

Jian Chen, The University of Hong Kong, LG 108,
Composite Building, Hong Kong, Hong Kong - PRC,
justinchenjian@gmail.com, George Q. Huang

We consider a synchronized scheduling of dynamic arriving customer orders in a hybrid flowshop. The objective is to achieve synchronized production that all products of a same order are simultaneously completed so that they are shipped in a batch. We decompose the dynamic problem into a series of periodic sub-problems. A mixed integer programming model is formulated for sub-problem which is solved by genetic algorithm. Numerical studies obtain several significant findings.

4 - Simulation Based Approximate Dynamic Programming for Stochastic Resource-constrained Project Scheduling

Yasin Gocgun, Assistant Professor, Istanbul Kemerburgaz
University, Mahmutbey Mah., Dilmelenler Cad.No: 26, Istanbul,
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Mahshid Parizi

We study dynamic stochastic resource-constrained project scheduling problems. We formulate these problems as Markov decision processes (MDPs). Since the state and actions spaces of the underlying MDP grow exponentially in parameters such as the number of project types and queue capacity, we pursue an approximate dynamic programming (ADP) approach. We compare the performance of the ADP technique against the myopic method.

5 - Scheduling with Convex Resource Allocation, Learning Effects, Job Deterioration, and Setup Times

Hossein Soroush, Professor, Kuwait University,
Dept. of Stat. & Opns. Res., POB 5969, Safat, 13060, Kuwait,
h.soroush@ku.edu.kw

We study single machine scheduling problems with convex resource dependent processing times, job learning and deterioration, and setup times. Polynomial time algorithms are proposed to find the optimal sequences and the optimal resource allocations that either minimize a composite function of some criteria subject to the constraint that the total resource cost does not exceed a given amount, or minimize the total resource cost such that the composite function does not surpass a specific limit.

■ WD03

03-Room 303, Marriott

Inventory Management for Supply Chains II

Contributed Session

Chair: Yang Bo, PhD, University of Texas at Dallas,
800 West Campbell Rd., Richardson, TX, United States of America,
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1 - A Three-Level Supply Chain with Up and Down-Stream Trade Credit Periods Linked to Ordered Quantity

Roshanak Akram, university of Tennessee, Knoxville, 727 Front
Avenue, Apartment 9, Knoxville, TN, 37902, United States of
America, roshanak@utk.edu, Rupy Sawhney

An EPQ model from manufacturer perspective in a 3-echelon supply chain is developed to minimize total cost considering that a trade credit is offered to the manufacturer, if his order quantity is more than a predetermined value. Customers are permitted to pay off manufacturer in a same or contrary credit period. Defective items can be produced and all would become perfect after rework. Optimal solutions for production lot size and backlogged shortage are obtained based on convex optimization.

2 - A Note on Integrality in Deterministic and Stochastic Inventory Models

Yang Bo, PhD, University of Texas at Dallas, 800 West Campbell
Rd., Richardson, TX, United States of America,
yxb120630@utdallas.edu

The "integrality" question for dynamic optimization models of inventory control asks if there exists an integral optimal policy, given integral initial inventory levels, capacities and demand realizations. For single-product, stochastic-demand problems in multi-echelon assembly systems, the answer is yes (Chen et al. 2013). For single-product, multi-echelon distribution and assembly-distribution systems, integrality holds under deterministic demands, but fails to hold under stochastic demands.

3 - A Joint Replenishment Problem with Dissimilar Items

Linda Li, Student, University of Alabama, 1105 17th Street,
5102A, Tuscaloosa, AL, 35401, United States of America,
lczy1985@163.com, Charles Schmidt

We study a joint replenishment problem with dissimilar items and demand of Poisson process. A class of continuous review policies is considered. The class is defined by three characteristics. Finding the optimal policy out of the class is demonstrated to be a combinatorial optimization problem. The findings reveal that the joint inventory position (a vector) is actually a subordinated continuous time Markov Chain. A new methodology is developed to solve this type of model.

■ WD04

04-Room 304, Marriott

Business Applications II

Contributed Session

Chair: James Ang, Research Advisor, The Logistics Institute Asia Pacific,
National University of Singapore, #04-01 21 Heng Mui Keng Terrace,
Singapore, 119613, Singapore, bizangsk@nus.edu.sg

1 - A Framework for Customer Analytics on Massive Data Sets

Ming Xie, IBM, Diamond Bld, ZGC Software Park, Beijing, China,
xieming@cn.ibm.com, Changrui Ren, Tianzhi Zhao, Miao He,
Jian Xu, Zhen Huang, Yuhui Fu

With the rapid growth of the amount of data accumulated, companies are facing opportunities and challenges for efficiently analyzing these massive data to generate insights and help business. Here we present a framework that leverages big data foundation to provide efficient customer analytical models designed to support the key customer service scenarios in banks. This framework has been verified in real cases.

2 - Data Science Approach for Dealership Performance Analysis

Haidar Almohri, Wayne State University, Detroit, MI, 48243,
United States of America, almohri@wayne.edu, Mark Colosimo,
Ratna Babu Chinnam

Due to the dynamics and complexity of the automotive market, managing automotive dealership performance has always been a challenge for business owners. We present a novel, data science approach for managing, assessing, and enhancing dealership performance using data from dealerships across the United States by first clustering the dealers. Results suggest that this new approach surpasses the traditional approach employed by the industry.

3 - Overview of Supply Chain Risk Management and the Current Issues of Closed-loop Supply Chain in China

Qiang Qiang, Pennsylvania State University, 30 E. Swedesford Rd., Malvern, PA, 19335, United States of America, qzq10@psu.edu

The path toward sustainability to demonstrate environmental and social responsibility has led to an increasing attention to the lifecycle of a product with a focus on value-added recovery activities. However, besides the risks encountered in traditional supply chains (or, sometimes referred to as the forward supply chain), the CLSC bears additional layer of risks if the products are not properly recycled. In this talk, we will provide an overview of both supply chain and CLSC risks in China.

4 - Supply Chain Risk

James Ang, Research Advisor, The Logistics Institute Asia Pacific, National University of Singapore, #04-01 21 Heng Mui Keng Terrace, Singapore, 119613, Singapore, bizangsk@nus.edu.sg

Supply chain risk analysis involves risk identification assessment. For the former, the failure mode effect analysis is improved using fuzzy theory and grey system theory. For the latter, simulation models of supply chains are built to quantitatively assess impacts of risks in terms of production rate, inventory level, and lead-time.

WD05

05-Room 305, Marriott

The Social Impacts of Social Media Analysis

Cluster: Social Media Analytics

Invited Session

Chair: Les Servi, The MITRE Corporation, 202 Burlington Road, Bedford, MA, United States of America, lservi@mitre.org

1 - Modeling Human Behavior in the Context of Social Media During Extreme Events

Yulia Tyshchuk, Researcher, USMA, 5 Winding Brook Dr. Apt. 2J, Guilderland, NY, 12084, United States of America, yulia.tyshchuk@gmail.com

This research examines how social science theory, Theory of Planned Behavior, can explain human behavior in response to extreme events on social media. Validation of this theory enables emergency response officials to create strategies that facilitate public response to extreme events such as diffusion of critical actionable information, providing confirmations, and taking the prescribed action. Effective public response can save lives and reduce property damage.

2 - Social Media Whispers during IPO Quiet Period

Julie Zhang, Assistant Professor, University of Massachusetts Lowell, One University Ave., Lowell, MA, 01854, United States of America, juheng_zhang@uml.edu

We investigate social media news for companies during their quiet periods for IPO. In this study, we examine whether the stock price of a company on its IPO day is associated with the volume and valence of its social media coverage during quiet period. We demonstrate the relationship between a company's stock price PARK volatility in the first week of IPO and its social media coverage in the first week and quiet period.

3 - Simulating Twitter Ego Networks

Inbal Yahav, Bar Ilan University, Bar Ilan University, Ramat Gan, 5290002, Israel, yoavac@gmail.com, Yoav Achiam

The network on the 2-level (followers, and their followers) Twitter social ego-network is studied. A simulation based on A. Barabasi's model is generated. The collected data contains the followers' names and a count of their followers. We found that followers' distribution follows a combination of power law and exponential distributions. The distribution of followers per companies (having more than 1000 followers) is steady over time, with a constant rate of new followers and departing followers

WD06

06-Room 306, Marriott

Portfolio Analysis I

Contributed Session

Chair: Umit Saglam, Assistant Professor, East Tennessee State University, Department of Management and Marketing, College of Business and Technology, Johnson City, TN, 37614, United States of America, saglam@etsu.edu

1 - Understanding Behaviors of Robust Portfolios

Woo Chang Kim, Associate Professor, KAIST, 291 Daehak-Ro, Yuseong-Gu, Daejeon, Korea, Republic of, wkim@kaist.ac.kr

Robust portfolio optimization has been developed to resolve the high sensitivity to inputs of the Markowitz mean-variance model. Although much effort has been put into forming robust portfolios, there have not been many attempts to analyze the characteristics of portfolios formed from robust optimization. In this presentation, we discuss the recent findings on the qualitative characteristics of the robust portfolios such as higher moment controllability, factor tilting behaviors, and robustness.

2 - Computing Near-optimal Value-at-risk Portfolios using Integer Programming Techniques

Onur Babat, PhD Student, Lehigh University, 217 W. Packer Ave, Bethlehem, PA, 18015, United States of America, onur.babat@lehigh.edu, Juan Vera, Luis Zuluaga

VaR is a non-convex risk measure. It is well-known that the VaR portfolio problem can be formulated as an integer program (IP), which can be difficult to solve with current IP solvers for large-scale instances of the problem. To tackle this drawback, we present an algorithm to compute near-optimal VaR portfolios that takes advantage this IP formulation and provides a guarantee of the near-optimality of the solution. Numerical results will be presented.

3 - Portfolio Optimization with Probabilistic Ratio Constraints

Ran Ji, PhD Candidate, The George Washington University, 2201 G St, NW, Fungler 415H, Washington, DC, 20052, United States of America, jiran@gwmail.gwu.edu, Miguel Lejeune

We propose a class of stochastic portfolio optimization models with probabilistic ratio constraints. The proposed probabilistic reward-risk ratio measures regard the asset returns/losses as random variables to mitigate the estimation risk due to mean return vectors. Each model includes a chance constraint with random technology matrix. We expand a combinatorial modeling framework to represent the feasible set of the chance constraint as a set of mixed-integer linear inequalities.

4 - A Marginal Conditional Stochastic Dominance Based Model of Enhanced Index Tracking

Qian Li, Professor, Xi'an Jiaotong University, No.74 West Yanta Road, Xi'an, China, lqian@mail.xjtu.edu.cn, Liang Bao

Stochastic dominance and mean-variance are two criteria used in optimal portfolio selection. In this paper, we present an enhanced model for index tracking with Marginal Conditional Stochastic Dominance (MCSD) rules. The model is still in the optimization framework but combined with two levels of MCSD criteria. By adopting an immunity based multiple objective optimization algorithm, the solutions for the model are developed. The model is then applied to 8 major markets.

5 - Revealed Preferences for Portfolio Selection – Does Skewness Matter?

Umit Saglam, Assistant Professor, East Tennessee State University, Department of Management and Marketing, College of Business and Technology, Johnson City, TN, 37614, United States of America, saglam@etsu.edu, Merrill Liechty

In this study, we consider two competing descriptions of portfolio selection, the traditional mean variance efficient portfolio versus a generalization allowing for decision makers to consider skewness in their asset allocation. Our numerical experiments are conducted on portfolio drawn from 30 different stocks from the Dow Jones. Numerical results show that investors' preferences are better explained when skewness is taken into account.

■ **WD07**

07-Room 307, Marriott

Risk Analysis I

Contributed Session

Chair: John Guo, Head of Consumer Credit Risk Analytics and Modeling, Fifth Third Bank, 5001 Kingsley Drive, Cincinnati, OH, 45227, United States of America, john.guo@53.com

1 - A Total Systems Framework to Integrate Risk, Safety and Quality Management Models

Mehdi Dorri, Solico Food Inc., East Azerbaijan Ave.
No.103, Tehran, Iran, me.dorri@gmail.com

Organizations that pursue excellence in their performance require to focus on systematic quality and performance improvement of all the components of their system. Integrated and collaborative quality, safety and risk management strategies, including ISO and OHSAS standards, Lean and Six Sigma, enable organizations to develop a strategy to identify critical performance measures for all the components of the system.

2 - The Determinants of Property Damage: Evidence from Hurricane Sandy

Sisi Meng, Dept. of Economics, Florida International University,
University Park Campus, Miami, FL, United States of America,
smeng003@fiu.edu, Pallab Mozumder

This paper analyzes the determinants of property damage caused by hurricane Sandy. We have constructed a hurricane destruction index by using HAZUS-MH. The effectiveness of hurricane preparedness and housing characteristics have been incorporated in explaining variations in property damages. Our results suggest that hurricane intensity has a large negative impact on property damages while effective hurricane preparedness can potentially reduce damages.

3 - Analysis of the Unimodality of the Newsvendor Problem with Mean-variance Trade-off

Javier Rubio-Herrero, Rutgers University, Piscataway, NJ,
United States of America, javier.rubioherrero@rutgers.edu,
Melike Baykal-Görsoy

We introduce an analysis on the conditions needed for the unimodality of the single-period newsvendor problem with two decision variables, namely, price and quantity. The analysis is carried for two different price-dependent functions commonly known as additive and multiplicative. We add risk considerations to the discussion by introducing a mean-variance trade-off used to model risk-averse and risk-seeking situations.

4 - A Two-Stage Approach in Consumer PD Models

John Guo, Head of Consumer Credit Risk Analytics and Modeling, Fifth Third Bank, 5001 Kingsley Drive, Cincinnati, OH, 45227, United States of America, john.guo@53.com

5/3 consumer risk analytics and modeling team proposed a novel two-stage approach to address a major drawback in the legacy modeling framework to predict the probability of default in Expected Loss models by the means of injecting macroeconomic dynamics into loan-level risk characteristics. The innovative two-stage approach not only successfully enhanced 5/3 consumer PD model framework but also addressed a common challenge faced by DFAST and CCAR practitioners.

■ **WD09**

09-Room 309, Marriott

Innovation and Entrepreneurship II

Contributed Session

Chair: Jiwon Hwang, Seoul National University, Ichondong
Yongsangu Kangchon Apt.101-807, Seoul, Korea, Republic of,
kyliehwang@gmail.com

1 - Impact of Open Innovation on Academic Performance of Firms in Nanotechnology Industry

Arman Sadreddin, Graduate Student - M.sc, Concordia
University, Montreal, QC, H3H 2J8, Canada,
a_sadre@encs.concordia.ca, Andrea Schiffauerova

This research focuses on open business models in nanotechnology industry. Based on a statistical analysis on a data, which was gathered from online survey, and simulation result, the frequency of applying two main types of open innovation practices were identified. Also, the impact of applying these practices on academic performance of firms were studied. This research found that applying both types of practices at the same time will lead to have more academic outcomes.

2 - Collaboration Network of Nano-tech Firms:**Open Innovation Approach**

Ehsan Ghalamzan, Research Assistant, Concordia University,
1455 De Maisonneuve Blvd. W., Montreal, QC, H3G1M8,
Canada, ehsan.ghl@gmail.com, Arman Sadreddin,
Andrea Schiffauerova

A substantial body of literature has been concerned about the collaboration networks and their importance in production and distribution of scientific knowledge on one hand, and Open Innovation and its innovative power for firms on the other hand. But no one pays attention to the impact of Open Innovation practices on collaboration network properties of the firm. This article aims to study the relation between applying OI practices and how the company stands in the network of its collaborators.

3 - University Technology Transfer: A Cross-national Comparison

Alfonso Cruz, Professor, Catholic University of Chile, School of Engineering, Avenida Vicuña Mackenna 4860, Campus
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This paper compares Spanish universities' technology transfer (TT) output and performance with similar universities in the United States. The study reveals that, for equivalent research & development expenditure, Spanish universities have lower levels of TT in spite of proportionally similar intellectual property protection activity. The most noticeable gaps found are the number of contracts licensed and licensing incomes, although startup creation shows comparable numbers in both countries.

4 - M&As as Substitutes or Stepping Stones to Innovation?**Examining the Impact of Financial Crisis**

Jiwon Hwang, Seoul National University, Ichondong
Yongsangu Kangchon Apt.101-807, Seoul, Korea, Republic of,
kyliehwang@gmail.com, Christine Choi

With the increase of knowledge intensive M&As, interest in the effect that M&A has on post-M&A innovation has been on the rise. This research strives to examine the strategic choice of whether M&As are used as substitutes or stepping stones to subsequent innovation efforts, by utilizing propensity score matching and DID methods. This paper further studies whether such choices differ between deals conducted during financial crisis and those conducted in non-financial crisis.

■ **WD10**

10-Room 310, Marriott

E-Business/Commerce II

Contributed Session

Chair: Shikui Wu, Assistant Professor, Ryerson University, 350 Victoria St., TRS 2-015, Toronto, Canada, shikui.wu@ryerson.ca

1 - The Impact of O2O Strategy Announcements on the Market Value of Firms in China

Yang Hu, Huazhong University of Science and Technology,
School of Management 310 Lab, Wuhan, China,
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O2O (online to offline) e-commerce mode which combines offline business opportunities with the Internet is blooming in China. Based on 105 samples from 2013 to 2015, we use event study methodology to examine the stock market reaction to O2O announcements. Furthermore, hypotheses concerning factors such as industry type, platform type, product type and risk warning are developed and tested. The results provide useful implications for making decisions about O2O mode to maximize the business value.

2 - When are Online Reviews Most Helpful? The Review Significance Index

Anupama Dash, Graduate Student, University of Maryland,
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United States of America, adash1@umbc.edu, Nazrul Shaikh,
Margaret Ricciuti

Our research looks into the interplay between the product and review characteristics with the aim of (a) determining when reviews are most helpful, (b) indexing products on the basis a review significance index (RSI) that brand teams could use for planning their reputation management efforts.

3 - The Effect of Benefit and Cost on Mobile Coupon Sharing in Social Network Sites: The Role of Social Capital

Han Lubin, Master Student, Huazhong University of Science and Technology, 1037 Luoyu Road, Wuhan, 430074, China,
hhanlubin@163.com, Zhao Xuefeng

This study investigates the influence of long benefit (i.e., reciprocity and social reward), short benefit (i.e., economic reward), long cost (i.e., privacy concern) and short cost (i.e., effort) on mobile coupon sharing by users in social network sites (SNSs). Moreover, this study examines how social capital moderates the relationship between benefit-cost and mobile coupon sharing in SNSs. A field survey with 377 subjects in China is conducted to test the research model.

4 - Managing Cross-border E-commerce: A Multichannel Integration Approach

Shikui Wu, Assistant Professor, Ryerson University, 350 Victoria St., TRS 2-015, Toronto, Canada, shikui.wu@ryerson.ca, Yuan Yuan Wu

This study adopts a multichannel integration approach to analyze and optimize online and offline business strategies and operations for cross-border e-commerce, including: pricing and inventory control; sales, deliveries and returns; and, online and in-store customer service. It helps cross-border businesses in adapting their strategies to market environment, streamlining their business processes, reducing operational costs, mitigating market uncertainty, and improving customer satisfaction.

■ WD11

11-Franklin 1, Marriott

Optimization Integer Programming III

Contributed Session

Chair: Carlos Eduardo De Andrade, Senior Inventive Scientist, AT&T Labs Research, 200 Laurel Avenue South, A5-1E33, Middletown, NJ, 07748, United States of America, cea@research.att.com

1 - Cardinality Constrained Portfolio Optimization via Mixed Integer Linear Programming

Nasim Dehghan Hardoroudi, Aalto University School of Business, Runeberginkatu 22-24, Helsinki, N/, 00100, Finland, nasim.dehghan@gmail.com, Abolfazl Keshvari

Controlling the number of active assets (cardinality of the portfolio) in a mean-variance portfolio problem is practically important but computationally difficult. Such task is commonly presented as a mixed integer quadratic programming (MIQP) problem. We propose a novel approach to reformulate such problem as a MILP problem. Our proposed formulation can be solved by standard MILP solvers much faster than the MIQP problem.

2 - On Linear Conic Relaxation of Discrete Quadratic Programming

Tiantian Nie, North Carolina State University, Department of Industrial and Systems, Engineering, Raleigh, NC, 27695, United States of America, tn timer@ncsu.edu, Shu-chen Fang, Qi An

Discrete quadratic programming problems (DQP) appear widely in real-life applications, but they are hard to solve. We proposed an RLT-based linear conic relaxation of DQP. When the proposed relaxation problem has an optimal solution with rank one or two, optimal solutions to the original DQP problem can be explicitly generated. Numerical results indicate that the proposed relaxation with a primal ADM procedure is capable of efficiently providing high-quality lower bounds for DQP.

3 - Location Problem of Electric Vehicles' Charge Stations under Uncertainty

Rui Chen, IE Department of Tsinghua University, ShunDe Building in Tsinghua University, Beijing, China, chenruiest@163.com

The location of charging stations spreads adoption of electric vehicles by consumer and it simultaneously affects the cost and revenue. This paper presents a location problem for electric vehicles' charge stations under fluctuation of electricity price. An integer programming model is proposed to solve this problem with uncertainty of demand. Then a hybrid algorithm is applied to and numerically verified by an actual example.

4 - A Learning Framework for Feasibility Pump

Carlos Eduardo De Andrade, Senior Inventive Scientist, AT&T Labs Research, 200 Laurel Avenue South, A5-1E33, Middletown, NJ, 07748, United States of America, cea@research.att.com, Shabbir Ahmed, Yufen Shao, George L. Nemhauser

We present a framework for finding feasible solutions for mixed integer programs. We use the feasibility pump heuristic (FP) coupled with a learning framework which is able to build a pool of projections and combine them using information of previous projections. Preliminary results shows that this approach is able to find feasible solutions for instances where the original FP fails.

■ WD12

12-Franklin 2, Marriott

Optimization Stochastic IV

Contributed Session

Chair: Jeremy Castaing, University of Michigan, IOE 1205 Beal Ave., Ann Arbor, MI, United States of America, jctg@umich.edu

1 - Application of Two-stage Risk-averse Optimization to Real-time Interday Portfolio Management

Sitki Gulten, Assistant Professor, Stockton University, 101 Vera King Farris Drive, Galloway, NJ, United States of America, sitki.gulten@stockton.edu, Andrzej Ruszczyński

We describe a study of application of risk-averse optimization techniques to daily portfolio management. First, we develop clustering methods for scenario tree construction. Then, we construct a two-stage stochastic programming problem with conditional measures of risk, which is used to re-balance the portfolio on a rolling horizon basis, with transaction costs included. Finally, we present an extensive simulation study on both intraday and interday real-world data of the methodology.

2 - Stochastic Mixed Integer and Gradient Search Methods for Constrained Problems

Larry Fenn, Hunter College, CUNY, 695 Park Avenue, New York, NY, 10021, United States of America, larry.fenn@gmail.com, Felisa Vazquez-abad

An ordinal variable b denotes resources. For each b , there is a control variable u that yields a convex cost $C(b, u)$. We seek minimal cost satisfying a constraint of the form $P(b, u) < a$. Both functions are steady state averages of a stationary complex process: function evaluations are very costly. We combine Fibonacci search in b with gradient search in u to find the optimal solution and propose sequential sampling for minimal computation. We analyze convergence and discuss parallel computation.

3 - Optimally Scheduling Satellite Communications under Uncertainty

Jeremy Castaing, University of Michigan, IOE 1205 Beal Ave., Ann Arbor, MI, United States of America, jctg@umich.edu, Amy Cohn, James Cutler

We consider the problem of scheduling and managing the download of data from collecting satellites to receiving ground stations under uncertainty of their availability. We design models and heuristics to compute download schedules over the planning horizon while addressing dynamics of collecting, storing, using, and spilling both data and energy.

■ WD13

13-Franklin 3, Marriott

Stochastic Programming

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Guzin Bayraksan, Associate Professor, The Ohio State University, Integrated Systems Engineering, Columbus, OH, 43209, United States of America, bayraksan.1@osu.edu

1 - Regularized Decomposition of High-dimensional Multistage Stochastic Programs with Markov Uncertainty

Tsvetan Asamov, Princeton University, Sherrerd Hall, Charlton Street, Princeton, NJ, 08544, United States of America, tasamov@princeton.edu, Warren Powell

We develop a quadratic regularization approach for the solution of high-dimensional multistage stochastic optimization problems. The resulting algorithms are shown to converge to an optimal policy after a finite number of iterations. Computational experiments are conducted using the setting of optimizing energy storage over a large transmission grid. The numerical results indicate that the proposed methods exhibit significantly faster convergence than their classical counterparts.

2 - Multistage Stochastic Optimization with Application in Energy Storage Control

Harsha Gangammanavar, University of Southern California, 3715, McClintock Avenue, GER 240, Los Angeles, CA, 90089, United States of America, gangamma@usc.edu, Suvrajeet Sen

In this talk we will present Time-staged Stochastic Decomposition, a sequential sampling algorithm which is applicable to multistage stochastic linear programs, in general, and control of distributed storage devices, in particular. The method is focused on stage independent uncertainty and its special cases, including autoregressive processes. We will present convergence properties of this algorithm, and computational results comparing it with algorithms like approximate dynamic programming.

3 - Dynamic Allocations for Cooperative Games under Uncertainty with Risk-averse Players

Nelson Uhan, Assistant Professor, United States Naval Academy, Mathematics Department, Chauvenet Hall, Annapolis, MD, 21402, United States of America, uhan@usna.edu, Alejandro Toriello

We consider a class of cooperative games in which the costs of cooperation are uncertain and evolve over time, and the players are risk averse. These games generalize the classic linear production game, and as a result, model a variety of cooperative settings. We give sufficient conditions for the existence of an allocation in the strong sequential core - the set of allocations that distribute costs as they are incurred and are stable against coalitional defections at any point in time.

4 - Ambiguous Stochastic Programs with Variation Distance

Hamed Rahimian, PhD Student, The Ohio State University, Integrated Systems Engineering, Columbus, OH, 43210, United States of America, rahimian.1@osu.edu, Guzin Bayraksan, Tito Homem-de-mello

Ambiguous stochastic programs relax the assumption of known distributions in stochastic programming and instead use an ambiguity set of distributions. We focus on the variation distance to form the ambiguity set, examine the resulting model properties, and propose a decomposition-based algorithm to solve it. We characterize a minimal scenario tree, where the presence of every scenario is critical in determining the optimal objective function.

■ WD14

14-Franklin 4, Marriott

Data Driven Optimization and Applications I

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Michael Kim, University of Toronto, 5 King's College Road, Toronto, Canada, mikekim@mie.utoronto.ca

1 - Robust Optimization with Learning

Andrew Lim, National University of Singapore/Department of Decision Sciences, Mochtar Riady Building, BIZ1 08-69, 15 Kent Ridge Drive, Singapore, Singapore, andrewlim@nus.edu.sg, Michael Kim

We consider a robust optimization problem with learning in the setting of a Bayesian mixture model and show how it is a natural framework for modeling customer heterogeneity in business analytics applications. Asymptotic equivalence to a mean-variance problem is established. More generally, we illustrate how robust Bayesian models are a natural framework for combining concerns for robustness and learning about uncertainty sets.

2 - Coordinating Pricing and Inventory Replenishment with Nonparametric Demand Learning

Boxiao (Beryl) Chen, University of Michigan-Ann Arbor, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, boxchen@umich.edu, Xiuli Chao, Hyun-Soo Ahn

We consider a finite horizon problem of dynamic pricing and inventory control for a nonperishable product. We develop a data-driven policy that does not require explicit information about the demand distribution and show that it is asymptotically optimal and converges at the fastest possible speed.

3 - Data-driven Assortment Optimization

Velibor Misić, Massachusetts Institute of Technology, 77 Massachusetts Avenue, E40-147, Cambridge, MA, 02139, United States of America, vvmisic@mit.edu, Dimitris Bertsimas

We present a practical method for transforming limited historical transaction data into effective assortment decisions. Our method consists of estimating a choice model from the data by efficiently solving a large-scale linear program, and finding the optimal assortment by solving a tractable mixed-integer program. Our method leads to assortments that achieve near-optimal revenues and significantly outperform assortments derived from other parametric and nonparametric approaches.

4 - Geo-demand Estimation and Inventory Allocation in Online Retailing

Long He, University of California, Berkeley, 1117 Etcheverry Hall, Berkeley, CA, 94720, United States of America, longhe@berkeley.edu, Zhiwei (Tony) Qin

For existing items, we first formulate the multi-dimensional geo-demand distribution estimation problem for existing items as a robust low-rank tensor recovery problem in a convex optimization framework. We also propose a tailored algorithm based on the alternating direction augmented Lagrangian method. For new items, we develop the estimation based on nested logit model and discuss the inventory allocation policy in practice.

■ WD15

15-Franklin 5, Marriott

Optimization Methodology I

Contributed Session

Chair: David Valembois, Head Of Business Development, ENGIE, Avenue Einstein, 2a, Louvain-la-Neuve, 1300, Belgium, david.valembois@external.engie.com

1 - Globally Solving Non-Convex Quadratic Programming Problems via Linear Integer Programming Techniques

Wei Xia, Lehigh University, 312 Brodhead Ave., Bethlehem, PA, 18015, United States of America, wex213@lehigh.edu, Luis Zuluaga, Juan Vera

Quadratic programming (QP) problems are NP-hard optimization problems. We propose an alternative way of globally solving nonconvex QPs by exploiting the Karush-Kuhn-Tucker conditions to linearize its objective. Then we reformulate the problem as a mixed integer linear problem with binary variables to model the KKT complementary constraints. We compare the performance of this solution approach with the benchmark global QP solver QuadprogBB on a variety of test QP instances.

2 - An Engie Novel Approach to the Solution of Thermal Unit Commitment Problem with Coupling Constraints

Melodie Mouffe, ENGIE, Avenue Einstein, 2A, NewTech Center, Louvain-la-Neuve, 1348, Belgium, melodie.mouffe@engie.com, Dimitri Tomanos

Engie developed PoweredPegase to optimize the commitment of its large number of plants on a medium term horizon, while taking into account supply delivery, storage and ancillary services. Getting to find a solution using a fine time granularity is difficult to achieve, specifically when dealing with global constraints. We propose a novel approach to find an accurate solution in a reasonable amount of time, without performing any model approximation, implementing a "smart" time decomposition.

3 - Poweredpegase : Engie's Next-gen Software for Joint Gas and Power Portfolio MT Optimization

David Valembois, Head Of Business Development, ENGIE, Avenue Einstein, 2a, Louvain-la-Neuve, 1300, Belgium, david.valembois@external.engie.com

PoweredPegase is ENGIE's next-gen software for joint gas & power portfolio MT optimization. PP delivers reliable and accurate solutions in remarkable short time thanks to disruptive "smart time" approach. PP open "working modules" allow modifying models by integrating your specific context. If flexibility and accuracy really matter, PoweredPegase is the answer. ENGIE (GDF-Suez) is the No. 1 Independent Energy Producer in the World. Winter is Coming—Optimize Your Energy with PoweredPegase.

■ WD16

16-Franklin 6, Marriott

Game Theory V

Contributed Session

Shuo Zeng, University of Arizona, McClelland Hall 430, 1130 E. Helen Street, Tucson AZ 85721, United States of America, shuozeng@email.arizona.edu

1 - Strategic Delay in Networked Bargaining

Thanh Nguyen, Krannert School of Management, Purdue University, West Lafayette, IN, United States of America, nguyet161@purdue.edu, Vijay Subramanian, Randall Berry

We study decentralized markets involving producers and consumers that are facilitated by middlemen. We do this by analyzing a non-cooperative networked bargaining game. We show that sunk cost problems and a heterogeneous network can give rise to delay or failure in negotiation, and therefore, reduce the total trade capacity of the network. In the limiting regime of extremely patient agents, we provide a sharp characterization of the trade pattern and the segmentation of these markets.

2 - A Joint Work on Knowledge Management and Operations Management: How to Keep Firm-Specific Knowledge

Kai Luo, Assistant Professor, KEDGE Business School, 450 Avenue François Arago CS 90262, La Garde, France, luokailk@sohu.com, Salomee Ruel, Sajjad Jasimuddin

Firm-specific knowledge (FSK) acquisition and maintenance is essential for a firm to fill knowledge gaps and enhance its competitive advantage. We start with qualitative research that identifies the existence and important features of the FSK problem, followed by quantitative research formulated as a principal-agent problem, providing closed-form solutions. We used our model to compare French and American firm styles via 40 numerical examples and develop managerial insights.

3 - Pooling Principals by a Repair Agent

Shuo Zeng, University of Arizona, McClelland Hall 430, 1130 E. Helen Street, Tucson, AZ, 85721, United States of America, shuozeng@email.arizona.edu, Moshe Dror

The literature on principal-agent interplay has its focus on the principal. We focus on the agent. For performance based service contracts it is known that the principal extracts all the surplus and the agent breaks even. But this is not the case for an agent contracting with multiple principals. We show that agent who contracts with a collection of principals with interdependent failure characteristics realizes a profit rate that is convexly increasing in the number of principals.

4 - A Game Theoretic Study on Fake Goods Issue in C2c E-commerce

Fen Ding, Huazhong University of Science and Technology, School of Management, 1037 Luoyu Road, Wuhan, China, ivyours319@163.com

This paper mainly researches the fake goods issue of C2C e-commerce sites by analysis on suppliers, buyers and sellers based on game theory. Supplier's credit problem leads to the spread of fake goods, which effect seller's credit and arouse fraud, caused by the imperfect credit management. Based on that, we build a game model, and then we make an improvement by regulating the suppliers.

5 - How Personality Type Changes the Impact of Recommendation on Investment Decisions

Jun-Yuan Chen, Frontier High School, 1601 East Debbie Ln, Apt. 1301, Mansfield, United States of America, piky1223@gmail.com

We study how personality types, measured by the Myer-Briggs Type Indicator (MBTI) survey, affect the impact of recommendations on investment choices. The MBTI measures personality types in multiple dimensions including how individual processes information, and react to stimulus. We manipulated the presence of a recommendation between two investment choices. We found the impact of this manipulation is mediated by the results of the personality type survey.

WD17

17-Franklin 7, Marriott

Networks and Graphs I

Contributed Session

Chair: Boris Brimkov, Rice University, 6100 Main MS-134, Houston, TX, 77005, United States of America, bb19@rice.edu

1 - Micro to Macro Community Scaling in Human and Bacterial Societies

Irina Cazan, Carnegie Mellon University, Electrical and Computer Engineering, 2134 Hamerschlag Hall, Pittsburgh, PA, United States of America, icazan@andrew.cmu.edu, Connor Walsh, Radu Marculescu

This decade has seen broad research in the social behavior of microbes, with parallels drawn to human behavior to explain core network formation processes. This work explores static and dynamic properties of microbial and human social networks to identify the role of such processes in forecasting community evolution. Using the human microbiome and startup networks, similarities are identified in static features and reaction to disruptions, and contrasts in dynamic evolution.

2 - Graph Based Approaches for Managing Cyber-physical Systems

Fabian Runge, Research Assistant, Jade University, Friedrich-Paffrath-Strasse 101, Wilhelmshaven, 26389, Germany, fabian.runge@jade-hs.de, Sabine Baumann, Oliver Eulenstein

Common solutions for controlling cyber-physical systems focus on linear approaches. However, the system consists of self-referential, but connected and interacting systems and thus high complexity. Given the growing amount of related (sensor) data and the interdependencies of the systems, graph based solutions, like neural networks, seems to be more suitable for controlling the production. This paper describes current graph related methods to handle the growing complexity.

3 - On the Statistical Monitoring of Communication Networks

Marcus Perry, University of Alabama, 305 Alston Hall, 361 Stadium Drive, Tuscaloosa, AL, 35487, United States of America, mperry@cba.ua.edu, Ketong Wang, Xuwen Zhu

Often, decision-makers need to be aware of significant organizational changes in advance to avoid or mitigate potential crisis. Communication networks often serve as a proxy for assessing organizational structure. In this talk, we discuss application of statistical process control methods to efficiently detect changes in macro organizational structure within communication networks. We apply our approach to a time series of daily email networks from the Enron email corpus during crisis time.

4 - Efficient Computation of Chromatic and Flow Polynomials

Boris Brimkov, Rice University, 6100 Main MS-134, Houston, TX, 77005, United States of America, bb19@rice.edu, Illya Hicks

The chromatic and flow polynomials of a graph count the number of ways to color and assign flow to the graph. We present closed formulas and polynomial-time algorithms for computing the chromatic polynomials of novel generalizations of trees, cliques, and cycles. We also use graph duality to compute the flow polynomials of outerplanar graphs and generalized wheel graphs.

WD18

18-Franklin 8, Marriott

Optimization Robust II

Contributed Session

Chair: Svenja Lagershausen, Leibniz Universität Hannover, Wirtschaftswissenschaftliche Fakultät, Königsworther Platz 1, Hannover, 30167, Germany, svenja.lagershausen@prod.uni-hannover.de

1 - Robust Pessimistic Bi-level Optimization

Ihsan Yanikoglu, Özyegin University, Nisantepe Cekmeköy, Istanbul, Turkey, ihsan.yanikoglu@ozyegin.edu.tr, Daniel Kuhn

This paper proposes a robust optimization approach for a class of pessimistic bilevel optimization problems with uncertain data. The associated optimization problem consists of binary "here and now" decisions that are made before data reveals itself; continuous "wait and see" decisions that are adjustable according to the revealed portion of the data. We propose conservative and progressive approximations of such bilevel optimization problems.

2 - Investor Avoidance from Risk as Uniform Portfolio Becomes Optimal

Ahmed Burak Paç, PhD Candidate, Bilkent University, Department of Industrial Engineering, Ankara, 06800, Turkey, burakpac@gmail.com

In a market of N risky assets, asset returns follow a multivariate distribution involving distributional uncertainty in a ball around a known nominal distribution. As the radius of uncertainty increases, optimal investment converges to the uniform portfolio with equal $1/N$ wealth on each asset. In this study, the tendency of the investor to respond to increasing uncertainty by avoiding risk, i.e., the uniform portfolio, is investigated, introducing a riskless asset.

3 - Robust Optimization of Process Industries under Price Uncertainty

Jens Bengtsson, Associate Professor, School of Economics and Business, Norwegian University of Life Sciences, P.O. Box 5003, Aas, 1432, Norway, jens.bengtsson@nmbu.no, Mikael Ronnqvist, Patrik Flisberg

Several studies indicate relationships between changes in input prices and output prices in process industries, e.g. oil refinery. It is of interest to analyze how such relationships can be incorporated in uncertainty constraints which then is used in robust optimization of decisions in the supply chain. Then it also of interest to analyze how different uncertainty constraints will affect the planning of the supply chain, risk exposures and the cost of robustness.

4 - Robust Harvesting Planning in Lumber Supply Chains with Random Supply and Demand

Omid Sanei Bajgiran, PhD Candidate, Concordia University, 1455 De Maisonneuve Blvd. W., Montreal, QC, Canada, o_sane@encs.concordia.ca, Mustapha Nourelfath, Masoumeh Kazemi Zanjani

We propose a robust harvesting planning model under log supply and demand uncertainty that affect the right hand side, constraints, and the objective function coefficients. The proposed robust optimization model which has been formulated based on "price of robustness" provides some insights into the adjustment of the level of robustness of the harvesting plan over the planning horizon and protection against uncertainty.

5 - Dynamic Multi-product Lot-sizing Problem under Uncertainty

Svenja Lagershausen, Leibniz Universität Hannover, Wirtschaftswissenschaftliche Fakultät, Königsworther Platz 1, Hannover, 30167, Germany, svenja.lagershausen@prod.uni-hannover.de

We present a stochastic single-level, multi-product dynamic lot-sizing problem subject to a strict production capacity constraint. The production schedule is determined such that the expected costs are minimized. The backlog is limited using a d-service-level constraint. This leads to a non-linear model that is approximated by a linearization model.

■ **WD19**

19-Franklin 9, Marriott

Core Algorithms and Techniques for Computational Optimization

Sponsor: Computing Society

Sponsored Session

Chair: Atharv Bhosekar, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, Pa, 15213, United States of America, abhoseka@andrew.cmu.edu

1 - Update Algorithms for the Roundoff-error-free LU and Cholesky Factorizations

Adolfo Escobedo, PhD Candidate, Texas A&M, 3131, TAMU, College Station, TX, 77843, United States of America, adolfoescobedo@tamu.edu, Erick Moreno-centeno

We introduce efficient update algorithms for the Roundoff-error-free (REF) LU and Cholesky factorizations. The updates are addition, deletion, and replacement of rows and columns of a basis. Combined with REF substitution, the featured algorithms provide a complete framework for solving LPs exactly and efficiently. A significant advantage of the REF LP framework is that the length of any coefficient calculated via its algorithms is bounded polynomially without having to use gcd operations.

2 - Status Update on GCG, a Generic Branch-price-and-cut Solver

Marco Luebbeke, Aachen University, Germany, marco.luebbeke@rwth-aachen.de, Jonas Witt, Michael Bastubbe, Christian Puchert

GCG is a source-open extension to SCIP to solve mixed-integer programs (MIPs) via branch-price-and-cut without any user interaction. It is meant as a research vehicle and “another trick in the bag” to solve MIPs. For specially structured MIPs, GCG (not surprisingly) outperforms standard MIP solvers by far while it (also not surprisingly) colossally fails on other instances. We report on the project's status, recent novelties, future plans, and potential benefits for a general audience.

3 - Integer Programming as Projection

John Hooker, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, jh38@andrew.cmu.edu, H. P. Williams

We develop an alternative theory of integer programming (IP) based on projection. We define valid inequalities that are analogous to Chvatal-Gomory cuts but based on congruences rather than rounding and have bounded rank. We show how to solve a general IP by branching solely on finite-domain auxiliary variables. We define an IP dual as a value function that is obtained by nested rounding of bounded depth and becomes shift periodic for large perturbations.

4 - Computational Experience with the Bam Global Optimization Algorithm for Derivative-Free Optimization

Atharv Bhosekar, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, abhoseka@andrew.cmu.edu, Luis Miguel Rios, Nikolaos Sahinidis

Branch-and-model (BAM) is a derivative-free optimization (DFO) algorithm that builds a model around each evaluated point using the surrounding evaluated points. The algorithm performs a dense search and employs a local search algorithm to identify local optima. We present extensive computational experience with the algorithm and comparisons with other DFO algorithms.

■ **WD21**

21-Franklin 11, Marriott

Operations Research Methodologies to Improve Healthcare Operations

Sponsor: Health Applications

Sponsored Session

Chair: Nazanin Esmaili, PhD Candidate, University of Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA, United States of America, nae22@pitt.edu

1 - Impact of Care Discontinuity on Patients' Length of Stay

Kimia Ghobadi, Massachusetts Institute of Technology, 77 Massachusetts Ave, Cambridge, MA, United States of America, kimiag@mit.edu, Retsef Levi, Ana Cecilia Zenteno Langle, Andrew Johnston

The Department of Medicine in Massachusetts General Hospital serves a wide variety of patients with various care levels. This functional heterogeneity has led to distributed care models which combined with consistent growth in demand has resulted in a congested system. In this talk, we explore contributors to clinically unnecessary delays in patient progression through the hospital, and more

specifically, the impact of care discontinuity during team handovers on patients' total length of stay.

2 - Appointment Scheduling Based Upon Continuously and Periodically Reported Data

Zlatana Nenova, University of Pittsburgh, 241 Mervis Hall, Roberto Clemente Drive, Pittsburgh, PA, 15260, United States of America, zdn3@pitt.edu, Jerrold H. May

We discuss an approach to determining the optimal timing of appointments for diabetic patients, based upon their blood glucose, blood pressure, and cholesterol readings. Blood pressure and cholesterol are reported periodically; blood glucose is reported multiple times per day. The approach is illustrated using examples from the VA Health System.

3 - Simulation of a Phlebotomy Station in an Outpatient Chemotherapy Infusion Clinic

Matthew Rouhana, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, United States of America, mrouhana@umich.edu, Amy Cohn, Pamela Martinez Villarreal, Marian Grace Boxer, Carolina Tpyaldos

We study the organization and operation of a phlebotomy station at the University of Michigan Comprehensive Cancer Center. By developing a simulation of the patient and work flow through the station, we evaluate alternative methods to reduce patient wait time and improve full-day patient experiences. For educational purposes, we create a simplified table-top version to demonstrate the underlying probability theory for hospital leadership.

4 - Hospital Nurse Staffing Improvements through Better Prediction of Surgical Case Volume

Nazanin Zinouri, Clemson University, 130 Freeman Hall, Clemson, SC, United States of America, nzinour@g.clemson.edu, Kevin Taaffe

Accurate approximations of final surgical case volume are difficult due to the high surgical demand variations. Staffing adjustments a few days prior to the day of surgery are difficult and inefficient. Having accurate demand prediction weeks in advance would help improve staff scheduling and decrease nurse workload pressure by allowing more flexibility in the schedule. We have studied current staff scheduling and workload prediction methods at a hospital to identify areas for improvement.

5 - Hybrid Inventory Policies for Hospitals with Shelf Space Restriction

Nazanin Esmaili, PhD Candidate, University of Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA, United States of America, nae22@pitt.edu, Bryan Norman, Jayant Rajgopal

We address the management of inventory for multiple non-perishable routine use items in a healthcare setting. We present a mixed-integer programming model for selecting the best inventory control system for each item and the best shelf configuration considering space, shelf, and inventory control policy constraints. The objective is to minimize the total average effort to monitor, manage and replenish items. We illustrate the model with data from a hospital.

■ **WD22**

22-Franklin 12, Marriott

Stochastic Processes I

Contributed Session

Chair: Toshikazu Aiyama, Professor, Tokyo Metropolitan University, 1-1 MinamiOhsawa, HachiOhji, Japan, tyaiyama@yahoo.com

1 - A Multi-Resolution Stochastic Graphene Growth Kinetics Model

Sobambo Sosina, Harvard University, 1 Oxford Street, 7th Floor Science Center, Cambridge, MA, 02138, United States of America, sosina@fas.harvard.edu, Tirthankar Dasgupta, Qiang Huang

Graphene has many important properties and has been identified as key component in many industrial applications. It is thus crucial that its growth process and the kinetics behind that process be thoroughly understood. Extending work done by collaborators, we derive a stochastic model for multi-resolution observations, which correctly quantifies uncertainty in the kinetics.

2 - Queueing Network Approximations with MAP(3)s

Sunkyo Kim, Professor, Ajou University, 206 World Cup Road, Youngtong Gu, Suwon, 16499, Korea, Republic of, sunkyo@ajou.ac.kr

We propose a minimal representation of MAP(3)s and present an exact moment matching method. The marginal and joint LST of stationary intervals of the MAP(3) is given in terms of nine parameters. As for queueing network applications, arrival and departure processes are approximated as a MAP(3) based on nine moments. We show that the MAP(3) approximation performs better than MAP(2) especially under moderate traffic intensities.

3 - A Storage Grid as a Network of “Internet of Things”

Ehsan Shirazi, West Virginia University, Morgantown, WV, 26505,
United States of America, ehshirazi@mix.wvu.edu

This work focuses on a high-density storage system in which each grid works as an agent. Combining the decentralized, agent-based control with supervisory oversight provides a higher level of efficiency of product movement within the storage grid. Metrics in the research focus on variations from theoretical number of movements.

4 - Framework of Multiple Stochastic Decision Process in a System

Toshikazu Aiyama, Professor, Tokyo Metropolitan University,
1-1 Minami Ohsawa, Hachiohji, Japan, tyaiyama@yahoo.com

Consider multiple stochastic decision process operating in a system. A system is open to its environment; thus allowing external variability. We will concentrate on a two-process system on this research. First we will present various types. Next we will analyze some characteristics of each types. Some elementary numerical results are presented to illustrate the implication of more than one process in a system.

WD23

23-Franklin 13, Marriott

Queueing Approximation and Simulation

Sponsor: Applied Probability

Sponsored Session

Chair: John Hasenbein, Mechanical Engineering, University of Texas at Austin, Austin, TX, United States of America, jhas@mail.utexas.edu

1 - Exact Simulation of Non-stationary Queues

Mohammad Mousavi, Assistant Professor, University of
Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA, 15212,
United States of America, mousavi@pitt.edu

We discuss the challenges that arise in the planning simulations of systems with time dependent arrival and service rates. Estimating how far back in time a simulation must be initialized is an essential problem in planning simulations. We propound using reflected Brownian motion (RBM) with time-dependent drift and volatility as a guide for estimating this initialization time. We develop an exact simulation method for RBM with time-dependent drift and volatility.

2 - Heavy-traffic Limits for a Fork-join Network in the Halfin – Whitt Regime

Hognyuan Lu, Penn State University, 355 Leonhard Bldg,
University Park, PA, 16802, United States of America,
hzl142@psu.edu, Guodong Pang

We study a multi-server fork-join network with non-exchangeable synchronization (NES), where all parallel service stations are operating in the Halfin-Whitt regime under the non-idling FCFS discipline. The NES requires that completed tasks are only synchronized if they are associated with the same job. We prove FWLLN and FCLT for the number of tasks in each waiting buffer for synchronization, jointly with the number of tasks in each parallel service station and the number of synchronized jobs.

3 - Optimal Stock Allocation for Production-inventory Systems with Multiple Impatient Customer Classes

Yasar Levent Kocaga, Assistant Professor Of Operations
Management, Yeshiva University, 500 West 185th Street, New
York, NY, 10033, United States of America, kocaga@yu.edu,
Yen-Ming Lee

We address the production and inventory control of a make-to-stock system with multiple impatient customer classes. We assume Poisson demand and exponential production times. Demand not satisfied immediately is backordered; but waits only up to an exponentially distributed amount of time, and is cancelled if not satisfied within this time. We show that the threshold inventory rationing policy is still optimal under certain conditions including a requirement on the order of abandonment rates.

4 - Routing and Scheduling in Fluid Gurovich Networks

John Hasenbein, Mechanical Engineering, University of Texas at
Austin, Austin, TX, United States of America,
jhas@mail.utexas.edu, Arda Sisbot

We examine a class of networks in which fluids may be routed to different classes at the same server. Extending previous work on single-station systems, we show that optimal policies in tandem Gurovich networks can exhibit interesting counter-intuitive behavior.

WD24

24-Room 401, Marriott

Artificial Intelligence I

Contributed Session

Chair: Stanislaus Solomon, Assistant Professor Of Supply Chain
Management, Sam Houston State University, 236S SHB,
Department of Management and Marketing, Huntsville, TX, 77340,
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1 - Active Learning for Relevance Vector Machine Regression

Youngdoo Son, PhD Candidate, Seoul National University,
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hand02@snu.ac.kr, Jaewook Lee

In this paper, we propose a novel active learning procedure for relevance vector machine regression. First, we propose the transductive relevance vector machine which uses both labeled and unlabeled data points to construct the model. Then, we suggest three simple querying strategies which exploit the characteristic of relevance vector machine regression. The proposed method showed significantly better performance than the benchmark, random selections, with both of artificial and real data sets.

2 - Rethinking Principal Component Analysis in EEG Classification

Xiaoxia Li, North Dakota State University, 124 East Bison Court,
Fargo, ND, 58102, United States of America, xiaoxia.li@ndsu.edu

Principal Component Analysis (PCA) is considered to be a powerful tool in dimension reduction. However, it is worth thinking of the suitability of application for EEG signal data. Two EEG datasets collected from alcoholic and control groups were used to test the prediction accuracy before and after PCA transformation with SVM and KNN methods. Based on the classification results, we found that PCA is not valid in EEG signal processing. We also concern that other factors might be confounding.

3 - Regret Transfer and Parameter Optimization

Noam Brown, Carnegie Mellon University, 5000 Forbes Ave,
Pittsburgh, PA, 15213, United States of America,
noamb@andrew.cmu.edu

Regret matching is a widely-used algorithm for learning how to act. We begin by proving that regrets on actions in one game can be transferred and discounted to warm start the regrets for solving a different game with same structure but different payoffs that are a function of parameters. This provides, to our knowledge, the first principled warm-starting method for no-regret learning. We then leverage this warm starting to optimize a parameter vector for a player in a two-player zero-sum game.

4 - Dynamic Programming Approximations for Stochastic Resource Planning under Partial Observation

Stanislaus Solomon, Assistant Professor Of Supply Chain
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77340, United States of America, solomon@shsu.edu,
Cipriano Santos, Haitao Li, Keith Womer

Assigning heterogeneous resources to jobs in a stochastic environment requires a sequential decision process. This research focuses on developing an approximate dynamic programming algorithm to address the problem scenario, where the information required to make decisions at each epoch is only partially observable. Hewlett-Packard's resource planning problem will be studied as an application.

WD25

25-Room 402, Marriott

Joint Session AI/ICS: AI Planning and Operations Research

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Chris Beck, University of Toronto, 5 King's College Rd,
University of Toronto, Toronto, ON, M5S3G8, Canada,
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1 - Heuristic Search in Dual Space for Constrained Stochastic Shortest Path Problems

Sylvie Thiebaux, ANU & NICTA, 7, London Circuit, Canberra,
Australia, Sylvie.Thiebaux@anu.edu.au, Felipe Trevizan,
Pedro Santana, Brian Williams

Constrained Stochastic Shortest Path Problems are a natural model for planning under uncertainty for resource-bounded agents with multiple competing objectives. We present i-dual, a heuristic search algorithm that generates optimal stochastic policies for these problems. It incrementally generates and explores promising regions of the 'dual' space of policy occupation measures, guided by a lower bound on the value function. Our experiments show significant run-time improvements over LP methods.

2 - Mixed-integer Programming Formulations for Partial-order Plans

Buser Say, Student, University of Toronto, 5 King's College Rd.,
ON M5S 3G8, Toronto, ON, M5S 3G8, Canada,
buser.say@mail.utoronto.ca, Andre Augusto Cire, Chris Beck

A partial-order plan (POP) is a set of actions associated with precedence constraints for which a goal is achieved in any total ordering of actions that respects the precedence constraints. POPs are more flexible than sequential plans since agents can dynamically commit to the ordering of certain actions at execution time. We investigate novel mixed-integer linear formulations to produce valid POPs from sequential plans, and compare their performance to state-of-the-art MaxSAT models.

3 - Fast Optimal Chance-constrained Scheduling under Uncertainty

Brian Williams, Professor of Aeronautics and Astronautics, MIT
CSAIL, 32 Vassar St, Cambridge, MA, 02139, United States of
America, williams@csail.mit.edu, Cheng Fang, Andrew Wang

Temporal uncertainty in large-scale logistics requires balancing lost efficiency through slack and costly replanning when deadlines are missed. This motivates a computational framework to quantify and bound the risk of violating schedule requirements. In this work, we decompose the problem into two subproblems: 1) optimal risk allocation; and 2) enforcing schedule requirements. This allows us to minimize conservatism while leveraging specialized solvers for each subproblem for fast solutions.

4 - Linear Optimization for Operator Counting in Automated Planning

Florian Pommerening, University of Basel, Spiegelgasse 5,
Basel, 4051, Switzerland, florian.pommerening@unibas.ch

Automated planning is the search for paths in factored state spaces. The recently suggested operator-counting framework uses LP/IP optimization to unify, combine and explain connections between state-of-the-art planning techniques. We present an easily accessible introduction to planning and operator counting. LP/IP methods are a hot topic in planning with significant potential for research collaborations between OR and AI researchers.

■ WD27

27-Room 404, Marriott

Optimization Nonlinear Programming I

Contributed Session

Chair: Dongdong Ge, Shanghai University of Finance and Economics,
100 Wudong Road, Shanghai, 200433, China, gedong78@163.com

1 - An Extended Cutting Plane Approach with PWL Approximation for Generalized Geometric Programming

Yiduo Zhan, PhD Student, University of Central Florida,
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United States of America, yzhan@knights.ucf.edu,
Chung-Li Tseng, Qipeng Zheng

We employ an extended cutting plane (ECP) approach combining with piecewise-linear (PWL) approximation to provide the global solution of GGP. In this approach, the constraints are separated by positive and negative terms. The negative terms are converted to mixed-integer linear constraints through PWL approximation. The partially linearized GGP becomes a mixed-integer nonlinear problem (MINLP). This MINLP is solved using ECP method. Numerical problems are tested and results are discussed.

2 - Solving Non-separable Quadratic Binary Programs using Projection and Surrogation

Jaehwan Jeong, Assistant Professor, Radford University,
Department of Management, P.O. Box 6954, Radford, VA, 24142,
United States of America, jjeong5@radford.edu, Chanaka
Edirisinghe

A new approach is developed to solve non-separable quadratic programs with binary variables. First, separability is induced using a projection technique and non-convex relaxation of the binary variables. Then, using constraint surrogation, an iterative sequence of nonconvex separable quadratic knapsack programs are solved efficiently using our previous algorithms. Preliminary computations are provided.

3 - Stochastic PDE-constrained Optimization of Vibrations of a Plate under a Piecewise-linear Current

Dmitry Chernikov, University of Iowa, 1010 W Benton St. #208F,
Iowa City, IA, 52246, United States of America, dmitry-
chernikov@uiowa.edu, Pavlo Krokhmal, Olesya Zhupanska

In this work a two-stage stochastic PDE-constrained optimization framework is applied to the problem of vibration control of a thin composite plate in the presence of electromagnetic field. The electric current is assumed to be of a piecewise-linear form. We compute the gradient of the objective function using adjoint numerical differentiation method. The value of the objective function is calculated by solving the governing PDEs, and a black-box approach is used for the minimization problem.

4 - Optimizing Blending Operations at the World's Largest Coal Export Port

Fabian Rigterink, The University of Newcastle, Australia,
University Drive, Callaghan NSW, 2308, Australia,
fabian.rigterink@newcastle.edu.au, Natasha Boland,
Thomas Kalinowski

The port of Newcastle, Australia, is the world's largest coal export port. We model the supply chain's medium- and long-term planning of blending operations as a time-expanded pooling problem. Using new multi-commodity flow formulations, we study the trade-off between continuous and discretized variables (NLP and MINLP). We evaluate the performance of unary, log unary and binary variable discretizations in an extensive computational study that concludes the talk.

5 - On the Complexity and Algorithms of Regularized Least Square Problems

Dongdong Ge, Shanghai University of Finance and Economics,
100 Wudong Road, Shanghai, 200433, China,
gedong78@163.com, Yinyu Ye, Zizhuo Wang, Hao Yin

We show that finding a global optimal solution for the regularized least square problem is strong NP-Hard as long as the nonlinear penalty function is concave and non-decreasing. This result clarifies the complexity for a large class of regularized optimization problems studied in the recent statistics literature.

■ WD28

28-Room 405, Marriott

Decision Analysis V

Contributed Session

Chair: Tianqin Shi, San Jose State University, One Washington Square,
Business Tower 450, San Jose, CA, 95192, United States of America,
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1 - Group Decision Making: A Flexible Methodology

Pascale Zaraté, Professor, Toulouse 1 Capitole University - IRIT, 2
rue du Doyen Gabriel Marty, Toulouse Cedex 9, 31042, France,
pascale.zarate@irit.fr

The specific benefice of a collective decision process mainly rests upon the possibility for the participants to confront their respective points of views. To this end, they must have cognitive and technical tools that ease the sharing their own preferences, while allowing keeping some information and feelings for their own. The paper presents the basis of such a flexible, cooperative decision making methodology. This methodology has been implemented in a GDSS called GRoUp Support.

2 - Identifying Patients at Risk using Fuzzy Logic

John Zaleski, Chief Informatics Officer, Nuvo, Inc., 4801 S.
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The use of "big data" for decision making has been a growing area of investigation and usage in healthcare enterprises. This paper shows how fuzzy rules can be used to operate on data obtained from the point of care to assist in clinical decision making, with application to real-time data collection in medical surgical units.

3 - The Effects of Patent Extension and Pharmaceutical Stewardship Program on Green Pharmacy

Tianqin Shi, San Jose State University, One Washington Square,
Business Tower 450, San Jose, CA, 95192, United States of
America, tianqin.shi@sjsu.edu, Dilip Chhajed, Nicholas Petrucci

The eco-toxicity arising from unused pharmaceuticals has drawn considerable attention. In this paper, an innovative pharmaceutical company faces price-dependent demand and decides whether to adopt green pharmacy in response to the regulatory policy as well as the competition from a generic company. A pharmaceutical company incurs a fixed cost to choose green pharmacy. We examine the impacts of two regulatory policies, patent extension and take-back regulation, on the choice of green pharmacy.

■ WD30

30-Room 407, Marriott

Information Systems III

Contributed Session

Chair: Miaomiao Lu, Huazhong University of Science and Technology, Room403, South Student Hostel, the Huazh, Wuhan, China, 1207170339@qq.com

1 - Online Social Networks: The Social Influence of Sentiment Content on Digital Product Diffusion

Tung Cu, Louisiana State University, 2200 Business Education Complex, Nicholson Extension, Baton Rouge, LA, 70803, United States of America, tcu1@lsu.edu, Helmut Schneider, James Van Scott

The study explores the role of user-generated content (UGC) during the diffusion process of digital artifacts. Data collection is conducted on 260 new digital products and more than 105 thousand social network nodes. The overall finding shows that Volume of Post and UGC Sentiment have a dynamic impact on diffusion of digital products. But, the relationships among them depend on certain situations. The study sheds light on the crowding power and the long-tail effect in online social networks.

2 - How Much to Open, How Fast to Fix? Effects of Making the Software Open Source

Rakesh Mallipeddi, PhD Student, Texas A&M University, 320 Wehner, 4217 TAMU, College Station, TX, 77843-4217, United States of America, rmallipeddi@mays.tamu.edu, Subodha Kumar, Ram Gopal, Emre Demirezen

We develop empirical and analytical models to examine the effects of making software open on the overall quality of software systems and behavior of software vendor. We derive and develop optimal strategies for software vendor to allocate resources for maintenance of existing software while developing new software.

3 - Towards a Theoretical Framework of IT-enabled Operations Strategy

Yeming Gong, Associate Professor, EMLYON Business School, 12 Rue Dunoir, Lyon, France, Gong@em-lyon.com, Hongyi Mao, Ryad Titah, Oliver Yao

By an integrated analysis of quantitative data from more than 100 organizations in Europe, Asia and North America and qualitative data from 56 cases, this paper presents a theoretical framework of IT-enabled operations strategy with the objective of investigating "How does information technology leverage resources and processes for operational agility?"

4 - Timing, Diffusion, and Substitution of Generations of Technological Innovations

Miaomiao Lu, Huazhong University of Science and Technology, Room403, South Student Hostel, The Huazh, Wuhan, China, 1207170339@qq.com

Diffusion processes across generations and over time have become increasingly complex and multifaceted in recent years. We discuss efforts to model simultaneously the substitution of successive generation of a durable technological innovation, and the diffusion of the technology. Empirical and normative implications of the proposed model are explored for four generations on Microsoft Windows operating system: win Vista; win xp; win 7; win 8.

■ WD31

31-Room 408, Marriott

Data Mining in Medical and Sociological Decision Making

Sponsor: Data Mining

Sponsored Session

Chair: Chitta Ranjan, Georgia Institute of Technology, Ferst Drive NW, Atlanta, GA, United States of America, nk.chitta.ranjan@gatech.edu

Co-Chair: Kamran Paynabar, School of Industrial and Systems Engineering, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, kpaynabar3@gatech.edu

1 - Online, Semi-Parametric Estimation of Treatment Allocations for the Control of Emerging Epidemics

Eric Laber, 211 Devonhall Lane, Cary, NC, 27518, United States of America, eblaber@ncsu.edu

A key component in controlling the spread of an epidemic across a network of individuals is deciding where, when, and to whom to apply an intervention. An allocation strategy formalizes this process as a sequence of functions that map up-to-date information on the epidemic to a subset of nodes targeted for treatment.

We derive estimating equations for the optimal allocation strategy that do not require a model the system dynamics and that scale to very large problems.

2 - A Novel Sequence Kernel Graph Transform for Clustering and Visualization

Chitta Ranjan, Georgia Institute of Technology, 755 Ferst Drive NW, Atlanta, GA, United States of America, nk.chitta.ranjan@gatech.edu, Samaneh Ebrahimi, Kamran Paynabar

We propose a novel sequence kernel graph (SKG) transform for non-parametric feature extraction on sequence data. The proposed method is accurate, faster than existing methods and parallelizable. The SKG transform can be used for finding similarity between sequences, and hence, alignment-free clustering. It can be extended to perform bi-clustering, and graph visualization of sequences; with application on various behavioral data (clickstream, purchase pattern), protein and gene sequences, etc.

3 - A Transfer Learning Approach for Predictive Modeling of Degenerate Biological Systems

Jing Li, Arizona State University, Tempe, AZ, United States of America, jinglz@asu.edu, Na Zou

Transfer learning, as a statistical modeling approach, refers to methods that integrate knowledge of old domains and data of a new domain, in order to develop a model for the new domain that is better than using the data of the new domain alone. We propose a transfer learning method for predictive modeling and apply it to degenerate biological systems. Theoretical results and findings from real-data analysis will also be presented.

4 - Bayesian Learning Without Recall: A Naive Social Learning Model

Mohammad Amin Rahimian, Graduate Research Fellow, University of Pennsylvania, Levine 4F, University of Pennsylvania, 3330 Walnut Street, Philadelphia, PA, 19104, United States of America, mohar@seas.upenn.edu, Ali Jadbabaie

We analyze a model of learning and belief formation in networks in which agents follow Bayes rule yet they do not recall their history of past observations and cannot reason about how other agents are making their decisions. This model avoids the complexities of fully rational inference and also provides a behavioral foundation for non-Bayesian updating. We present the implications of the choice of signal and action structures for such agents leading to familiar update forms.

■ WD32

32-Room 409, Marriott

Data Mining and Optimization

Contributed Session

Chair: Fatma Yerlikaya Ozkurt, Middle East Technical University, Institute of Applied Mathematics, Ankara, Turkey, fatmayerlikaya@gmail.com

1 - Data Classification via Cluster Covering

Zhengyu Ma, Korea University, Room 551, Engineering Building, Seoul, 136-713, Korea, Republic of, mazhengyu@hotmail.com, Kwangsoo Kim, Hong Ryoo

For data classification, a homogeneous cluster containing only one type of data can easily be identified via neighborhood measure. Using clusters for patterns in LAD, one can obtain a set of homogeneous clusters and next optimize their interplay to discover a decision theory. This new framework of supervised data analytics inherits the major advantage of LAD while it avoids redundant data binarization and also the difficult stages of support feature selection and pattern generation in LAD.

2 - Wastewater Sewerage Treatment Plant Aeration Process Optimization: A Data-driven Approach

Anoop Verma, Research Associate, Wayne State University, 4815 4th St, Detroit, MI, 48201, United States of America, anoop.verma@wayne.edu, Kai Yang, Ali Asadi

Being water quality oriented, large-scale industries such as wastewater treatment plants tend to overlook potential savings in energy consumption. Wastewater treatment process includes energy intensive equipment such as pumps and blowers to move and treat wastewater. Presently, a data-driven approach has been applied for aeration process modeling and optimization of one large scale wastewater in Midwest. A great deal of saving in energy can be made while keeping the water quality within limit.

3 - Optimal Experimental System Design

Alireza Mohseni, Oregon State University, 204 Rogers, Corvallis, OR, 97331, United States of America, mohseni.s.alireza@gmail.com, David Kim

This research examines how the design of a factorial experiment can be modeled as a cost and time constrained discrete optimization problem. Initial results with respect to creating a statistical model for an experiment will be presented.

4 - A Hybrid Computational Method based on Convex Optimization for Outlier Problems

Fatma Yerlikaya Ozkurt, Middle East Technical University,
Institute of Applied Mathematics, Ankara, Turkey,
fatmayerlikaya@gmail.com, Aysegul Askan,
Gerhard Wilhelm Weber

Statistical modeling plays a central role for any prediction problem of interest. However, predictive models may give misleading results when the data contain outliers. In many applications, it is important to identify and treat the outliers without direct elimination. To handle such issues, a hybrid computational method based on conic quadratic programming is introduced and employed on earthquake ground motion data set. Results are compared against widely-used ground motion prediction models.

■ WD35

35-Room 412, Marriott

Global Issues II

Contributed Session

Chair: Feifan Wang, Zhejiang University, No.38, Zheda Road, Hangzhou, China, wangfeifan@zju.edu.cn

1 - A Framework of Social Recommender System Combining Social Network and Sentiment Analysis

Donghui Yang, Southeast University, Sipailou 2#, Nanjing, China, dhyang@seu.edu.cn

In this contribution, we propose a new framework for a social recommender system based on both network structure analysis and social context mining. Exponential random graph models and sentiment similarities are used to make the social recommender system much more precise and to satisfy users' psychological preferences. The recommendation results of diabetes accounts of Sina Weibo show that our method outperforms other social recommender systems.

2 - Decision Tree Based Method for Prediction of Preventable Readmissions in Acute Myocardial Infarction

Andres Garcia-Arce, University of South Florida, 4202 E. Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, andresg@mail.usf.edu, Jose L. Zayas-Castro, Florentino Rico, Shuai Huang

Preventable readmissions are recognized as a target for quality improvement. The US government implemented economic penalties to decrease the preventable readmissions, which leads stakeholders to improve to avoid penalties. The literature show several statistical models that help hospitals understand readmissions risk in their institutions, however, these models usually fail to achieve a good discriminatory power. A random forest-based predictive model is studied, achieving an AUC=0.7494.

3 - Assess Care Coordination by Multi-criteria Ranking

Wei Liu, Purdue University, Industrial Engineering, West Lafayette, IN, United States of America, liu317@purdue.edu, Ping Huang, Steven Landry

Care coordination reflects the quality of care and impacts the patient outcome. It remains a challenge to quantify the interactions among providers from various services as well as the relationships among patients and providers. We use a novel method of multi-criteria ranking to assess the care coordination under consideration. It may aid decision makers to identify appropriate interventions to improve care.

4 - Performance of Different Generalized Propensity Methods in Evaluating Multi-arm Nonrandomized Study

Feifan Wang, Zhejiang University, No.38, Zheda Road, Hangzhou, China, wangfeifan@zju.edu.cn, Haomiao Jin, Zhengxiao Wang

Generalized propensity score (GPS) is a widely used approach to adjust the inherent bias existed in multi-arm nonrandomized study. A simulation study is conducted to assess the performance of four GPS methods: regression adjustment, matching, stratification, and inverse probability weighting. Practical implications are discussed and a case is provided.

■ WD36

36-Room 413, Marriott

Humanitarian Operations Management Applications

Sponsor: Public Sector OR

Sponsored Session

Chair: Alfonso Pedraza-Martinez, Assistant Professor, Indiana University, 1309 E 10th Street, Bloomington, IN, 47405, United States of America, alpedraz@indiana.edu

1 - Fast and Frugal Disaster Response? Decisions in Typhoon Haiyan

Tina Comes, University of Agder, Postboks 509, Grimstad, 4898, Norway, tina.comes@uia.no, Bartel Van De Walle

In the response to sudden-onset disasters, humanitarian organisations operate under trying conditions in which response targets evolve as information on the actual impact becomes available. The pressing humanitarian needs require fast decision making, including decisions on warehouse locations and the allocation of relief items, yet with little time for more than frugal analyses. In this presentation, we study the response to Typhoon Haiyan which struck the Philippines in November 2013.

2 - Estimating and Incorporating Deprivation Costs into Humanitarian Logistic Models for Relief Response

Victor Cantillo, Associated Professor, Universidad del Norte, Km 5 via Puerto Colombia, Barranquilla, Colombia, vcantill@uninorte.edu.co, Nathalie Cotes, Luis Macea, Ivan Serrano

This research allows mathematical formulations using discrete choice modelling to quantify externalities associated to the lack of access to critical commodities in the aftermath of a disaster. Thus the estimated deprivation cost function is explicitly incorporated into the objective function of facility location models for prepositioning supplies, which attempt to minimize the total social costs, as determined by both operational and social considerations. The models are applied to a real case.

3 - Assembling High Quality and Timely Information for Humanitarian Organizations from Social Media

Eunae Yoo, Arizona State University, P.O. Box 874706, Tempe, AZ, 85287, United States of America, Eunae.Yoo@asu.edu, Mahyar Eftekhari, Elliot Rabinovich, Bin Gu

To support operational decision making, humanitarian organizations require high quality and timely data. We investigate how such information can be extracted from social media using automated data mining mechanisms that rapidly process data. The effectiveness of data mining mechanisms are tested using a sample of Twitter data. Our results help shed light on what constitutes high quality information for humanitarian organizations and how it can be speedily obtained from social media.

4 - Humanitarian Funding in a Multi-donor Market with Donation Uncertainty

Alfonso Pedraza-Martinez, Assistant Professor, Indiana University, 1309 E 10th Street, Bloomington, IN, 47405, United States of America, alpedraz@indiana.edu, Arian Aflaki

We analyze the trade-off between earmarked funding and operational performance. If a Humanitarian Organization (HO) allows donors to earmark their donations, HO's expected funding increases but its operational efficiency decreases. We use the Scarf's minimax approach and the newsvendor framework, and calibrate our model using data from 15 disasters.

■ WD37

37-Room 414, Marriott

Health Care Strategy and Policy II

Contributed Session

Chair: Neil Desnoyers, Instructor, Saint Joseph's University, 133 Green Valley Rd, Upper Darby, PA, 19082, United States of America, ntidesnoyers@gmail.com

1 - Revenue-based Booking Policy for Clinic Appointment with Overbooking Considering Patient No-shows

Jiafu Tang, Chair Professor, Dean, Dongbei University of Finance and Economics, School of Management Science, and Engineering, Dalian, 116025, China, jftang@mail.neu.edu.cn, Pingping Cao, Xuanzhu Fan

In this paper, an advanced clinic access system is designed. We formulate a Markov Decision Process model with its extension considering regular patients' no-shows and patient choice to improve clinic revenue by overbooking same-day patients, and then to improve patient satisfaction by allowing patients to choose either a same-day or a scheduled future appointment. Numerical experiments and analysis are made finally.

2 - What Can Merger and Acquisition (M&A) do for Healthcare Services?

Yujiun Tsai, Texas A&M University, 3131 TAMU, College Station, TX, United States of America, yjt2009@tamu.edu

We would like to explore the rationalization of hospitals using M&A to differentiate themselves through services, quality measures, and customer satisfaction.

3 - The Impact of Knowledge Sharing on Healthcare Risk Management Performance

Mecit Can Emre Simsekler, Research Associate, UCL School of Management, UCL, Gower Street, London, WC1E 6BT, United Kingdom, e.simsekler@ucl.ac.uk, Bilal Gokpinar

Considering two key components of knowledge sharing among healthcare personnel, (i) codified in the form of written documents and (ii) tacit with behaviors and daily practices, we examine how knowledge sharing capabilities in healthcare settings translate into risk management performance. We employ a unique dataset from the NHS acute trusts in England to investigate our hypotheses.

4 - Infectious Disease Outbreak Response Strategies for Ebola

Neil Desnoyers, Instructor, Saint Joseph's University, 133 Green Valley Rd, Upper Darby, PA, 19082, United States of America, ntidesnoyers@gmail.com

High viral-load Ebola patients cause an outsize proportion of all transmissions. Outbreak response strategy should include the construction and/or use of permanent, temporary, and/or mobile healthcare facilities, simultaneously. I investigate the use of information on the requirements of high vs. low viral-load Ebola patients. I discuss optimal healthcare facility use to inform Ebola outbreak response and facility deployment strategies, thereby achieving maximum benefit at minimum cost.

■ WD38

38-Room 415, Marriott

Optimization Combinatorial III

Contributed Session

Chair: Pascal Rebreyend, Senior Lecturer, Högskolan Dalarna, Rödavägen, Falun, 79188, Sweden, prb@du.se

1 - The J-set and Successive McCormick Relaxations for Polynomial Programming Problems

Evrin Dalkiran, Wayne State University, 4815 4th St. MEB # 2149, Detroit, MI, 48202, United States of America, evrind@wayne.edu

We analyze the relative strength and tractability of the two linear programming relaxations obtained by the J-set of constraints constructed for the original polynomial formulations and the McCormick relaxations constructed for equivalent quadratic formulations via successive quadratification scheme. We propose a hybrid algorithm that judiciously selects among the J-set relaxation and the McCormick inequalities based on the problem's structural characteristics.

2 - Symmetry: What LP Can Learn from MIP

Roland Wunderling, IBM, Annenstrasse 9, Graz, Austria, roland.wunderling@at.ibm.com, Jean-francois Puget

Symmetry has long been exploited in the solution of mixed integer programs. While LP does not suffer from the same combinatorial explosion of the search space due to symmetry as MIP does, symmetries can be identified and exploited for LP as well. We will evaluate the effect of doing so.

3 - Profit-oriented Ring Arboriculture Problems

Alessandro Hill, Hamburg University of Technology, Schwarzenbergstrasse 95 D, Hamburg, Germany, alessandro.hill@tuhh.de, Roberto Baldacci, Edna Hoshino

In this work we study three new problems in extended network design. Two types of customer nodes and Steiner nodes can be used in a two-level network. Type two customers have to be in circuits that intersect in a depot. Type one customers may also be used in arborescences that extend this ring core. Objectives take into account the arc costs, customer-dependent profits or both. We present MIP models, valid inequalities, corresponding exact algorithms, heuristics and computational results.

4 - Testing Algorithm for Large P-median Problems in Heterogeneous Road Networks

Pascal Rebreyend, Senior Lecturer, Högskolan Dalarna, Rödavägen, Falun, 79188, Sweden, prb@du.se, Laurent Lemarchand

This paper presents and compares different algorithms on large scale p-median problems, up to 2000 candidate nodes. Our main focus is instances where the demand is asymmetric distributed. We use as real data the Swedish road network including distances and as demand points the location of Swedish citizens as our

experimental context. Tested methods simulated annealing, volume algorithm and Cplex. Our new hybrid genetic approach outperforms other existing approaches on large instances.

5 - Conic Least Squares Problem

Yu Xia, Assistant Professor, Lakehead University, 955 Oliver Rd, Thunder Bay, ON, P7B 5E1, Canada, yxia@lakeheadu.ca

I give two reformulations of the dual of the constrained least squares problem over convex cones. The conic least squares problem is then solved by applying modified Nesterov's excessive gap method or Nesterov's smooth method. Numerical experiments comparing this approach with interior-point method based state-of-art software are given.

■ WD39

39-Room 100, CC

Marketing/Operations Management

Cluster: Operations/Marketing Interface

Invited Session

Chair: Rachel Chen, University of California, Davis, CA, United States of America, Associate Professor, rachen@ucdavis.edu

Co-Chair: Cuihong Li, University of Connecticut, 2100 Hillside Rd, Storrs, CT, United States of America, Cuihong.Li@business.uconn.edu

1 - Retailer Adoption of Innovative Products

Jane Gu, Assistant Professor, University of Connecticut, 2100 Hillside Road, Storrs, CT, United States of America, jane.gu@business.uconn.edu, Yunchuan Liu

We consider a research context where innovators with new product development expertise lack direct-selling capabilities and big retailers control the access to the consumer market. We examine how a retailer decides whether to carry an innovator's product based on its private information regarding the market acceptance to the innovative product. Our investigation reveals the interesting impact of vertical and the horizontal channel structures on the retailer's innovation adoption decision.

2 - Product Line Design: Variety and Responsiveness

Cuihong Li, University of Connecticut, 2100 Hillside Rd, Storrs, CT, 06269, United States of America, Cuihong.Li@business.uconn.edu, Laurens Debo

A larger product variety allows a firm to better satisfy the needs of heterogeneous customers, but, in a make-to-order environment, it increases the job completion time, leading to longer waiting of customers. We study the trade-off between product variety and responsiveness to align product line design and operations system design.

3 - Why and Where to Have Outlet Stores?

Shuya Yin, University of California, Irvine, Merage School of Business, Irvine, CA, United States of America, shuya.yin@uci.edu, Jiarui Bai, Haresh Gurnani

Outlet stores have been both complementary to and competing with the main stores. In this project, our goal is to understand the tradeoffs involved in offering outlet stores. In particular, we study how much product differentiation and physical distance should be kept between the main and outlet stores.

4 - Open Or Closed? Technology Strategy, Supplier Investment, and Competition

Bin Hu, Assistant Professor, UNC Kenan-Flagler Business School, CB#3490 McColl Bldg, University of North Carolina, Chapel Hill, NC, 27519, United States of America, Bin_Hu@kenan-flagler.unc.edu, Ming Hu, Yi Yang

We analyze a model where each of two manufacturers decides whether to open its technology to the competitor, and a supplier subsequently decides what technologies to invest in. We find that open technology incentivizes supplier investment, and also leads to a technology-risk-pooling benefit. The manufacturers may also be faced with the prisoner's dilemma. Finally, we show that manufacturers may close their technologies to force the supplier to make a technology investment.

5 - Money-back Guarantees When Physical and On-line Retailers Compete

Hang Ren, University College London, London, United Kingdom, hang.ren.13@ucl.ac.uk, Tingliang Huang, Chris Tang, Ying-ju Chen

We study the pricing and product return policies when physical and on-line stores compete. We find that the on-line store offers money-back guarantees when its salvage advantage outweighs total return hassle. Interestingly, better service quality may hurt the on-line store. When consumers can showroom, i.e. buying online after trying the product offline, we show that the on-line store should offer hassle-free money-back guarantees.

■ **WD40**

40- Room 101, CC

Operations Management/Marketing Interface III

Contributed Session

Chair: Ashkan Negahban, Auburn University, 3301 Shelby Center, Auburn, AL, 36849, United States of America, anegahban@auburn.edu

1 - Fulfillment Service in Online Marketplaces

Wenjing Shen, Drexel University, 3220 Market Street, Philadelphia, PA, 19104, United States of America, ws84@drexel.edu, Gangshu Cai, Xiangfeng Chen

Dominant online retailers, such as Amazon.com and Sears.com, allow small retailers to sell on their online marketplaces and offer fulfillment service to handle the order fulfillment activities for small retailers. In exchange, small retailers pay a fulfillment fee per unit of sales. In this paper, we investigate the benefit of such fulfillment programs and study the optimal fulfillment fees for the dominant retailer.

2 - Try Before You Buy Pricing: Should Rental Fees Apply to Purchases?

Monire Jalili, University of Oregon, 1208 University of Oregon, Eugene, OR, United States of America, mjalili@uoregon.edu, Michael Pangburn

When a product has uncertain value or is used repeatedly over time, customers may opt to rent before purchase. Some sellers entice purchase conversions by offering part of a paid rental price as a subsequent discount. Other sellers offer no such credit. We analyze the optimal pricing and discount policy for a monopolist selling to a market of consumers facing uncertain product value, and derive the conditions under which sellers should optimally apply some of the rental price towards a purchase.

3 - Responding to Forecasting Errors for New Products: An Agent-based Simulation Approach

Ashkan Negahban, Auburn University, 3301 Shelby Center, Auburn, AL, 36849, United States of America, anegahban@auburn.edu, Jeffrey S. Smith

Many real-world examples show that even companies with significant experience in successful product launches have faced huge financial losses due to incorrect demand forecasts for their new products. We consider the case where the demand for the new product grows beyond expectations and use agent-based simulation to evaluate different after-the-fact reactive strategies including capacity expansion, viral marketing, and sales control to reduce potential losses under different market dynamics.

■ **WD41**

41-Room 102A, CC

Scheduling in Healthcare Operations

Sponsor: Manufacturing & Service Operations
Mgmt/Healthcare Operations
Sponsored Session

Chair: Shrutivandana Sharma, Singapore University of Technology and Design, 8 Somapah Road, Singapore, 487372, Singapore, shrutivandana@sutd.edu.sg

Co-Chair: Hossein Abouee Mehri, University of Waterloo, 200 University Avenue West, Department of Management Sciences, Waterloo, ON, N2L 3G1, Canada, habouee@uwaterloo.ca

1 - Long Term Surgery Planning and Scheduling

Maya Bam, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, mbam@umich.edu, Brian Denton, Mark Van Oyen

Scheduling surgeries in a timely manner is a challenge due to competing criteria, such as patient wait time and the availability and utilization of multiple resources (i.e., operating room, surgical service block time). Based on collaboration with a local hospital, we present a mixed integer programming planning model that strives to achieve high resource utilization and provide timely access.

2 - Data-driven Patient Scheduling in Emergency Departments

Meilin Zhang, PhD Candidate, NUS Business School, BIZ 2 Building, 1 Business Link, Singapore 117592, Singapore, Si, 117592, Singapore, 214101@gmail.com, Shuangchi He, Melvyn Sim

We focus on the dynamic scheduling of Emergency Department (ED) patients aiming to mitigate the ED crowding and consequential delays. We propose a novel modeling framework for this patient flow control based on robust optimization approach which is of high fidelity to real ED operations. Our

numerical study is inspired from empirical data and the proposed policy well retains the computation tractability and yields promising benefits on achieving ED targets comparing to other common policies.

3 - Combined Advance and Appointment Scheduling

Mehmet Begen, Ivey Business School - Western University, 1255 Western Road, London, ON, N6G0N1, Canada, mbegen@ivey.uwo.ca, Jonathan Patrick, Antoine Sauré

Appointment scheduling and advance scheduling have generally been addressed as two separate problems despite being highly dependent on each other. We attempt to develop a framework that combines the two problems and present our findings.

4 - Determining Non-clinical Predictors of Hospital Ward Length-of-stay

Taylor Corcoran, PhD Student, UCLA Anderson School of Management, 110 Westwood Plaza, Los Angeles, CA, 90095, United States of America, taylor.corcoran.1@anderson.ucla.edu, Ira Hofer, Nirav Kamdar, Elisa Long

Post-surgical hospital length-of-stay is influenced by patient acuity and surgery procedure, and other factors including patient demographics, ward assignment, surgeon, census levels, discharge day and location. We design an econometric model to identify non-clinical predictors of length-of-stay using 24 months of data from the Ronald Reagan UCLA Medical Center, which regularly experiences occupancy near 100%. Reduced ward length-of-stay could alleviate congestion and improve on-time surgeries.

■ **WD43**

43-Room 103A, CC

Pricing & Revenue Management with New Ingredients

Sponsor: Revenue Management and Pricing
Sponsored Session

Chair: Xin Geng, Xin.Geng@sauder.ubc.ca

1 - Threshold Discounts Comparison: Across-the-board or Partial?

Thunyarat Amornpetchkul, Faculty Member, NIDA Business School, 118 Seri-Thai Road, Bangkok, Boonchana-Atthakorn Bldg. 8th Fl., Bangkok, 10240, Thailand, thunyarat.a@nida.ac.th

An increasingly ubiquitous discount format that is taking over traditional price cuts is "threshold discount," under which a price reduction is awarded to a purchase that meets a minimum quantity or minimum spending requirement. We consider the use of two popular discount schemes: all-unit and incremental discount, in a retail setting. Our focus is to investigate when it is more profitable for the retailer to offer an all-unit discount or an incremental discount.

2 - In Parallel to Ongoing Efforts to Deoptimal Contract Designs for Carbon Capture and Storage Systems

Wenbo Selina Cai, Assistant Professor, New Jersey Institute of Technology, Newark, NJ, cai@njit.edu, Dashi Singham

In parallel to ongoing efforts to develop improved CCS technology, we model the decision processes of CCS participants who face uncertainty in both costs and emissions, and optimize incentives to encourage storage operators to provide the service of transportation and storage of CO₂ from emitters who have heterogeneous emissions profiles. We also evaluate the impact of the cap-and-trade carbon policy on CCS participants' sequestration efforts and storage operators' performance.

3 - Consumer Subsidies in Developing Economies: Advance Selling and Self-control

Qiao-Chu He, PhD Candidate, University of California, Berkeley, 1117 Etcheverry Hall, Berkeley, CA, United States of America, heqc0425@berkeley.edu, Zuo-jun Max Shen, Ying-jun Chen

We present an explanation to the product adoption puzzle in developing economies via consumers' lack of self-control due to their present-bias. We explore the roles of advance selling and consumer subsidy in resolving this puzzle.

4 - Advance Selling to Strategic Consumers: Preorder Contingent Pricing or Preorder Contingent Production

Mike Wei, Assistant Professor, University at Buffalo, 326C Jacobs Management Center, Buffalo, 14260, United States of America, mcwei@buffalo.edu, Fuqiang Zhang

Motivated by emerging industry practices, this paper studies the effectiveness of two new advance selling strategies in counteracting strategic consumer behavior: the preorder contingent production (PCP) strategy and the preorder contingent pricing (PCP) strategy, where the seller's preorder production and price are a function of the preorder quantities respectively.

■ WD44

44-Room 103B, CC

Revenue Management and Pricing in Social Networks

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Amir Ajorlou, Postdoctoral Fellow, Massachusetts Institute of Technology, E32-D569, 32 Vassar Street, Cambridge, MA, 02139, United States of America, ajorlou@mit.edu

1 - Ergodic Social Learning

Alireza Tahbaz-Salehi, Columbia Business School, 3022 Broadway, Uris Hall 418, New York, NY, 10023, United States of America, alirezat@columbia.edu, Ali Jadbabaie, Pooya Molavi

This paper examines how the structure of a social network and the quality of information available to different agents determine the speed of social learning. In a variant of the DeGroot learning model, we show that the rate of learning has a simple analytical characterization in terms of the relative entropy of agents' signal structures and their eigenvector centralities.

2 - Cournot Competition in Networked Markets

Shayan Ehsani, Stanford University, 450 Serra Mall, Stanford, CA, 94305, United States of America, shayane@stanford.edu, Kostas Bimpikis

The paper considers competition among firms that produce a homogeneous good in a networked environment. A bipartite graph determines which subset of markets a firm can supply to. We characterize equilibrium supply quantities, prices, and profits, and provide several insights regarding entering a new market or two firms merging.

3 - Maximizing Stochastic Monotone Submodular Functions

Arash Asadpour, Assistant Professor, New York University, 44 West 4th Street, Suite 8-60, New York, NY, 10012, United States of America, aasadpou@stern.nyu.edu, Hamid Nazerzadeh

We study the problem of maximizing a stochastic monotone submodular function with respect to a matroid constraint. We show that the adaptivity gap ϕ the ratio between the values of optimal adaptive and optimal non-adaptive policies ϕ is bounded and is equal to $e/(e-1)$. We propose a polynomial-time non-adaptive policy that achieves this bound. We also present an adaptive myopic policy that obtains at least half of the optimal value.

4 - Dynamic Pricing in Social Networks: The Word of Mouth Effect

Amir Ajorlou, Postdoctoral Fellow, Massachusetts Institute of Technology, E32-D569, 32 Vassar Street, Cambridge, MA, 02139, United States of America, ajorlou@mit.edu, Ali Jadbabaie, Ali Kakhbod

We study the problem of optimal dynamic pricing for a monopolist selling a product to consumers in a social network. The only means of spread of information about the product is via Word of Mouth communication. We show that, in line with the real world evidence from smartphone applications, the optimal dynamic pricing policy for durable products drops the price to zero infinitely often, giving away the immediate profit in full to expand the informed network in order to exploit it in future.

■ WD45

45-Room 103C, CC

Sustainability III

Contributed Session

Chair: Rajab Khalilpour, Dr, University of Sydney, School of Chemical and Biomolecular Eng, Sydney 2006, Australia, rajab.khalilpour@sydney.edu.au

1 - Understanding Spatio-temporal Diffusion of New Durable Products: The Toyota Prius Hybrid Vehicle

David Keith, Assistant Professor, MIT Sloan School of Management, 100 Main St, Room E62-441, Cambridge, MA, 02138, United States of America, dkeith@mit.edu, Jeroen Struben, John D. Sterman

We propose an analytical framework in which spatio-temporal diffusion is explained by social influence between adopters and potential adopters at different geographic scales, for which data are more readily observable. We analyze Prius sales in 4 US cities selected to capture variation in conduciveness and observed adoption. We find that variation in Prius adoption is primarily explained by social contagion within each ZIP code, amplifying underlying market heterogeneities.

2 - Sustainability Consciousness in Engineering Education

Qiong Wang, National University of Singapore, #12-207C, North Tower, University Town, Singapore, 138601, Singapore, qiong.wang@u.nus.edu

University sustainability education programs in several European countries and the US have been compared to find common characteristics of the curricula in environmental science and engineering programs. This study investigates differences in the world's top universities for engineering and technology with the QS World University Rankings and Times Higher Education World University Rankings by Faculty in the academic year 2014-15.

3 - Sustainability Trends in Service Sectors: A Text Mining Approach

Youqin Pan, Assistant Professor, Salem State University, 352 Lafayette Street, Salem, MA, 01970, United States of America, youqinpan@my.unt.edu, Xiaocun Sun

In this paper, sustainability reports of major companies in the service sectors are obtained and used. To extract useful information or uncover hidden patterns from these reports, text mining is applied. The higher the frequency of a certain term, the greater is the emphasis that companies place on them and hence the more important they are to the companies.

4 - Financial Sustainability of Operator Assisted E-government Kiosks in Emerging Economies

Rajesh Sharma, Research Scholar, Indian Institute of Management, Prabandh Shikhar, Rau, Indore, MP, 453556, India, f12rajeshs@iimdr.ac.in, Rajhans Mishra

The paper addresses the issue of financial sustainability of operator assisted kiosks which are deployed in emerging economies to overcome the handicap of low education, PC penetration and lack of Internet connectivity.

5 - Feasibility Study of Grid Defection with PV and Battery

Rajab Khalilpour, Dr, University of Sydney, School of Chemical and Biomolecular Eng, University of Sydney, University of Sydney, 2006, Australia, rajab.khalilpour@sydney.edu.au, Anthony Vassallo

We have developed a mixed-integer decision support tool for rigorous assessment of the feasibility of leaving the grid. Numerous sensitivity analyses are carried out over critical parameters such as technology costs, system size, load, and feed-in-tariff. The results show that leaving-the-grid is not the best economic option and it might be more beneficial to keep the connection with the grid, but minimize the electricity purchase by installation of an optimal size of a PV-battery system.

■ WD46

46-Room 104A, CC

Empirical Research in Service Operations

Sponsor: Manufacturing & Service Oper Mgmt/Service Operations

Sponsored Session

Chair: Ryan Buell, Harvard Business School, Morgan Hall 429, Boston, MA, 02163, United States of America, rbuell@hbs.edu

1 - Strategically Giving Service: Information Visibility and Driver Behavior in E-hailing Services

Antonio Moreno-Garcia, Northwestern University, 2001 Sheridan Rd, Evanston, IL, 60208, United States of America, a-morenogarcia@kellogg.northwestern.edu, Can Ozkan

Using data from a leading eHailing platform, we study how drivers react to the existence of detailed information about the location of their competitors, and we analyze how this phenomenon affects operational efficiency.

2 - Increasing Sales by Managing Congestion in Self-service Environments: Evidence from A Field Experiment

Saravanan Kesavan, Associate Professor, University of North Carolina at Chapel Hill, Kenan-Flagler Business School, Chapel Hill, NC, 27514, United States of America, Saravanan_Kesavan@kenan-flagler.unc.edu, Hyun Seok Lee, Vinayak Deshpande

We examine the impact of congestion in fitting-room on store performance. We demonstrate an inverted-U relationship between fitting-room traffic and sales. We find that co-production is more effective: increasing fitting-room labor by one person through field experiment increases sales per hour by 15.77%. Our solution was adopted with around 100 stores. Finally, we tease out two mechanisms of congestion effect by closely observing other retail store: 1) Waiting time and 2) Phantom stock-out.

3 - The Performance Benefits of Not Working

Bradley Staats, Associate Professor, UNC-Chapel Hill, NC,
United States of America, Bradley_Staats@kenan-flagler.unc.edu

Using lab and field experiments we examine how performance may be improved by doing less and thinking more.

4 - The Persistence of Customer Incompatibility: Evidence from a Retail Bank Acquisition

Ryan Buell, Harvard Business School, Morgan Hall 429,
Boston, MA, 02163, United States of America, rbuell@hbs.edu,
Dennis Campbell

When a firm acquires a customer whose needs and preferences are misaligned with its operating system, will the customer's preferences conform over time? Will the customer defect? Or, will the misalignment persist? We leverage a natural experiment created when one nationwide retail bank acquired another to answer these questions.

■ WD47

47-Room 104B, CC

Strategic Planning for the Closed Loop Supply Chain

Sponsor: Manufacturing & Service Oper
Mgmt/Sustainable Operations
Sponsored Session

Chair: Daniel Steeneck, Post Doctoral Associate, MIT Center for Transportation and Logistics, 1 Amherst St., E40-211, Cambridge, MA, 02142, United States of America, steeneck@mit.edu

1 - To Remarket Now or Save for Warranty Claims

Cerag Pince, Kuehne Logistics University, Grosser Grasbrook 17,
Hamburg, Germany, Cerag.Pince@the-klu.org, Beril Toktay,
Mark Ferguson

Consumer returns constitute a substantial fraction of sales in the consumer electronics industry and often cannot be re-sold as new due to litigation concerns. Therefore, identifying the best joint pricing and disposition strategy is a challenging but important decision for consumer electronics OEMs. This paper investigates how an OEM should price new and refurbished products while allocating consumer returns between remarketing and warranty coverage options over the product's short life cycle.

2 - Optimal Product Design in a Remanufacturing Setting

Serkan M. Akturk, PhD Candidate, Texas A&M University, 4217
TAMU Wehner 320 M, College Station, TX, United States of
America, makturk@mays.tamu.edu, James Abbey, Neil Geismar,
V. Daniel R. Guide, Jr.

This study analytically investigates how remanufacturing firms should choose among varying design philosophies ranging from integral to modular to part-based designs. Firms believe that increasing the level of remanufacturability would also increase the profitability by lowering remanufacturing costs. However, several factors such as industry clockspeed and time-to-market complicate this decision.

3 - The Effect of Channel Structure on End-of-Life Product Collection Strategies

Elizabeth J. Durango-Cohen, Associate Professor, Illinois Institute
of Technology, 10 W. 35th Street, Chicao, IL, 60616,
United States of America, durango-cohen@iit.edu, Chia-hang Li

In this talk, we address the coordination issue of deciding on the proper reverse channel strategy to collect End-of-Life products in a three-echelon closed-loop supply chain, under the presence of a strategic recycler. We find that the manufacturer is always better-off by outsourcing product collection activities either to the retailer or the recycler. We discuss the impact of a strategic recycler, whether a price taker or price maker, on equilibrium prices, profits, and collection rates.

4 - End-of-life Option and Product Design

Daniel Steeneck, Post Doctoral Associate, MIT Center for Transportation and Logistics, 1 Amherst St., E40-211, Cambridge, MA, 02142, United States of America, steeneck@mit.edu,
Subhash C. Sarin

The characteristics of a product and its parts determine its optimal End-of-Life (EOL) option. However, a product's design plays a large role in determining the characteristics of a product. Insights relating product design to optimal EOL option are presented.

■ WD48

48-Room 105A, CC

Revenue Management Pricing II

Contributed Session

Chair: John Wilson, Ivey School of Business, 1255 Western Road,
London, ON, N6G 0N1, Canada, jwilson@ivey.ca

1 - Optimal Subscription Pricing for Free Delivery Services

Chinmoy Mohapatra, PhD Candidate, University of Texas at Austin, 3500 Greystone Drive, Apt. 126, Austin, TX, 78731, United States of America, chinmoym@utexas.edu, Anant Balakrishnan, Shankar Sundaresan

We study the subscription pricing problem of a retailer that offers its consumers two delivery choices: a pay-per-delivery option and a subscription option with free delivery. The retailer balances the "loss" incurred in covering the shipping costs of subscribers against the increase in revenue from the "lift" in their order quantity. Considering a model with a general utility framework, heterogeneous consumers, and an outside option, we characterize the retailer's optimal subscription price.

2 - Budget Constrained Markdown Optimization

Emrah Zarifoglu, Team Leader - Optimization And Modeling, IBM, 1001 Hillsdale Blvd. Ste 400, Foster City, CA, United States of America, emrah.zarifoglu@utexas.edu, Xiao Chun Li, Jun Lei Chen

Markdown is a schedule of known price reductions taken over short time with the purpose of managing a product out the assortment gracefully and cost-effectively. Markdown budget is an important constraint when retailers run a markdown recommendation for a plan. It is crucial to limit total markdown dollars under budget. We provide a method to ensure markdown dollar to be limited to markdown budget and avoid the performance issue when considering the total budget across all store-products level.

3 - Dynamic Nonlinear Pricing of Inventories Over Finite Sales Horizons

Yan Liu, University of Science and Technology of China, No.96, Jin Zhai Road Baohe District, Hefei, China, terenceliuyan@gmail.com, Guillermo Gallego, Michael Li

We present three dynamic pricing models in a setting where customers can be incentivized to purchase multiple units. The dynamic linear pricing (DLP) model charges a uniform price that depends on the time-to-go and the remaining capacity. The dynamic package pricing (DPP) model allows complete freedom in pricing different bundle sizes. We also study dynamic block pricing (DBP) as an intermediate scheme where prices are linear within each block.

4 - Dynamic Pricing for a Single Perishable Product Based on Customer Inertia

Yusheng Hu, Student, School of Management and Economics, Beijing Institute of Technology, No. 5 South Zhong Guan Cun Street, Beijing, 100081, China, huyusheng1981@163.com, Jinlin Li

This paper investigates a dynamic pricing problem for a single perishable product in the presence of customer inertia. Dynamic pricing model about customer inertia is established using the dynamic programming method, and structural properties of the optimal price are given. The results show that customer inertia produces negative effect on the optimal price, which is monotonically decreasing in inertia depth and inertia breadth.

5 - Optimising Name-your-own-price Auctions Over Different Channels and Number of Bids

John Wilson, Ivey School of Business, 1255 Western Road, London, ON, N6G 0N1, Canada, jwilson@ivey.ca

Optimality results for designing Name-Your-Own-Price Auctions with other distribution channels will be presented. For the case of just a Name-Your-Own-Price Auction, the optimality results regarding allowing one or more bids will be presented.

■ WD49

49-Room 105B, CC

Facility Location I

Contributed Session

Chair: Kenneth Carling, Professor, Dalarna University, Sweden, Högskolan Dalarna, Falun, 79188, Sweden, kca@du.se

1 - Locating and Sizing Storage Units in a Drainage System using a Simulated Annealing Approach

Maria Cunha, Professor, University of Coimbra, DEC Polo II da Universidade, Coimbra, 3030-165, Portugal, mccunha@dec.uc.pt, Nuno Simies, Joao Zeferino

Urban stormwater drainage systems are very important assets to sustainable development. Attention must be paid to the effects of the rapid process of urbanization and climate change with extreme weather and heavy rains occurring more frequently. A pioneering tool will be presented, comprising interlinked modules (including an optimization model for locating and sizing units to store excess flows taking into account climate change) to redesign sustainable urban stormwater drainage systems.

2 - Developing a Transportation Network for UAVs Delivery

Amirali Ghahari, University of Arkansas, 891 W. Melmar Dr., Apt #83, Fayetteville, AR, 72703, United States of America, aghahari@uark.edu, Edward Pohl

Recently, the use of Unmanned Ariel Vehicle (UAV) for package delivery has become an interesting topic for giant corporations. In our research, we develop a strategic model that constructs a transportation and support network which enables the UAVs to fly long distances and make deliveries to a variety of demand points. Since the developed models cannot be solved optimally for large representative problems using exact methods, a heuristic algorithm is developed to solve real world examples.

3 - Cold Supply Chain Design with Environmental Considerations: A Simulation-optimization Approach

Ahmed Saif, University of Waterloo, 200 University Avenue, Waterloo, Canada, asaif@uwaterloo.ca, Samir Elhedhli

Cold supply chains have high levels of greenhouse gas emissions due to the high energy consumption and refrigerant gas leakages. We model the cold supply chain design problem as a mixed-integer concave minimization problem with dual objectives of minimizing the total cost and the global warming impact. A novel hybrid simulation-optimization approach is proposed to solve the problem.

4 - On Administrative Borders and Accessibility to Public Services

Kenneth Carling, Professor, Dalarna University, Sweden, Högskolan Dalarna, Falun, 79188, Sweden, kca@du.se, Pascal Rebreyend, Xiangli Meng, Johan Håkansson

Do the Europeans suffer from a poor accessibility to public services due to internal borders? We address this question by studying the effect of administrative borders within Sweden on the population's spatial accessibility to hospital service. We have elaborated several scenarios ranging from strongly confining regional borders to no confinements of borders as well as long-term population redistribution. Our findings imply that the borders are only marginally worsening the accessibility.

■ WD50

50-Room 106A, CC

Urban Spatial and Environmental Issues

Sponsor: Manufacturing & Service Operations Management
Sponsored Session

Chair: Elena Belavina, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, United States of America, elena.belavina@chicagobooth.edu

1 - Shipment Policies for Perishable Products in Two-tier Supply Chains

Arzum Akkas, Boston University, 595 Commonwealth Avenue, Boston, MA, United States of America, arzumakkas@gmail.com, Vishal Gaur, David Simchi-levi, Roy Welsch

Product expiration is an important problem in the consumer packaged goods industry with substantial impact on the environment and profits of firms. We found that shelf life erosion is one of the drivers of expiration. In this study, we establish shipment policies for manufacturers to address the shelf life erosion problem.

2 - Online Fresh Grocery Retail: A La Carte Or Buffet?

Elena Belavina, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, United States of America, elena.belavina@chicagobooth.edu

Grocery delivery is a market that many try to conquer. Appropriate pricing is key for success. There is little consensus among different players (at times even within one firm operating in different locations) on what is the best pricing scheme. For example, Amazon Fresh in Seattle is using per order pricing while in San Francisco - subscription fee. We provide recommendation for the preferred pricing scheme based on various characteristics (delivery logistics, demand variability etc.).

3 - Customer Behavior in Bike-share Systems

Karan Girotra, Associate Professor, INSEAD, Boulevard de Constance, Fontainebleau, 77300, France, Karan.Girotra@insead.edu

Using a large high-frequency dataset, we identify the impact of the accessibility of bike-share stations and the associated service-levels on the usage of these systems. We illustrate the use of our estimates to support operational decisions such as station network reorganization and system investments.

4 - Service Region Design for Urban Electric Vehicle Sharing Systems

Ho-Yin Mak, Associate Professor, Saad Business School, University of Oxford, Park End Street, Oxford, United Kingdom, Ho-Yin.Mak@sbs.ox.ac.uk, Ying Rong, Long He, Zuo-Jun Max Shen

We consider the service region design problem for electric vehicle sharing systems. We then develop a model that incorporates both customer adoption behavior and fleet operations under spatially-imbalanced and time-varying travel patterns. To address the uncertainty in adoption patterns, we employ a distributionally-robust optimization framework. Applying this approach to the case of Car2Go's service in San Diego, CA, with real operations data, we address a number of planning questions.

■ WD51

51-Room 106B, CC

Strategic Behavior and Decision Making within Supply Chains

Sponsor: Manufacturing & Service Operations Management
Sponsored Session

Chair: Pelin Pekgun, Assistant Professor, University of South Carolina, 1014 Greene Street, Columbia, SC, 29208, United States of America, pelin.pekgun@moore.sc.edu

1 - The Effects of Product Recalls on Promotions and Sales

Yan Dong, Moore School of Business, University of South Carolina, 1014 Greene St, Columbia, SC, 29201, United States of America, Yan.Dong@moore.sc.edu, Chen Zhou, Rafael Becerril, Tony Haitao Cui

This study investigates firm decisions in response to a major product recall, which has a direct effect to the recalled brand and an indirect effect to the market and the competitors. In the wake of the recall, firms may adopt different strategies to take advantage of the recall, by promoting their own products more aggressively, for example, to increase sales. Analyzing a dataset of recalls in the automobile industry, this study shows how the competitors can proactively react to a major recall.

2 - Mitigating Supplier Risks via Diversification Versus Improvement: An Experimental Evaluation

Basak Kalkanci, Georgia Institute of Technology, 800 W Peachtree St, NW, Atlanta, GA, United States of America, Basak.Kalkanci@scheller.gatech.edu

Using economic experiments, we evaluate the performance of supplier diversification versus improvement to mitigate supply chain risks of a buyer facing suppliers with different costs and risk profiles. We show that the buyers diversify their orders more than theory and the orders are artificially inflated to benefit from quantity hedging. We also demonstrate that sourcing commitment hurts a buyer by reducing the subsequent supplier improvement effort, contrary to theory.

2 - Analytical Stochastic Link Transmission Model Suitable for Large-scale Analysis

Jing Lu, Massachusetts Institute of Technology, Cambridge, MA,
United States of America, luj@mit.edu, Carolina Osorio

We formulate a model that builds upon the previously formulated analytical stochastic network loading model of Osorio and Flötterod (2013). The proposed model has a complexity that is linear, rather than cubic, in the space capacity of the links in the network. It is a scalable approach suitable for large-scale network analysis. The model is validated versus stochastic simulation results, and is then used to analyze a network with intricate network dynamics.

3 - A Graph-based Approach to Measure the Efficiency of Urban Taxi Service System

Xianyuan Zhan, PhD Candidate, Purdue University, 550 Stadium
Mall Drive, School of Civil Engineering, West Lafayette, IN,
47906, United States of America, zhanxianyuan@purdue.edu,
Xinwu Qian, Satish V. Ukkusuri

This study investigates the efficiency level of the taxi service system using real world large-scale taxi trip data from New York City. Two large-scale optimization problems are formulated and transformed into equivalent graph problems to find the theoretical optimal strategy that minimizes the cost of vacant trips, and results in minimum number of taxis required to satisfy all observed trips. Huge performance gap is observed between current system and the optimal system, which suggests the potential gain by sharing system-wide information among taxi drivers and passengers.

4 - Combining Data-driven and Model-driven Approaches for Traffic Simulator Calibration Problems

Kevin Zhang, Massachusetts Institute of Technology, Cambridge
MA, United States of America, kzhang81@mit.edu

In this presentation, we approach the problem of parameter calibration of stochastic traffic simulators through the use of Kalman filtering. We build upon an established Kalman filtering approach by incorporating network-specific structural information supplied by an analytical queueing model. The approach is benchmarked versus other traditional calibration methods. Results on low-dimensional calibration problems are presented.

WD69

69-Room 201C, CC

Real-Time Traffic Monitoring and Control

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Xuan Di, University of Michigan, Ann Arbor, MI,
United State of America, sharondi@umich.edu

1 - Psychological Benefits of Real-Time Travel Information on Route Choice Behavior – Analysis of Interactive Driving Simulator Experiment Data

Dong Yoon Song, Purdue University, West Lafayette, IN,
United States of America, song50@purdue.edu, Srinivas Peeta

This study proposes a comprehensive framework to understand the psychological mechanisms associated with real-time travel information provided. A structural equation model with latent variables is presented to address the driver's psychological processes associated with real-time information based on revealed preference data from interactive driving simulator experiments and the associated survey data. Insights from the interactive driving simulator experiments will also be discussed.

2 - Determining Optimal Toll Gantry Locations on Tollway

Ruoyu Liu, CDM Smith, 8140 Walnut Hill Ln # 1000, Dallas, TX,
United States of America, happylyr@gmail.com,
Worapong Hirunyanitiwattana

Toll Gantry Locations can affect traffic flow and toll revenue on tollway. The model maximizes toll revenue and also minimizes the travel cost. Genetic algorithm is used to search the optimal solution based on result from a traffic assignment model.

3 - Real-Time Lane-Based Traffic State Estimation and Prediction

Kerem Demirtas, Arizona State University, Tucson, AZ,
United States of America, kerem.demirtas@asu.edu,
Pitu Mirchandani, Xuesong Zhou

Given new lane-based ITS applications such as speed controls and managed lanes, one needs to estimate and predict the state of the traffic in each lane of a highway. Based on Newell's 1993 Simplified Kinematic Wave Model, and the p-detector interpretation of Daganzo, we have an approach to estimate past trajectories from Lagrangian flow-density measurements and subsequently predict short-term trajectories using simplified behavior models. Analysis using real and simulated data is discussed.

4 - Desirability Measures and Discovery Analysis for Multi-Modal Services Based on Daily Trajectory Pattern Data

Yi-Chang Chiu, University of Arizona, Tucson, AZ,
United States of America, chiu@email.arizona.edu, Ali Arian

This talk focuses on presenting a computational method to estimate the desirability measures for various transportation modes available to a traveler based on known multi-day daily GPS trajectory pattern data. Algorithmic details and case studies are presented.

WD70

70-Room 202A, CC

Vehicle Routing III

Contributed Session

Chair: Alexander Düge, TU München, Arcisstr. 21, München, Germany,
alexander.doege@tum.de

1 - Appointment Scheduling with Multiple Providers and Stochastic Service Times

Mohamad Soltani, University of Alberta, PhD Office, Business
Building, Edmonton, AB, T6G 2R3, Canada, soltani@ualberta.ca,
Michele Samorani, Bora Kolfal

We consider a multi-server appointment scheduling problem in which patients may not show up, and those who show up require stochastic service times. We model this problem to evaluate each candidate solution. We statistically find some properties for the optimal or near optimal solutions, and design a simulation optimization approach using these properties. We also propose a heuristic algorithm, and validate its performance by comparing its result with our simulation optimization approach.

2 - Exact Optimization Frameworks for Time-consistent Routing

Anirudh Subramanyam, Graduate Student, Carnegie Mellon
University, DH3122, 5000 Forbes Ave, Pittsburgh, PA, 15213,
United States of America, asubramanyam@cmu.edu,
Chrysanthos Gounaris

We present exact approaches for the Consistent Traveling Salesman Problem, wherein arrival-time consistency across multiple periods is enforced for each customer. Our first approach is based on branch-and-cut. We compare alternative formulations and propose new valid inequalities. Our second approach is based on decomposition into single-period TSPTWs, where consistency is enforced by tightening the windows during the search. We compare our approaches on benchmark instances derived from TSPLIB.

3 - Rollout Algorithm for The Dynamic Vehicle Routing Problem In City Logistics

Gitae Kim, Assistant Professor, Hanbat National University, N4 -
207, 125 Dongseo-daero, Yuseong-gu, Daejeon, 305-719, Korea,
Republic of, gitae.kim@gmail.com, Yew Soon Ong,
Taesu Cheong

This paper suggests a dynamic vehicle routing problem (DVRP) model in city logistics. Depending on the traffic conditions, the travel time between two nodes, particularly in a city, changes both dynamically and stochastically over time. In this paper, we propose a Markov decision process (MDP) model for the DVRP with the travel time dynamics under traffic congestion in the city area and adopt the rollout algorithm to solve the problem.

4 - Vehicle Routing with Flexible Delivery Locations

Alexander Düge, TU München, Arcisstr. 21, München, Germany,
alexander.doege@tum.de, Daniel Gartner, Markus M. Frey

We present a new extension of the vehicle routing problem (VRP): The VRP with flexible delivery locations and time points (VRPFLTP). In the VRPFLTP, a customer not only corresponds to exactly one location but has to be served at one out of a set of possible capacitated locations. We develop an adaptive large neighborhood search which demonstrates high quality solutions within short computation times. In our economic analysis, we trade off location flexibility on a variety of performance metrics.

■ **WD71**

71-Room 202B, CC

Transportation Operations III

Contributed Session

Chair: Sara Saberi, PhD Candidate, University of Massachusetts Amherst, Department of Operations and Information, Isenberg School of Management, Amherst, MA, 01003, United States of America, ssaberi@som.umass.edu

1 - Vehicle Routing for Urban Drainage Operations: A VRP with Stochastic On-site Durations

Hamid Zaman, Graduate Student, University of Alberta, 9105 116 Street NW, Edmonton, AB, Canada, hzaman@ualberta.ca,
Mohamed Al-hussein, Ahmed Bouferguene

Operational preventive maintenance of urban drainage network involves various short-duration flushing/cleaning activities performed at selected locations across the city, which results in large amount of travel. Moreover, the stochastic nature of the on-site activity durations can lead to unused time at the end of work shifts. This study thus formulates drainage operations scheduling as a combinatorial optimization problem which minimizes the aforementioned travel and unused times.

2 - Operational Flexibility in the Truckload Trucking Industry

Hossein Zolfagharinia, Wilfrid Laurier University, 125 Lincoln Road, Waterloo, ON, N2J2N9, Canada, hzolfagharinia@wlu.ca,
Michael Haughton

Inspired by a real-life operating carrier, this study addresses a dynamic pickup and delivery problem with full truckload (DDPFL) for local operators. The main purpose of this work is to investigate the impact of potential factors on the carriers' operational efficiency. These factors, which are usually under the managerial influence, are diversion capability, re-optimization interval, and advance load information (ALI).

3 - An Integrated Multi-Ship Crane Allocation in a Transshipment Container Terminal

Nabil Nehme, Assistant Professor, Lebanese American University, Byblos, Lebanon, nabil.nehme01@lau.edu.lb, Bacer Maddah,
Isam Kaysi

This research investigates the integration between the quay and yard sides for multiple berthing ships with transshipment containers. An integer linear programming model is formulated to minimize the total number of cranes used in both quay and yard sides for all berthing ships unloading at the same time horizon. The number of containers unloaded is determined for each crane used, quay location and for the storage location of containers on the yard per berthing ship.

4 - A Continuous Approximation Model for Logistic Distribution System Delivered by Trucks and Drones

Li Yu Shan, PhD, Tsinghua University, Beijing Haidian Tsinghua University, Shuenn-Der Building, 615 South, Beijing, 100084, China, lyslys_1990@126.com

This paper presents a continuous approximation model to evaluate cost of Logistics distribution model. The problem is a realistic variant of vehicle routing problem, in which expresses are delivered by trucks and drones. With Amazon's Prime Air UAVs project, many companies pay attention to deliver goods with UAVs. Aim to evaluate economy of drones and build routing costs model with CA method. Analyze parameters of model and provide some insights for managers with ensuing decision-making reference.

5 - Supply Chain Network Competition in Price and Quality with Multiple Manufacturers and Carriers

Sara Saberi, PhD Candidate, University of Massachusetts Amherst, Department of Operations and Information, Isenberg School of Management, Amherst, MA, 01003, United States of America, ssaberi@som.umass.edu, Anna Nagurney, Shivani Shukla,
Jonas Floden

We develop multitiered static and dynamic supply chain network models with manufacturers and freight service providers (carrier) with multiple modes of shipment competing on price and quality. They maximize their utilities while considering the consequences of the competitors' prices and quality levels. An algorithm tracking the evolution of the strategic variables over time through discrete-time adjustment is presented. The framework is illustrated numerically and its practicality demonstrated.

■ **WD72**

72-Room 203A, CC

Image and Functional Data Analysis: Methods and Applications

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Kamran Paynabar, Georgia Institute of Technology, 755 Ferst Drive, Atlanta, GA, 30332, United States of America, kamran.paynabar@isye.gatech.edu

1 - Porosity Detection in Additive Manufacturing using Spatial Statistical Model

Zhenyu Kong, Associate Professor, Virginia Tech University, 123 Durham Hall (MC 0118) 1145 Perry Str, Blacksburg, VA, 24061, United States of America, zkong@vt.edu, Jia (peter) Liu,
Pralhad Rao

In order to realize nondestructive quality monitoring for additive manufacturing (AM), we propose a nonparametric spatial statistical model to monitor porosity in AM products. We use sliced images acquired by Micro CT to estimate the spatial distribution of porosity by employing Dirichlet process model, which can effectively handle the nonstationarity of the spatial distribution.

2 - Calibrating Functional Parameters in Computer Models, A Case Study

Matthew Plumlee, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, mplumlee@umich.edu

The output from a computational model depends on a set of parameters which are unknown, but a modeler can estimate them by collecting physical data. In the described study of the ion channels of ventricular myocytes, our parameter of interest is a function as opposed to a scalar or a set of scalars. New methods are devised to address this unique situation.

3 - A Degradation-based Prognostic Model using Image Data

Xiaolei Fang, Georgia Tech, 1546 Woodlake Dr. NE, Apt. E, Atlanta, GA, 30329, United States of America, xfang33@gatech.edu, Kamran Paynabar, Nagi Gebraeel

Due to the rapid development of sensing technology, it is possible to capture the degradation process of engineering systems using sequential image data. In this talk, we present a novel prognostic model utilizing degradation-based image data.

■ **WD73**

73-Room 203B, CC

Maintenance/Reliability Models

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Kai He, University of Pittsburgh, 1048 Benedum Hall, 3700 O'Hara Street, Pittsburgh, PA, 15261, United States of America, kah167@pitt.edu

1 - Competitive and Cooperative Game-theoretic Models for Usage-based Lease Contracts

Maryam Hamidi, PhD Candidate, University of Arizona, 1127 E. James E. Rogers Way, Room 111, P.O. Box 210020, Tucson, AZ, 85721, United States of America, mhamidi@email.arizona.edu, Haitao Liao

We develop competitive and cooperative game-theoretic models for lease contracts based on Nash equilibrium and total maximum profit, respectively. Under the contracts, the owner (lessor) rents an equipment which deteriorates with both age and usage to a user (lessee). The lessee determines the optimal lease period and usage rate, and the lessor develops a preventive maintenance policy. Our results illustrate that cooperation can significantly increase the profit, under certain conditions.

2 - On The Benefits of Condition-based Maintenance over Time-based Maintenance

Bram De Jonge, University of Groningen, P.O. Box 800, 9700 AV, Groningen, Netherlands, b.de.jonge@rug.nl, Ruud Teunter,
Tiedo Tinga

Developments in condition monitoring technology have led to an ongoing shift from time-based maintenance (TBM) to condition-based maintenance (CBM). Although CBM allows for more effectively planned maintenance, its performance strongly depends on the behavior of the deterioration process, severity of failures, required setup time, accuracy of the condition measurements, and amount of randomness in the failure level. This study points out how the relative benefit of CBM depends on these factors.

3 - Estimation of Servers Utilization in an Unreliable Queueing System with Stacked Servers

Maboubeh Madadi, University of Arkansas, Fayetteville, AR, United States of America, mmadadi@uark.edu, Richard Cassidy, Shengfan Zhang, Lisa Maillart

We consider a queueing system comprised of a set of identical servers that are stored in a stack when not in use. In such cases, customers may find it more convenient to select the server that is on top of the stack. We develop a continuous-time Markov chain model to compute the cumulative, transient utilization and age of each server based on the number of servers in the system, the server's initial position in the stack, the arrival rate and the service rate.

4 - Optimal Preventive Maintenance Planning in Anticipation of Imperfect Implementation

Kai He, University of Pittsburgh, 1048 Benedum Hall 3700 O'Hara Street, Pittsburgh, PA, 15261, United States of America, kah167@pitt.edu, Oleg Prokopyev, Lisa Maillart

Maintenance planners usually assume perfect implementation of their prescribed preventive maintenance (PM) policies. However, the maintenance workers often deviate from the intended PM policy resulting in imperfectly timed PM actions. We formulate cost rate-minimizing models to investigate the impact of such deviations, assuming that the actual PM time differs from the scheduled PM time in a probabilistic manner. We establish results for age replacement with and without minimal repair policies.

■ WD74

74-Room 204A, CC

Reliability III

Contributed Session

Chair: Faranak Fathi Aghdam, The University of Arizona, 3125 E. Bellevue Street, Tucson, AZ, 85716, United States of America, faranakf@email.arizona.edu

1 - A Reliability Model for Multi-State Systems with Multi-State Components with Different Failures

Carlos Solorio, Assistant Professor, CETYS Universidad, Calzada S/N, Mexicali, Mexico, carlos.solorio@cetys.mx

A general model that evaluates the reliability of complex engineering systems that suffer soft failures due to common degradation of physical systems and catastrophic failures due to sudden shocks that provoke powerful stresses is presented. The general reliability model considers multi-state systems with multi-state components, where system reliability is evaluated based on the states of the components. Performance measures are presented that help us decide which system is better.

2 - Optimal CBM Policies under the Gamma Degradation Process

David Han, University of Texas, One UTSA Circle, San Antonio, TX, United States of America, David.Han@utsa.edu

CBM is an effective method to reduce unexpected failures as well as the O&M costs. This talk discusses the CBM policy with optimal inspection points under the gamma degradation process. A random effect parameter is used to account for population heterogeneities and its distribution is continuously updated at each inspection epoch. The observed degradation level along with the system age is utilized for making the optimal maintenance decision, and the structure of the optimal policy is examined.

3 - An Opportunistic Condition-Based Maintenance Policy with Two Degradation Thresholds

Joeri Poppe, KU Leuven, Naamsestraat 69, Leuven, 3000, Belgium, joeri.poppe@kuleuven.be, Robert Boute, Marc Lambrecht

Condition-based maintenance (CBM) is a maintenance strategy that makes use of the actual condition of the component. We introduce CBM in combination with preventive and corrective maintenance. We propose a CBM policy that relies on two thresholds of the degradation level, which can initiate a maintenance action on the monitored component. We find that major reductions in both maintenance cost and system unavailability can be realised, compared to the established maintenance policies.

4 - Reliability Study of High-k Bi-layer Dielectrics with Non-weibullian Failure Time Distribution

Faranak Fathi Aghdam, The University of Arizona, 3125 E. Bellevue Street, Tucson, AZ, 85716, United States of America, faranakf@email.arizona.edu, Haitao Liao

As electronic devices get smaller, reliability issues pose new challenges due to unknown underlying physics of failure. This necessitates new reliability analysis approaches related to nano-scale devices. The time-dependent breakdown of dielectric films is one of the most important reliability issues. In this research, we study two new approaches for modeling the time to breakdown of high-k bi-layer dielectrics.

■ WD76

76-Room 204C, CC

Simulation and Optimization

Contributed Session

Chair: Siyang Gao, Assistant Professor, City University of Hong Kong, Tat Chee Avenue, P6605, AC1, Kowloon, Hong Kong - PRC, siyangao@cityu.edu.hk

1 - A Simulation Based Traffic Control Policy for Hazardous Materials Transportation

Sara Masoud, The University of Arizona, A214, 1300 E. Fort Lowell Rd., Tucson, AZ, 85719, United States of America, saramasoud@email.arizona.edu, Sojung Kim, Young-jun Son

A simulation-based traffic control policy for hazardous materials (hazmat) vehicles is devised to enhance public safety without sacrificing traffic efficiency, by considering two traffic control policies simultaneously: 1) Network Design which restricts hazmat vehicles from freeways; and 2) Dual Toll Pricing which levies toll on both hazmat vehicles and regular vehicles in tollways. The proposed approach is demonstrated via AnyLogic/Æ ABS software with a real traffic data of San Antonio, Texas.

2 - General-Purpose Ranking and Selection

Soonhui Lee, UNIST, UNIST-gil 50, Ulsan, Korea, Republic of, shlee@unist.ac.kr, Barry Nelson

In this study we take a step toward general-purpose Ranking & Selection procedures that work for many types of performance measures and output distributions, including situations in which different simulated alternatives have entirely different output distribution families. To obtain the required PCS we exploit intense computation via bootstrapping, and establish the asymptotic PCS of these procedures.

3 - Convex Risk Measures: Efficient Computations via Monte Carlo

Zhaolin Hu, Associate Professor, Tongji University, School of Economics and Management, Shanghai, China, huzhaolin@gmail.com

In this paper, we study an important class of convex risk measures called utility-based shortfall risk (SR). We develop efficient Monte Carlo methods for estimation of SR, sensitivity analysis of SR, and optimization of SR. Numerical experiments are studied extensively, which further demonstrate the effectiveness of our methods.

4 - Territory Design under Uncertainty

Peter Verderame, Air Products and Chemicals, Inc., 7201 Hamilton Boulevard, Allentown, PA, United States of America, verderpm@airproducts.com, Subhajit Ghoshal, Erdem Arslan, Pratik Misra

Territory design looks to maximize the efficiency of a company's resources through intelligent, objective placement and allocation of assets. Balancing workload across territories is a critical factor for successful deployment; however, projected workload is often uncertain which in turn greatly impacts design robustness. We developed a sophisticated optimization-and-simulation-based framework which explicitly considers the parametric or nonparametric uncertainty surrounding workload forecasts.

5 - Efficient Feasibility Determination with Multiple Performance Measure Constraints

Siyang Gao, Assistant Professor, City University of Hong Kong, T at Chee Avenue, P6605, AC1, Kowloon, Hong Kong - PRC, siyangao@cityu.edu.hk, Weiwei Chen

Feasibility determination has emerged as a widely applied problem in simulation optimization. It seeks to provide all the feasible designs from a finite set of design alternatives. In this paper, we consider this problem in presence of multiple performance measure constraints. The optimal solution to maximize the probability of correct selection is derived under asymptotic approximation. The numerical testing shows that our approach can enhance the simulation efficiency significantly.

■ **WD77**

77-Room 300, CC

Supply Chain Competition II

Contributed Session

Chair: Masoud Narenji, Doctor, Iran University of Science and Technology, Narmak, Tehran, 1894119493, Iran, mnarenji@iust.ac.ir

1 - Volume Guarantees in Global Health Procurement

Alexander Rothkopf, Julius-Maximilians-University
Wuerzburg, Stephanstraße 1, Wuerzburg, Germany,
alexander.rothkopf@uni-wuerzburg.de, Eirini Spiliotopoulou

Recently global health buyers granted volume guarantees to pharma manufacturers in an effort to reduce prices through competition and higher economies of scale. However, guaranteeing volumes affect market competition and new supplier entry in the future. Our analysis lends insights to policy makers how to optimally structure a volume guarantee.

2 - Information Asymmetry and Competitive Implications for Horizontal Outsourcing

Seung Hwan Jung, Washington University in St. Louis, Olin
Business School, Campus Box 1133, 1 Brookings Drive,
St. Louis, MO, 63130, United States of America,
seunghwan.jung@wustl.edu, Panos Kouvelis

We investigate the role of information asymmetry in business relationship between competing firms. We consider a two-echelon supply chain in which a vertically integrated (VI) firm sells a component to a component outsourcing (CO) firm. The VI firm has its own brand which competes with the CO firm's product. Under this circumstance, we characterize firms' sourcing and pricing decisions. This work highlights the role of information asymmetry in competing firms' operational strategy.

3 - Impact of Channel Power and Fairness Concern on Supplier's Market Entry Decision

Jie Zhang, Associate Professor, Guangdong University of Finance
and Economics, 21 Luntou Road, Haizhu District, Guangzhou,
510320, China, jiezhang@gdufe.edu.cn, Baozhuang Niu

We consider a two-stage supply chain with a supplier and a retailer, and incorporate the concepts of channel power and fairness concern to analyze the supplier's decision on its online direct channel. We show that a direct channel leads to the decline of online product's quality and its price. Furthermore, the retailer's order shifting strategy results in a lose-lose situation for the two firms. We also find that the supplier's fairness concern may make it less likely to open an online channel.

4 - Integrated Bioenergy Supply Chain Optimization under Crop Competition and Uncertainties

Yuanzhe Li, PhD Student, University of California, Davis,
Dept. of Civil & Environmental Engineer, Ghausi Hall,
One Shields Avenue, Davis, CA, 95616, United States of America,
rgli@ucdavis.edu, Yueyue Fan

An integrated optimization program was developed to model the bioenergy production system where dedicated energy crop is competing with incumbent agricultural crops as feedstock. The model addresses crop adoption decisions under competition and infrastructure deployment strategies under supply and demand uncertainties simultaneously. A case study for the U.S. Pacific Northwest region is conducted to obtain practical insights for the industry.

5 - Competition of Supply Chains and Their Internal Elements in a Market with Two Classes of Customers

Masoud Narenji, Doctor, Iran University of Science and
Technology, Narmak, Tehran, 1894119493, Iran,
mnarenji@iust.ac.ir, Mohammad Fathia

We follow competition and coordination strategies between two chains. Each supply chain has a manufacturer and a distributor. There are two types of customers with different sensitivity to price and delivery time. Each member of a chain can choose their own individual policy (dedicated or shared capacity) with respect to importance of the customers. The evolutionary game approach was followed to illustrate the best combination of strategy-policy, and heuristic methods was used to solve them.

■ **WD78**

78-Room 301, CC

Analytic Hierarchy Process

Contributed Session

Chair: Luis Vargas, Professor, Business Analytics and Operations, Joseph M. Katz Graduate School of Business, University of Pittsburgh, 356 Mervis Hall, Pittsburgh, PA, 15260, United States of America, lgvargas@pitt.edu

1 - Impact of NPD-SCM Alignment on Competitiveness of Indian Automotive Industry

Bimal Nepal, Associate Professor, Texas A&M University,
3367 TAMU, College Station, TX, 77843, United States of
America, nepal@tamu.edu, Ankur Pareek, Ajay P.S. Rathore,
Rakesh Jain

This paper attempts to measure NPD-SCM Alignment and evaluate its impact on Competitive Advantage in comparison to some established competitive priorities such as Cost, Quality, Delivery, Flexibility, and Innovation. A large scale survey data from Indian automobile industry has been collected and analyzed using ANP to capture the effect of inter-dependence among variables. Findings have been validated through three longitudinal in-depth case studies.

2 - From Actors' Analysis to Multicriteria Decision Aiding: A Mixed Method Approach

Valentina Ferretti, Politecnico di Torino, Corso Castellidardo
30/A, Torino, Italy, valentina.ferretti@polito.it

This paper proposes a methodological approach based on the combined use of different tools for designing complex urban regeneration processes. The purpose of the paper is to investigate synergies between the Social Network Analysis of actors and stakeholders and the Analytic Network Process in order to support the design of urban regeneration strategies. The framework has been tested on a real case study concerning the requalification for abandoned military barracks in Turin (Italy).

3 - Voting with Intensity of Preferences

Luis Vargas, Professor, Business Analytics and Operations, Joseph
M. Katz Graduate School of Business, University of Pittsburgh,
356 Mervis Hall, Pittsburgh, PA, 15260, United States of America,
lgvargas@pitt.edu

In this paper we develop a method based on the idea of pairwise voting to rank projects or candidates and incorporate in the ranking process how strongly the referees/voters feel about the comparisons they make. Voting is a modified form of ranking and all the votes are equally important. However, there are situations similar to voting in which the votes are not just ordinal but each voter expresses an intensity of preference for the different candidates, e.g., ranking projects for funding.

Wednesday, 4:30pm - 6:00pm■ **WE01**

01-Room 301, Marriott

Scheduling, Workload and Complexity

Sponsor: Military Applications

Sponsored Session

Chair: Thomas Willemain, TomW@smartcorp.com

1 - A Simulation Optimization Approach for a Task Process to Balance Mental Workload

Cansu Kandemir, Old Dominion University, 5115 Hampton Blvd.,
Norfolk, VA, 23529, United States of America,
ckand002@odu.edu, Holly A. H. Handley

This research employs a human performance modeling simulation tool with meta-heuristic methods in order to assign personnel to tasks based on credentials, while still maintaining a workload balance among them. An initial simulation-optimization application on the task process of "Air Interdiction Mission Planning" will be presented.

2 - Addressing Complexity of Hurricane Sandy with Innovative Kingdon's Model

Eliot Evans, Lt Col & Graduate Student, George Mason University
School of Public Policy, Government, & International Affairs,
12308 Cicero Drive, Alpharetta, GA, 30022,
United States of America, eliotevans11@gmail.com

Losses due to the impact of Hurricane Sandy in 2012 raise the concern of the effectiveness of disaster management and its operations. FEMA's Hurricane Sandy After-Action Report revealed three significant problems 1) lack of collaboration 2) inadequate survivors' needs met, 3) shortage of an agile, professional emergency management workforce. This research aims to analyze the complexity of Hurricane Sandy and its problems, to propose an agenda and alternatives, and to recommend public policies.

3 - throughput Analysis of Reserve Component Mobilization Training Capacity

Katharina Best, Associate Operations Researcher, The RAND Corporation, 1200 S. Hayes St, Arlington, VA, 22202,
United States of America, kbest@rand.org, Jeremy Eckhause, Igor Mikolic-torreira, Michael Linick

Army Reserve Component units require administrative processing and varying amounts of high-quality training at specialized installations before deploying to contingency locations. Capacity at such facilities is limited and opening bases quickly can be problematic. We present a mixed-integer programming model that optimizes training schedules under different assumptions about training time, facilities ramp-up, unit type prioritization, demand timing, and Active/Reserve Component force mix.

4 - Optimal Multi-stage Allocation via Approximate Dynamic Programming

Darryl Ahner, Asst Professor, Air Force Institute of Technology,
2950 Hobson Way, Wright-Patterson AFB, OH, 45433-7765,
United States of America, darryl.ahner@afit.edu, Carl Parson

We consider the optimal allocation of resources over multiple stages to a collection of tasks with the objective of maximizing the reward for completing tasks where the task arrivals follow a known distribution, namely stochastic weapon-target assignment. Simulation and mathematical programming are used within a dynamic programming framework to update functional approximations representing future rewards using subgradient information and thereby determine allocation strategies.

WE02

02-Room 302, Marriott

Scheduling V

Contributed Session

Chair: Majid Algwaiz, Engineering Specialist, Saudi Aramco Oil Company, P.O. Box 19422, Dhahran, 31311, Saudi Arabia, majid.gwaiz@gmail.com

1 - A Genetic Algorithm for the Resource Leveling Problem with Generalized Precedence Relations

Hongbo Li, Shanghai University, School of Management, Shangda Road 99, Shanghai, 200444, China, ishongboli@gmail.com,
Yinbin Liu, Li Xiong

We present a bi-chromosome based genetic algorithm (BGA) for the resource leveling problem with generalized precedence relations. In the BGA, a solution is represented by a bi-chromosome that consists of two parts: a random key vector and a percentage based shift vector. To demonstrate the effectiveness of our BGA, we conduct extensive computational experiments on a set of benchmarks with up to 500 activities and compare the BGA with two best metaheuristics in the literature.

2 - Results on throughput Maximization with Limited Advance Information

Ishwar Murthy, Professor, Indian Institute of Management Bangalore, Bannerghatta Road, Bangalore, 560076, India, ishwar@iimb.ernet.in

We consider throughput maximization, given limited advance information. For problems where job lengths are equal, we propose an on-line algorithm whose competitive ratio improves as the duration of the advance information increases. Further, the performance of this on-line algorithm asymptotically approaches that of the off-line algorithm. More importantly, we help to identify the structure of the worst case instances – those that correspond to the competitive ratios.

3 - A Lower Bound Analysis for the Flowshop Scheduling Problem with Makespan Minimization

Carlos Ernani Fries, Professor, Federal University of Santa Catarina, Caixa Postal 5185, Florianopolis, SC, 88040-970, Brazil, carlos.fries@ufsc.br, Bruno De Souza Alves

This paper deals with a lower bound (LB) analysis for makespan measure of FSP. The LB measures are compared with solutions obtained with exact models and

the popular CDS heuristic. Simulations varying the number of jobs, machines and processing times show that solutions discrepancies tend to increase until N less than M and decrease for N greater than M , with largest discrepancy observed for N equal M . The divergences tend to be larger when greater variability on processing times is considered.

4 - Stochastic Patient Scheduling by Chance Constraint Programming

Bulent Erenay, PhD Candidate, Wilkes University,
5667 Barney Lane, Columbus, OH, 43235,
United States of America, be977209@ohio.edu

A stochastic patient scheduling problem is studied by using chance constraint programming. The time patient stays at the hospital is considered as probabilistic.

5 - Optimizing Ship Loading Schedules for Oil and Gas Terminals

Majid Algwaiz, Engineering Specialist, Saudi Aramco Oil Company, P.O.Box 19422, Dhahran, 31311, Saudi Arabia, majid.gwaiz@gmail.com, Abdulaziz Nutaifi

We consider in this paper an oil and gas firm that owns its entire hydrocarbon supply chain with many production facilities and ship loading terminals. Customers make purchases a month in advance but only provide a four day notice on the specific pickup times and the requested products and quantities. We present a MILP formulation to manage the hydrocarbon network and assign ships to berths on an hourly basis. Our objective is to minimize the ship waiting times along with the demurrage fees.

WE03

03-Room 303, Marriott

Inventory Management - Inventory Policies

Contributed Session

Chair: Jim Shi, Assistant Professor, New Jersey Institute of Technology, University Heights, Newark, NJ, 07102, United States of America, jshi@njit.edu

1 - Stochastic Integrated Location-inventory Up-to-S Model in Distribution System

Maxim Bushuev, Assistant Professor, Kent State University - Geauga, 1835 Beacon Hill Cir #21, Cuyahoga Falls, OH, 44221, United States of America, mbushuev@kent.edu

A stochastic integrated location-inventory problem with up-to-S policy is discussed. Simple proportional allocation rule is proposed which allows defining and solving the problem as convex optimization. This is the first stochastic model in the area of integrated location-inventory problems.

2 - An Extension of the Stochastic Dynamic Lot-Size Model of Vargus to a Model with Uncertain Production

Hendrik Vermuyten, PhD Student, KU Leuven, Warmoesberg 26, Brussel, 1000, Belgium, hendrik.vermuyten@kuleuven.be

We derive the optimal solution for the production planning for a single product for every period in the planning horizon, when demand is stochastic and non-stationary and the achievable production per period is stochastic as well. The model is an adaption of the stochastic dynamic lot-size model of Vargus without production restrictions. Simulation studies show a significant improvement in expected costs for this model compared to the model of Vargus in case of uncertain production capacity.

3 - Extended MIP Formulations for the Stochastic Lot-sizing Problem

Huseyin Tunc, Hacettepe University, Institute of Population Studies, Sıhhiye, Ankara, Turkey, huseyin.tunc@hacettepe.edu.tr

We revisit the certainty equivalent mixed integer programming formulations of the stochastic lot-sizing problem under the static-dynamic uncertainty strategy, and develop extended formulations thereof. The extended formulations are far more time-efficient than the existing formulations in the literature. Also, instead of working with a pre-determined piece-wise linear approximation of the cost function, they can find a minimum cost solution by means of a novel dynamic cut generation procedure.

4 - Stockout Risk Control of a Continuous Production-inventory System

Jim Shi, Assistant Professor, New Jersey Institute of Technology, University Heights, Newark, NJ, 07102, United States of America, Jshi@njit.edu

This paper studies the stockout control problem pertaining to a single-product continuous-time production-inventory system with a constant replenishment rate. Our objective is to optimize the expected system cost subject to a predetermined stockout acceptance level.

■ WE04

04-Room 304, Marriott

Inventory Management - Stochastic Demand

Contributed Session

Chair: Nicholas Leifker, St. John Fisher College, 3690 East Ave., Rochester, NY, 14618, United States of America, nleifker@sjfc.edu

1 - Managing Inventory for a Stochastic and a Deterministic Demand Stream

Rob Basten, Eindhoven University of Technology, P.O. Box 513, Eindhoven, 5600MB, Netherlands, r.j.i.basten@tue.nl, Jennifer Ryan

We consider a stock point for an item that observes two streams of demands. Our motivating example is the maintenance of capital assets. The low priority demand is observed before parts need to be ordered and thus exhibits perfect advance demand information (e.g., preventive maintenance), while the high priority demand is observed afterwards (e.g., corrective maintenance). We characterize the structure of the optimal inventory control policy and we propose a myopic heuristic policy.

2 - Percentile Threshold Policies for Inventory Problems with Partially Observed Markovian Demands

Parisa Mansourifard, PhD Candidate, University of Southern California, 1820 E Del Mar Blvd., Pasadena, CA, 91107, United States of America, parisama@usc.edu, Tara Javidi, Bhaskar Krishnamachari

We consider the case of partially observed demand in the context of a multi-period inventory problem with lost sales. We present an interesting class of policies with a percentile threshold (PT) structure which outperforms the myopic policy and performs close to the optimal policy. We derive the performance guarantee of PT policies and present the optimal PT policy with a reasonable performance guarantee.

3 - A One-Warehouse Multi-Retailer Inventory System with Non-Homogeneous Poisson Demand

Christian Bohner, Technische Universität München, Arcisstr. 21, Munich, Germany, christian.bohner@tum.de, Stefan Minner

Product lifecycles and demand seasonality are important characteristics of inventory systems. We extend the continuous review one-warehouse multi-retailer inventory problem to non-homogeneous Poisson demand. Using the unit-tracking approach, we find optimal time-dependent parameters for base-stock policies both for the warehouse and the retailers. A numerical study shows that the exact dynamic solution clearly outperforms the solution obtained from time decomposition.

4 - Inventory Control of Intermittent Demand Combined with Economic Indicators

Meng Yang, Tsinghua University, 519 Shunde Building, Beijing, 100084, China, yangm0628@gmail.com, Wanshan Zhu

The inventory cost can be very high for expensive service parts of many companies, e.g., Caterpillar Inc., because their demand is highly unpredictable due to its intermittency. One way to reduce the cost is to make use of economic indicators that have a leading effect on the demand. We develop a Markov decision model to incorporate the economic indicator information for better controlling the inventory and quantify the value of this information.

5 - An Integrated Method of Optimization of the Final Order of Spare Parts

Nicholas Leifker, St. John Fisher College, 3690 East Ave., Rochester, NY, 14618, United States of America, nleifker@sjfc.edu, Timothy Lowe, Philip Jones

At the end of a product's life cycle, companies may place a final order of spare parts to satisfy all future demand for the part. Determining the optimal policy can be complicated when products contain multiple types of parts in which the failure rates of the parts and products are not independent; in such cases, the optimal final order quantities for all part types must be determined simultaneously. We explore the concavity properties of this optimization problem, and present a solution method.

■ WE06

06-Room 306, Marriott

Portfolio Analysis II

Contributed Session

Chair: Dhanya Jothimani, Doctoral Student, Indian Institute of Technology Delhi, Department of Management Studies, New Delhi, India, dhanyajothimani@gmail.com

1 - The Robust Merton Problem of an Ambiguity Averse Investor

Mustafa C. Pinar, Bilkent University, Faculty of Engineering, Ankara, Turkey, mustafap@bilkent.edu.tr, Sara Biagini

We derive a closed form portfolio optimization rule for an CRRA investor diffident about mean return and volatility estimates. Confidence is represented by ellipsoidal uncertainty sets for the drift, given a volatility realization. The optimal policy is shaped by a rescaled market Sharpe ratio, computed under the worst case volatility. The result is based on a max-min HJB-Isaacs PDE, which extends the classical Merton problem and reverts to it for an ambiguity-neutral investor.

2 - An Orthogonal Genetic Algorithm for Indexing Tracking Problem

Liang Bao, Professor, Xidian University, No. 2 South Taibai Road, Xi'an, China, baoliang@mail.xidian.edu.cn

In this paper, we propose an orthogonal genetic algorithm for index tracking problem. Its significant feature is to incorporate an orthogonal design method into the initial population generation process and crossover operation. Our algorithm is more robust and can search the solution space in a statistically sound manner. We executed our algorithm to 5 datasets drawn from major world markets. The results compared with other published results show that our method has superior performance.

3 - Embedded Options in Institutional Investors' Asset Allocation Problems

Changle Lin, Princeton University, 10 Lawrence Drive, Apt 505, Princeton, NJ, 08540, United States of America, changlel@princeton.edu, John Mulvey

Various options are embedded in institutional investors' asset allocation problems. Pension funds are shorting a put option on the fund itself by requiring sponsors to contribute if underfunded. Sovereign wealth funds and family offices, have transfers from state or family businesses. The transfers depend on businesses' performances and generate embedded options. We model the options and their implications on asset allocation with real option theory, stochastic control and dynamic programming.

4 - Modeling Uncertainties in Mean Variance Framework using Robust Optimization

Dhanya Jothimani, Doctoral Student, Indian Institute of Technology Delhi, Department of Management Studies, New Delhi, India, dhanyajothimani@gmail.com, Ravi Shankar, Surendra Singh Yadav

The classical mean variance (MV) framework ignores the uncertainties associated with the estimates of the expected returns; hence, the classical portfolio optimization problem is often called as error maximizer. In order to model the data uncertainty in MV framework, this study uses robust optimization technique to select the portfolios. The excess returns of portfolios obtained using robust estimators were found to be favorable compared to those obtained using classical estimators.

■ WE07

07-Room 307, Marriott

Risk Analysis II

Contributed Session

Chair: Maryam Tabibzadeh, California State University, Northridge, 1157 W., 30th St., Los Angeles, CA, United States of America, m.tabibzadeh@gmail.com

1 - Modular Production Capacity Expansion: An Examination of Collateral Risk

Martin Wortman, Professor, Texas A&M University, Dept of ISEN, College Station, TX, 77843-3131, United States of America, wortman@atmu.edu, Cesar Malave

Modular production operations are gaining considerable attention within electric power generation, chemical products, and bio-pharmaceutical industries. Modular capacity expansion can greatly reduce the financial risk associated with capitalizing production operations. However, modularized operations can also present collateral risk that can be greatly exacerbated. We offer an analytical explanation of this circumstance.

2 - Optimal Portfolio of Supply Chain Risk Mitigating Plans

Sayan Mukherjee, Doctoral Candidate, XLRI, Jamshedpur,
XLRI Campus, CH Area East, Jamshedpur, India,
sayan.mukherjee@astra.xlri.ac.in, Rajiv Misra,
Tas Vijayaraghavan

Frequency of occurrence, time for which a risk occurs/ has an effect, Rate of loss and detectability of the risks are taken as random variables to model the distribution of the losses due to the supply chain risks. Bayesian Belief Network has been used as a modeling tool. The effect of a mitigation plan is judged by the expected loss reduction due to the plans. Then a multi-objective non-linear programming formulation is done for optimal portfolio selection of mitigation plans for the risks.

3 - An Exploration and Comparison of Resilience Metrics

Daniel Romero, Student, USF/ UAC, 4411 Shady Terrace Ln,
Tampa, FL, 33613, United States of America,
danielromero@mail.usf.edu, Weimar Ardila, Alex Savachkin,
Alvaro Sierra

A comparison of quantitative resilience metrics in different areas for the identification of key elements and approaches in order to get an accurate estimation of system resilience. Common factors in the resilience of physical systems are tested for predicted resilience measurements.

4 - Proactive Risk Assessment Framework to Address Safety-critical Issues of Offshore Drilling

Maryam Tabibzadeh, California State University, Northridge,
1157 W., 30th St., Los Angeles, CA, United States of America,
m.tabibzadeh@gmail.com

Although accident investigation frameworks are used to analyze the contributing causes of previous incidents in different complex technological and high-risk industries, they provide a retrospective point of view. They however can be incorporated into a proactive risk assessment system. This study proposes a series of safety leading indicators and integrate them with a developed AcciMap framework to address and assess the safety of offshore drilling, as part of a proactive total-system analysis.

WE08

08-Room 308, Marriott

E-Business/Commerce III

Contributed Session

Chair: Huili Zhang, Huazhong University of Science and Technology,
1037 Luoyu Road, Hongshan District, Wuhan, China,
zhanghuili@hust.edu.cn

1 - A Study on Online Shopping Intention and Moderators from the Perspective of Reverse Generation

Yingzi Xiong, Professor, School of Management, Xiamen
University, 422 Siming South Road, Xiamen, China,
xyingzi@xmu.edu.cn, Shaoqin Ye

This paper chooses online shopping as background, two generations in China as objectives, tests the process of the consumer socialization influenced on elderly generation by the younger generation, shows the mechanism and form of reverse generational influence, understands the reverse generation influence on elderly generation's online shopping intent and other factors that might result in online shopping.

2 - Evaluating Determinants of Satisfaction of Intermediary in Delivery of E-government Services

Rajesh Sharma, Research Scholar, Indian Institute of
Management, Prabhakar Shikhar, Rau, Indore, MP, 453556, India,
f12rajeshs@iimdr.ac.in, Rajhans Mishra

This research is grounded in the Stakeholder Theory (Freeman 1984) and deals with an important stakeholders in the delivery process in India, namely, the Village Level Entrepreneur (VLE). The study aims at identifying the determinants of satisfaction of VLEs who are running assisted kiosks in rural parts where the computer literacy and computer penetration is rather low. We propose a generic model of satisfaction consisting of institutional, interface, social and economic support.

3 - Consumers' Usage Behavior of M-coupons: The Moderating Role of Regulatory Focus

Huili Zhang, Huazhong University of Science and Technology,
1037 Luoyu Road, Hongshan District, Wuhan, China,
zhanghuili@hust.edu.cn, Xuefeng Zhao

Given the important role of consumers' personal traits in accelerating the usage of M-coupons, this paper aims to explore the moderating effects of regulatory focus on the relationship between perceived benefits or costs and consumers' attitude as well as the impact of perceived benefits and costs on consumers' behavioral intention based on the Valence Framework. A total amount of 325 valid questionnaires from different areas in China are recruited to examine the measurement model we developed.

4 - A Trust Transitivity Model of Agriculture and Local Products in WeChat Marketing

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Ganjingzi District, Dalian City, Liaoning Province, P.R.C., Dalian,
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Business of agriculture and local products is emerging in WeChat marketing. The challenge is how to establish consumer's trust because the serious food security problem in China. We establish trust transitivity model to forecast consumers' trust in Wechat. The model measures factors based on complex networks analysis, combines the psychology of trust, Subjective Logistics and multi-attribute decision making method to compute trust degree through transitivity and consensus process.

5 - The Use of Mobile Applications for Travel-related Needs

Ozay Ozaydin, Assistant Professor, Dogus University, Zeamet Cad
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With m-commerce still in its infancy, there have been relatively few attempts to systematically explore the opportunities and challenges posed by m-commerce. This study is an early attempt aims to provide empirical data on consumer perception of mobile applications. This paper first examines the value proposition of mobility, then investigates operation modes and potential consumer-based applications. Results provide useful insights into m-commerce applications and their commercial potentials.

WE09

09-Room 309, Marriott

Research and Development

Contributed Session

Chair: Tian Sun, Shanghai Kijiji Information Technology Co., Ltd.,
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1 - An Empirical Research on the Choice of R&D Patterns based on Enterprise Knowledge Base

Yanlan Yang, Huazhong University of Science and Technology,
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This article studies the impact of enterprise knowledge base on the choice of R&D patterns by using data collected from 437 firms with technology center in Hubei Province. The results show that the breadth of enterprise knowledge base positive influence enterprise' choice of internal R&D pattern; the relationship between the enterprise knowledge depth and the choice of internal R&D pattern there is inverted u-shaped, in contrast, knowledge depth and the choice of external R&D pattern is u-shaped.

2 - A Comparison of National Innovation Systems Efficiency between the OECD and BRIC

Jing Liu, PhD, Peking University, Guanghua School of
Management, Peking Univ, No.5 Yiheyuan Road Haidian District,
Beijing, 100871, China, liujingokay@163.com, Tao Huang,
Zhuojun Li

Although there are plenty of descriptions of national innovation system (NIS), a systematic comparison between different countries and classification have not been made so far. This paper measures the innovation efficiency of NIS in a systematic framework and makes comparison between the OECD and BRIC.

3 - When The Well Runs Dry: Predicting Observed Grace Satellite Groundwater Storage Trends

Roshanak Nateghi, Assistant Professor, Purdue University, 412
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Groundwater is an essential component of global access to fresh water. It has an impact on political stability, health, economic growth and well-being. Identifying trends in groundwater storage using GRACE satellite observations is a promising new line of research. We have conducted extensive data analyses to find the best predictors of the observed trends using agricultural, climate, demographic, land-use and economic variables in 81 countries.

4 - Text Mining Techniques in Classified Websites: Spam Filtering and Information Organization

Tian Sun, Shanghai Kijiji Information Technology Co., Ltd.,
55 Guangyuan West Road, Xuhui District, Shanghai, China,
suntian@baixing.com, Shi Lin, Zhe Liang

Millions of advertisements have been posted on the classified websites every day. Those advertisements attract viewers who are in need of the services provided by ad posters. In order to operate a successful classified website, two major issues have to be solved: safety and classification. Text mining techniques are applied to detect spam and ensure correct information classification.

■ WE10

10-Room 310, Marriott

Marketing in E-Business/Commerce

Contributed Session

Chair: Pei-hua Chen, National Chiao Tung University, 1001 University Rd, 16C, HsinChu, 300, Taiwan - ROC, peihuamail@gmail.com

1 - Investigation of How Social Relationships Contribute to M-commerce Continuance Intentions

Chao Wen, Eastern Illinois University, 600 Lincoln Avenue, Charleston, IL, 61920, United States of America, cwen@eiu.edu

The purpose of this study is to provide a better understanding of how social relationships influence mobile commerce continuance intentions. An integrated research model was developed based on the theory and literature review. A questionnaire was designed and distributed through Amazon Mechanical Turk for data collection. Survey data from 298 m-commerce customers allowed testing the research hypotheses, and structural equation modeling allowed validation of the research framework.

2 - Temporally Pricing Low or Spotlighting Your App?: An Empirical Study on Amazon Free App of The Day

Kevin Lachaud, Duquesne University, Palumbo-Donahue School of Business, 600 Forbes Avenue, Pittsburgh, PA, 15282, United States of America, lachaudk@duq.edu, Wenqi Zhou

This research examines the effect of visibility and pricing, and their interaction effect, on apps' market performance. In particular, we empirically study Amazon's Free App of the Day, which puts a single app daily in the spotlight at a zero price. We test how high visibility and temporally free pricing resulted from this promotion strategy affect online user-generated conversations and sales rank on Amazon, which in turn affects apps' sales and revenues on the Android app market.

3 - The Impact of User-generated Vs Firm-generated Content on Purchase Intention of High/Low Involvement Product

Huma Amir, Chairperson Marketing Dept.; Assistant Professor, Institute of Business Administration, 218 Fauji Foundation, University Enclave, Gulshan-e-Iqbal, Karachi, 75400, Pakistan, huma.amir@hotmail.co.uk

Effects of user-generated content (UGC) and firm-generated content of Facebook official brand pages on attitudes towards the brands and consumer purchase intentions are examined for low-involvement (LI) and high-involvement products (HI). Findings show positive correlation between attitudes towards HI for both UGC and FGC. FGC showed higher correlation with attitude towards a brand as compared to UGC, and positive impact on attitudes towards HI. LI do not exhibit any significant correlations.

4 - The Effects of Service Convenience, Trust and Perceived Risks on Third-party Payment Usage Intention

Pei-Hua Chen, National Chiao Tung University, 1001 University Rd, 16C, HsinChu, 300, Taiwan - ROC, peihuamail@gmail.com, Chia-Yi Chen

This study investigated the relationships of service convenience, trust and perceived risks to consumers' intention to use third-party payment in Taiwan. A web-based questionnaire was created and sent to 300 participants with online shopping experiences. The results showed that service convenience, perceived risk and trust all have positive effects on usage intention for third-party payment.

■ WE11

11-Franklin 1, Marriott

Optimization Integer Programming IV

Contributed Session

Chair: Ayse Bayrak, TUBITAK, Tunus Caddesi No:80, Ankara, Turkey, aysebayrak.tubitak@gmail.com

1 - Integrated Batching and Lot Streaming with Variable Sublots and Sequence-dependent Setup

Shasha Wang, Clemson University, Freeman Hall, Clemson, SC, 29634, United States of America, shashaw@g.clemson.edu, Scott Mason, Cole Smith

Customers order multiple products belonging to some job family that can be batched together for manufacturing. Each product can be split into several sublots so that overlapping production is possible in a two-stage hybrid flow shop. We model this practically-motivated integrated batching and lot streaming problem with variable sublots and incompatible job families in the presence of sequence-dependent setup times to minimize total weighted completion time and present promising results.

2 - An Integer Programming Approach for Patrol Police Assignment in the Philippines

Rhoda Namoco, Mindanao University of Science and Technology, Lapasan, Cagayan De Oro City, 9000, Philippines, rhodaagdeppanamoco@gmail.com, Eleajen Lago

In this study, an integer programming model is developed to solve the Police Assignment Problem (PAM) which consists of assigning policemen to beat areas to ensure optimum police visibility in the central business district (CBD) of Cagayan de Oro City, Philippines. Results of the study show that the proposed model provides better police visibility than the current police assignment around the CBD of the city.

3 - Branching Rule in the Branch and Bound Algorithm: An Approach Based in Polyhedral Information

Ivan Derpich, Doctor, Universidad de Santiago de Chile, Ave. Ecuador 3769 Santiago, Santiago, Chile, ivan.derpich@usach.cl

This work presents a new variable branching rule for the B&B algorithm, the hybrid rule. It is based in a combination of the flatness rule and the pseudocosts rule. The result of this work showed that the number of nodes generated using the hybrid rule yielded to these test problems, a 80% less node than the produced when using the pseudocost rule.

4 - Valid Inequalities for Economic Lot-sizing Problems with Remanufacturing: Joint Setups Case

Sharifah Aishah Syed Ali, PhD Researcher, Dept. of Management Science, University of Strathclyde, Graham Hills Building, RM 858, 40 George Street, Glasgow, G1 1QE, United Kingdom, sharifah-aishah-binti-syed-ali@strath.ac.uk, Kerem Akartunali, Mahdi Doostmohammadi, Robert Van Der Meer

In this talk, we study the polyhedral structure of a mixed integer set arising from the feasible set of economic lot-sizing problems with remanufacturing and joint setups. First, we present the basic properties and some general results about trivial facet-defining inequalities. Then, we derive new families of valid inequalities and identify cases where they define facets. Finally, some preliminary computational results are presented to test the effectiveness of these inequalities.

5 - Pharmaceutical Industry Waste Management

Ayşe Bayrak, TUBITAK, Tunus Caddesi No:80, Ankara, Turkey, aysebayrak.tubitak@gmail.com, Bahar Ozyoruk

The measures taken for Environmental Pollution has made significant efforts in waste management. In this study, in Turkey, the waste of pharmaceutical industry will be discussed. Pharmaceutical waste will appear, the pharmaceutical industry waste management will be modeled. In this context, a mathematical model will be developed for recycling and disposal of waste and solutions related methods will be investigated.

■ WE13

13-Franklin 3, Marriott

Robust/Stochastic Optimization

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Tahir Ekin, Assistant Professor, Texas State University, 601 University Dr. McCoy Hall 411, San Marcos, TX, 78666, United States of America, t_e18@txstate.edu

1 - Simulation Based Approaches for Stochastic Optimization with Endogenous Uncertainty

Tahir Ekin, Assistant Professor, Texas State University, 601 University Dr. McCoy Hall 411, San Marcos, TX, 78666, United States of America, t_e18@txstate.edu, Nicholas Polson, Refik Soyer

We present two simulation based approaches to solve stochastic programs with decision dependent (endogenous) uncertainty. We develop an augmented probability model where the decision variable is treated as random and sampling from the marginal decision variable results with the optimal decision. Markov chain Monte Carlo simulation and nested sampling algorithms are utilized. We illustrate the methodology on a two stage news-vendor problem with stock-dependent uncertain demand.

2 - Novel Sampling Technique for High Dimensional Stochastic Optimization Problem

Nishant Dige, Graduate Student Industrial Engineering,
University of Illinois at Chicago, 1200 W Harrison Street,
Chicago, IL, 60607, United States of America, ndige2@uic.edu,
Urmila Diwekar

Computational speed is critical in optimizing large scale stochastic problems and the major bottleneck is the computational intensity of samples. For sampling randomness is important but uniformity governs its accuracy. This paper presents a novel sampling approach; combining LHS & Sobol Sampling for better uniformity in single as well as multi dimensions & also to avoid clustering effect for higher dimensions. We have implemented this technique on stochastic supply chain network design problem.

3 - Inventory Management Based on Target-oriented Robust Optimization

Yun Fong Lim, Associate Professor, Singapore Management
University, 50 Stamford Road, #04-01, Singapore, 178899,
Singapore, yflim@smu.edu.sg, Chen Wang

We propose a target-oriented robust optimization approach to solve a multi-product, multi-period inventory problem subject to capacity constraints. The product demands are characterized by uncertainty sets. We find an ordering policy that maximizes the uncertainty sets such that all demand realizations from the sets result in a cost lower than a pre-specified target. We prove that a static policy is optimal and it can achieve a balance between the expected cost and the associated cost variance.

4 - Optimal Learning of Demand for The Nested Lagged Commitment Problem

Nana Aboagye, PhD Candidate, Princeton University,
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United States of America, aboagye@princeton.edu,
Warren Powell

We address the problem of making lagged commitments to resources in order to maximize revenue over time while sequentially making decisions. The motivating application is hotel resource management and a separate dimension involves learning how the market will respond to price. We consider two cases: where demand is unknown but static and where demand is unknown and dynamic. We use the optimization algorithm called the Knowledge gradient to learn the optimal demand function.

5 - Continuity of Robust Optimization Problems with Respect to the Uncertainty Set

Philip Allen Mar, Dept. of MIE, University of Toronto,
5 King's College Road, Toronto, ON, M5S 3G8, Canada,
philip.mar@mail.utoronto.ca, Timothy Chan

We discuss the stability properties of robust problems satisfying the Strong Slater condition, with respect to their uncertainty sets. We show, by way of results in Linear Semi-Infinite Optimization, that the optimal values of the robust optimization problem are Lipschitz continuous with respect to the Hausdorff distance between their respective uncertainty sets. We also present implications for measuring a price of robustness and approximating robust optimization with complex uncertainty sets.

WE14

14-Franklin 4, Marriott

Risk-Aware Decision Making under Uncertainty

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Ruiwei Jiang, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, ruiwei@umich.edu

1 - A Composite Risk Measure Framework for Decision Making under Uncertainty

Pengyu Qian, Columbia University, Columbia Business School c/o
PhD Office, 3022 Broadway, 311 Uris Hall, New York, NY, 10027,
United States of America, qianpengyu@pku.edu.cn, Zaiwen Wen,
Zizhuo Wang

In this talk, we present a unified framework for decision making under uncertainty. Our framework is based on the composite of two risk measures accounting for parametric (given distribution) and distributional uncertainty respectively. The framework generalizes many existing models. We also propose new models within this framework whose solutions have probabilistic guarantees and are less conservative comparing to traditional models. Numerical experiments demonstrate the strength of our models.

2 - Risk-averse Two-stage Stochastic Program with Distributional Ambiguity

Ruiwei Jiang, University of Michigan, 1205 Beal Ave., Ann Arbor,
MI, 48109, United States of America, ruiwei@umich.edu, Y
ongpei Guan

We develop a risk-averse two-stage stochastic program (RTSP) taking into account the distributional ambiguity. We derive an equivalent reformulation for RTSP that applies to both discrete and continuous distributions. Also, the reformulation reflects its linkage with a full spectrum of coherent risk measures under varying data availability.

3 - Risk Sharing in Classification Problems

Constantine Vitt, PhD Candidate, Rutgers University,
1 Washington Park, Newark, NJ, 07102,
United States of America, constantine.vitt@rutgers.edu,
Darinka Dentcheva, Hui Xiong

We develop a new approach to solving classification problems based on the theory of coherent measures of risk and risk sharing. We view labeled training data as random samples from populations with unknown distributions, subject to change. The key idea of the proposed methodology is to associate individual measures of risk with the misclassification of each class. We analyze the problem theoretically and propose a numerical method to identify the proper risk sharing among the classes.

WE15

15-Franklin 5, Marriott

Optimization Methodology II

Contributed Session

Chair: Vahid Nourbakhsh, PhD Student, UC Irvine, The Paul Merage School of Business, The Paul Merage School of Business, University of California-Irvine, Irvine, CA, 92697, United States of America, vahidn@uci.edu

1 - Reliability Optimization for Multi-components System in the Design Phase

Qianru Ge, PhD Candidate, Technology University of Eindhoven,
Paviljoen E.03, IE&IS, Eindhoven, 5612 AZ, Netherlands,
q.ge@tue.nl

We develop an optimization model to determine the optimal failure rate of critical components in a system. Since the system is under a service contract, a penalty cost should be paid by the OEM when the total system down time exceeds a predetermined level, which complicates the evaluation of the life cycle costs. Furthermore, in the design phase for each critical component, the failure rate can be chosen from a certain range.

2 - Multistage News Vendor Problem with Targets

Vishwakant Malladi, Doctoral Student, UT Austin, Austin, TX,
78703, United States of America,
Vishwakant.Malladi@phd.mcombs.utexas.edu

We analyze the optimal control policy of a multi-stage new vendor problem with targets. The results show a tractable and intuitive control policy for each stage.

3 - Efficient Methodology to Maximizing Total Noise Reduction and Minimize Total Cost in Traffic Design

Golshan Madraki, PhD Candidate, Ohio University,
15 Station St. Apt F, Athens, Oh, 45701,
United States of America, g.madraki@gmail.com

Three crucial variables that affect the efficiency of a Traffic noise barrier are: the distance from receivers, height of the barrier and the material of the barrier. A novel combination of methodologies is proposed to maximize the efficiency of the barrier with minimum cost. An example model of the barriers are simulated by TNM2.5 software used to perform Factorial design of experiment to fit a meta-model. LP-metric method is applied to solve the multi-objective math-model.

4 - On Solving Bi-level Programming Problem with Fuzzy Random Variable Coefficients

Vishnu Pratap Singh, Research Scholar, Indian Institute of
Technology Kharagpur, Department of Mathematics, Kharagpur,
721302, India, vishnupratapsingh56@gmail.com,
Debjani Chakraborty

This paper represents the bi-level linear programming problem in an imprecise and uncertain mixed environment. The aim of this paper is to introduce leader and the follower's demand as fuzzy random variable. To determine the optimal value of the leader and follower's objectives a new methodology is developed for bi-level linear programming model in presence of fuzzy random variable. A numerical example is solved to demonstrate the methodology.

5 - Generalizing Shifting Quadratic Envelopes for Solving Non-convex Routing Problem

Vahid Nourbakhsh, PhD Student, UC Irvine, The Paul Merage School of Business, The Paul Merage School of Business, Irvine, CA, 92697, United States of America, vahidn@uci.edu, John Turner

We will study routing of jobs to service centers. Jobs arrive to job nodes each node with different arrival rate and there can be more than one server at a service center. The service time depends on the job node to which the job arrives and the service center. The objective is maximizing the total number of jobs that are served without any delay upon arrival. We analyze the convexity of this problem and propose an outer-approximation method to solve the problem.

■ WE16

16-Franklin 6, Marriott

Optimization Large Scale I

Contributed Session

Chair: Sam Davanloo Tajbakhsh, Visiting Assistant Professor, Virginia Tech, 412 Hutcheson, Blacksburg, VA, 24060, United States of America, sdt144@vt.edu

1 - Communication-efficient Distributed Optimization of Self-concordant Empirical Loss

Yuchen Zhang, PhD Student, University of California, Berkeley, 495 Soda Hall, Berkeley, CA, 94709, United States of America, zhangyuc@gmail.com

We consider distributed convex optimization where each machine has access to a local loss function constructed with i.i.d. data. We propose a communication-efficient distributed algorithm to minimize the overall loss function. We show that in a standard setting for supervised learning, the required number of communication rounds of the algorithm does not increase with the sample size, and only grows slowly with the number of machines.

2 - Formulation of a New Complex Fleet Modernization Problem for the Capability Portfolio Analysis Tool

Frank Muldoon, Sandia National Laboratories, P.O. Box 5800 MS 1188, Albuquerque, NM, 87185-1188, United States of America, fmmuldo@sandia.gov, Matthew Hoffman, Stephen Henry

The Capability Portfolio Analysis Tool (CPAT) (2015 Edelman Finalist) is currently being used to model the fleet of logistics and support systems under the U.S. Army PEO Combat Support & Combat Service Support to provide analytical capability in support of modernization and investment decisions. Initially, this MILP modeled the Army's Ground Combat Systems but the formulation has since evolved to meet the challenges posed by the CS&CSS fleet such as system age, recapitalization, and its large size

3 - A Provable Two-Stage Algorithm for Fitting Gaussian Process Models

Sam Davanloo Tajbakhsh, Visiting Assistant Professor, Virginia Tech, 412 Hutcheson, Blacksburg, VA, 24060, United States of America, sdt144@vt.edu, Enrique Del Castillo, Necdet Serhat Aybat

Fitting Gaussian Process models and finding the Maximum Likelihood Estimate (MLE) of the parameters requires a nonconvex optimization. The problem is aggravated in big data settings since the computational complexity of the MLE is $O(n^3)$ where n is the number of distinct locations at which the process is observed. We proposed a theoretically provable two-stage algorithm which solves a semidefinite program in the first stage and a least square problem in the second stage.

4 - A Framework of Asynchronous Parallel Algorithms for Monotone Inclusions and Optimization

Ming Yan, Assistant Professor, Michigan State University, 220 Trowbridge Rd, East Lansing, MI, 48824, United States of America, yanm@math.ucla.edu, Wotao Yin, Zhimin Peng, Yangyang Xu

We propose a framework of async-parallel algorithms for finding a fixed point to a nonexpansive operator by multiple uncoordinated agents (e.g., nodes, CPUs, GPU cores). Each time, an agent updates a random (block) coordinate of the variables. There is no global timing or memory locking. Its sequence converges to a fixed point almost surely. Special-case async-parallel algorithms are proposed for linear equations and distributed convex optimization problems.

■ WE17

17-Franklin 7, Marriott

Networks and Graphs II

Contributed Session

Chair: Ian Herszterg, Pontifícia Universidade Católica do Rio de Janeiro, Rua Marquês de São Vicente, 225, Gávea, Rio de Janeiro RJ 22451-900, Brazil, iherzterg@inf.puc-rio.br

1 - Heuristic Procedures for K-Chinese Postman Problem with Workload Balancing

Yasemin Limon, Middle East Technical University, Industrial Engineering Department, Ankara, Turkey, yaseminlimon@gmail.com, Meral Azizoglu

This study considers the k-Chinese Postman Problem. The problem can be defined as the assignment of each postman to a set of arcs so as to cover all arcs at least once and guarantee feasible routes that start and terminate at the depot. Our aim is to assign the arcs to the postman so as to balance their workloads as much as possible. We define heuristic procedures that involve construction and improvement mechanisms. We find that our procedures find high quality solutions in reasonable times.

2 - The Dynamics of Stochastic Opinions

Luis Castro, PhD Student - Research Assistant, University of Miami, Department of Industrial Engineering, 268 McArthur Engineering Building, Coral Gables, FL, 33146, United States of America, l.castro6@umiami.edu, Nazrul Shaikh

We model the dynamics of stochastic opinions and derive a set of conditions for global and local consensus. Our results suggest that new opinions are more likely to be adopted if they belong to the intersection set of consensus distributions between groups.

3 - Multigroup Multicast Routing for High-quality Interactive Multimedia

Pavel Troubil, PhD Student, Masaryk University, Faculty of Informatics, Botanická 68a, Brno, 60200, Czech Republic, pavel@troubil.cz

In tight runtime limits, we solve multigroup multicast routing problem for interactive collaboration over high-quality multimedia: with on-the-fly recompression of video for per-user adaptation of content quality, and under uncertain network topology and capacity. We react dynamically to network events and request changes, and minimize path perturbation. Our ant colony optimization heuristic is applied for sign-language interpretation in university education or live broadcasts of sport events.

4 - Phase Unwrapping: Attacking the Problem with Operations Research

Ian Herszterg, Pontifícia Universidade Católica do Rio de Janeiro, Rua Marquês de São Vicente, 225, Gávea, Rio de Janeiro, RJ, 22451-900, Brazil, iherzterg@inf.puc-rio.br, Marcus Poggi, Thibaut Vidal

We propose a new model for L0-norm 2D Phase Unwrapping (2DPU). We associate the discontinuities of the wrapped phase image (residues) to a graph, where the vertices have different polarities (+1/-1), and seek a minimum cost balanced spanning forest where the sum of polarities is equal to zero in each tree. We propose a branch-and-cut algorithm and a population metaheuristic to address the problem, leading to an efficient approach for L0-norm 2DPU, viewed as "highly desirable" but intractable.

■ WE18

18-Franklin 8, Marriott

Optimization Linear Programming

Contributed Session

Chair: Fariborz Partovi, Professor, Drexel University, 33rd Chestnut Street, Department of Decision Sciences, Philadelphia, PA, 19003, United States of America, Partovi@Drexel.edu

1 - O.R. Optimization Methods as Used for Protecting Statistical Data

Paul Massell, Mathematical Statistician, U.S. Census Bureau, 4600 Silver Hill Road, Room 6H130F, Washington, DC, 20233, United States of America, paul.b.massell@census.gov

Magnitude data tables are used by agencies for displaying economic data. These tables are additive; i.e., for each set of rows, a sum row is also given (same for columns). Sensitive cells are determined based on a dominance rule; such cells are suppressed. To prevent values of sensitive cells from being recovered, secondary suppressions are found using a L.P. model. This LP is a heuristic for the true I.P. model. We also discuss ways to protect cells using noise.

2 - Transportation Optimizer System as Applied to Rail Car Assignment Problem

Ilya Buzytsky, BIAS Intelligence, 7741 37th Ave NE, Seattle, WA, 98115, United States of America, ilya@biasintelligence.com

BIAS Optimizer System was developed to address problems frequently encountered in many transportation and distribution logistics applications. Its objective is to find optimal solution to problems that can be formulated in terms of supply/cost/demand configuration across large matrix representing a multi-node network: The solution helps find an assignment that would meet the demand supported by available supply across all nodes and satisfy all business rules and constraints at the minimum cost.

3 - Diet Problem Revisited

Fariborz Partovi, Professor, Drexel University, 33rd Chestnut Street, Department of Decision Sciences, Philadelphia, PA, 19003, United States of America, Partovi@Drexel.edu

It has been close to seventy years since the Diet problem was introduced by Stigler (Stigler 1945). However the problem with the classical Diet models is based on lack of proper presentation of food preferences. For many people, especially when they are eating outside their home, the content of the food as far as nutrition is concern may be not as important as the taste of the food. In this article we modify Diet problem using extensions of linear programming to consider the above issues

WE19

19-Franklin 9, Marriott

Computational Optimization with Risk and Uncertainty

Sponsor: Computing Society

Sponsored Session

Chair: John Sirola, Sandia National Laboratories, P.O. Box 5800, MS 1326, Albuquerque, NM, 87185-1326, United States of America, jdsirola@sandia.gov

1 - Multistage Power Generation Capacity Expansion Models with Different Risk Measures

Shu Tu, Lehigh University, H.S. Mohler Laboratory, 200 West Packer, Bethlehem, PA, 18015, United States of America, sht213@lehigh.edu, Boris Defourny

We investigate different stochastic optimization formulations for the multistage power generation capacity expansion problem. In particular, we focus on risk measures whose parameters can be calibrated from market data.

2 - Exploiting Inter-scenario Information to Accelerate Progressive Hedging

John Sirola, Sandia National Laboratories, P.O. Box 5800, MS 1326, Albuquerque, NM, 87185-1326, United States of America, jdsirola@sandia.gov, Jean-paul Watson, David Woodruff

Progressive Hedging (PH) is a scalable and effective approach for solving large stochastic programming problems through scenario-based decomposition. However, PH is sensitive to key tuning parameters (notably ρ) and for many problems can exhibit slow convergence. In this work we present new approaches for accelerating convergence and improved tuning by propagating key information among scenarios.

3 - Production Planning under Uncertainty and Service Level Constraints

Suleyman Karabuk, Associate Professor, University of Oklahoma, School of Industrial and Sys Engineering, 202 W. Boyd St., Room 124, Norman, OK, 73019, United States of America, karabuk@ou.edu

Consider a production planning problem with machine changeover and inventory carrying costs, and service level constraints, where demand for products is probabilistic. We formulate the problem as a multistage stochastic programming model with recourse. The resulting model is very large scale even for trivially small size instances. We develop an effective decomposition algorithm where individual product sub problems are solved by a novel probabilistic dynamic programming model.

WE21

21-Franklin 11, Marriott

Mathematical Modeling of HIV at the Cellular, Individual, and Population Level

Sponsor: Health Applications

Sponsored Session

Chair: Eva Enns, Assistant Professor, University of Minnesota, 420 Delaware St. SE, Minneapolis, MN, 55408, United States of America, eenns@umn.edu

1 - Mathematical Modeling of HIV Viral Dynamics and Immune Response During Treatment Interruptions

Nargesalsadat Dorratoltaj, Virginia Tech, Room 392, Vet Med Phase II., Blacksburg, VA, 24060, United States of America, nargesd@vt.edu, Josep Bassaganya-riera, Stanca Ciupe, Stephen Eubank, Margaret O'dell, Hazhir Rahmandad, Kaja Abbas

The objective of this study is to understand and predict HIV viral and immune dynamics at the individual level during treatment interruption and low adherence in developing AIDS. We use ordinary differential equations to build immune-viral dynamics of HIV/AIDS during treatment interruption. The results of the simulation show that the time that patients start treatment and for how long they stay on treatment before interruption are unique predictor for time to progress to AIDS.

2 - A Data-driven Approach to Understanding HIV Care Trajectories and Retention in Care Challenges

Eva Enns, Assistant Professor, University of Minnesota, 420 Delaware St. SE, Minneapolis, MN, 55408, United States of America, eenns@umn.edu

Sub-optimal retention in HIV primary care is associated with increased risks of mortality, detectable viral loads, and other complications compared to regular, ongoing care; however, the standard dichotomous measures of retention (e.g., in/out of care) ignore the diversity and complexity of individual care trajectories. In this talk, I describe a data-driven approach to understanding HIV care patterns and how to incorporate complex care behaviors into mathematical models of HIV interventions.

3 - Modeling a Bi-layer Contact Network of Injection Drug Users and The Spread of Blood-borne Infections

Rui Fu, Stanford University, 74 Barnes CT, Stanford, CA, 94305, United States of America, ruifu@stanford.edu, Alexander Gutfraind, Margaret L. Brandeau

Blood-borne infections can spread among injection drug users (IDUs) via risky sexual and needle-sharing contacts. To accurately model the spread of such contagions among IDUs, we build a bi-layer network that captures both types of risky contacts. We present methodology for inferring important model parameters. Such a model can be used to evaluate the efficacy of various programs that aim to combat drug addiction and contain blood-borne diseases among IDUs.

4 - Measuring the Potential Impact of Combination Prevention in Sub-Saharan Africa

Amin Khademi, Assistant Professor, Clemson University, 130-D Freeman Hall, Clemson, SC, 29634, United States of America, khademi@clemson.edu, Sunanth Anand

A public health approach to combination HIV prevention is advocated to contain the epidemic in Sub-Saharan Africa. We explore the implications of universal access to treatment along with HIV education scale-up in the region. We develop an HIV transmission model, calibrate it with data from South Africa and simulate the impacts of universal access to treatment along with HIV education scale-up on HIV trends.

■ WE22

22-Franklin 12, Marriott

Stochastic Processes II

Contributed Session

Chair: Vincent Slaugh, Visiting Assistant Professor, Smeal College of Business, Penn State University, 465 Business Bldg, University Park, PA, 16802, United States of America, vws102@psu.edu

1 - Solving Strategic Refinery Planning and Financial Risk Problems via Pyomo

Ariel Uribe, Ecopetrol S.A., Km 7 Via Piedecuesta, Piedecuesta, Colombia, ariel.uribe@ecopetrol.com.co, Wilson Briceño

In this work we reformulate the problem proposed by Bagajewicz & Lakkhanawat (2008), in which is solved a refinery planning problem taking into account financial risk management issues and the pricing effect on the planning decisions. As a first step, we compare from a computational point of view the performance of the deterministic and stochastic solutions between gams and pyomo. Finally, we explore pyomo in a parallel environment.

2 - Valuation and Operation of Three Types of Power Plants using Continuous Time Stochastic Control

Rune Ramsdal Ernsten, University of Copenhagen, Finsensvej 42, 4.tv, Frederiksberg, 2000, Denmark, rre@math.ku.dk

With the increasing focus on renewable energy in the deregulated energy markets, it is to be expected that the energy mix will change and along with it the dynamics of the energy prices. This will change the values of the existing and new power plants, and thus change the investment incentives. My research is based on valuation and operation of three different types of power plants in a new electricity market: a renewable power plant, a conventional power plant and a storage power plant.

3 - Reservation Admission Control in Rental Systems

Vincent Slaugh, Visiting Assistant Professor, Smeal College of Business, Penn State University, 465 Business Bldg, University Park, PA, 16802, United States of America, vws102@psu.edu, Alan Scheller-wolf, Sridhar Tayur

Using a multiserver queueing model, we study the problem of whether a rental firm should accept reservation requests during a rental season. We discuss performance bounds and the structure of the optimal policy for admitting reservations, and propose an easy-to-implement newsvendor-style heuristic for accepting reservations. We show that the heuristic performs well in test cases, and also observe that the system's profit is decreasing in the reservation notice time.

■ WE23

23-Franklin 13, Marriott

New Directions in Applied Probability

Sponsor: Applied Probability

Sponsored Session

Chair: David Goldberg, Assistant Professor, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, dgoldberg9@isye.gatech.edu

1 - Data-driven Dynamic Pricing and Inventory Control with Limited Price Changes

Boxiao (beryl) Chen, University of Michigan-Ann Arbor, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, boxchen@umich.edu, Xiuli Chao

We consider periodic review joint pricing and inventory control problem. Demand is random and price sensitive, and the firm has limited prior knowledge about its distribution. The firm learns the demand to maximize profit, but is faced with the business constraint that prevents it from conducting extensive price experimentations. We develop data-driven algorithms for pricing and inventory decisions and prove they converge to the optimal decision at the fastest possible speed.

2 - Rare Events in a Single Server Queue

Harsha Honnappa, Purdue University, West Lafayette, IN, United States of America, honnappa@purdue.edu, Peter Glynn

We characterize the rare event paths of the workload process in a FIFO single server queue that offers general service. The arrival times of a large, but finite, population of jobs are modeled as ordered statistics of i.i.d. random variables. We prove a large deviations principle (LDP) that shows that unlike a random walk, the most likely paths to hit a high level are not linear. We also extend this analysis to periodic traffic patterns, and develop an LDP for this setting as well.

3 - Efficient Monte Carlo Simulation using A Representation for Viscosity Solutions of Hamilton Jacobi Equations

Pierre Nyquist, Brown University, 182 George Street, Providence, RI, 02912, United States of America, pierre_nyquist@brown.edu, Henrik Hult, Boualem Djehiche

The design of efficient Monte Carlo methods is intimately connected to (sub)solutions of certain Hamilton-Jacobi (HJ) equations. However, such subsolutions can be hard to construct for a given problem. We discuss a min-max representation for viscosity solutions of HJ equations and its applications to rare-event simulation. To illustrate the result we focus on a specific setting: The use of importance sampling to estimate rare-event probabilities in a Markovian intensity model for credit risk.

■ WE24

24-Room 401, Marriott

Artificial Intelligence II

Contributed Session

Chair: Alexandra Diamond, Hunter College CUNY, 695 Park Avenue, New York, NY, 10021, United States of America, alexandradiamond@yahoo.com

1 - Role-assignment for Game-theoretic Cooperation

Catherine Moon, Duke University, 213 Social Sciences, Box 90097, Durham, NC, 27705, United States of America, csm17@duke.edu, Vincent Conitzer

In multiagent systems, a team of agents may work on multiple projects together. Here, we focus on the game-theoretic aspect that needs to be considered: when the agents are self-interested, careful role assignment is necessary to make cooperation the repeated game's equilibrium. We formalize this problem and find an easy-to-check necessary and sufficient condition for a given role assignment to induce cooperation. We also show that finding whether such assignment exists is in general NP-hard.

2 - Discretization of Continuous Action Spaces in Extensive-form Games

Christian Kroer, PhD Student, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, ckroer@cs.cmu.edu, Tuomas Sandholm

Most equilibrium-finding algorithms for sequential games require discrete, finite games, whereas applications often have continuity. Leveraging recent results on abstraction solution quality, we develop the first framework for providing bounds on solution quality for discretization of continuous action spaces in extensive-form games. Based on this framework, we develop algorithms for finding bound-minimizing abstractions under various structural assumptions.

3 - A New Fuzzy Kernel-free Support Vector Machine Model

Jian Luo, Assistant Professor, Dongbei University of Finance and Economics, 217 Jianshan Street, Shahekou District, Dalian, 116025, China, luojian546@hotmail.com, Zhibin Deng, Xingkai Yang, Huixiang Su, Chang Liu

A new kernel-free fuzzy support vector machine model is proposed using the concept of Fisher discriminant analysis and a new fuzzy membership function. A decomposition algorithm is designed to solve this proposed model. Computational results indicate that the proposed model outperforms well-known fuzzy support vector machine models with kernels.

4 - Stochastic Approximation for Optimal Self-driven Sensor-guided Rescue Robots under Uncertainty

Alexandra Diamond, Hunter College CUNY, 695 Park Avenue, New York, NY, 10021, United States of America, alexandradiamond@yahoo.com, Felisa Vazquez-abad

A robot must locate and retrieve an artifact that has a limited battery for sending signals. We compare two scenarios. (1) All calculations are done in the cloud using signals from the artifact to estimate position. The robot is then sent to the rescue. (2) The robot has computational and sensing capabilities and it performs the optimization in real time as it moves towards the object. The "risk" is associated with the probability of missing the target by a certain amount. We discuss convergence

■ WE26

26-Room 403, Marriott

Project Management II

Contributed Session

Chair: Fang Xie, PhD Student, Beihang University, 37 Xueyuan Road, Haidian District, Beijing, 100191, China, xiefangmm@163.com

1 - Estimation of Resource Allocation Patterns in a Portfolio of Engineering Projects

Vishwanath Hegde, California State University East Bay, 25800 Carlos Bee Blvd, Hayward, CA, 94542, United States of America, vish.hegde@csueastbay.edu, Zinovy Radovitsky

Using historic resource loading data in a multi-project setting, we show that resource distribution patterns can be captured by parametric regression models, which can forecast resource distribution during project lifetime using project due date and other attributes.

2 - Improved Design of CMS by Considering Operators Primary and Backup Decision-making Styles

Mohammad Rezaei-Malek, University of Tehran, No. 3, Ganji Alley, North Khosh Street, Tehran, 1457813353, Iran, m.rezaeimalek@ut.ac.ir, Reza Tavakkoli-Moghaddam, Nima Salehi Sadghiani

This paper considers decision-making style (as an index of operator's personal characteristics) in CFP to design an operator-consistent CMS. Decision-making style not only influences the interaction of two operators, but also affects the work that operator does on a machine, and these interactions both need to observe consistency. Hence, this paper presents a mathematical model for CFP that considers consistency between each two operators and consistency between operator and assigned task.

3 - Reactive Project Scheduling with a Cash Flow Balanced Objective

Minjing Ning, Xi'an Jiaotong University, No.28, Xianning West Road, Xi'an, China, ningminjing@stu.xjtu.edu.cn, Zhengwen He

This paper investigates reactive project scheduling which may be used to repair project schedules that suffer from multiple activity duration disruptions during project execution. The objective is to minimize the cumulative cash flow gap of the contractor in the real executing process of the project.

4 - Robust Scheduling of the Resource-constrained DTCTP with Uncertain Activity Costs

Fang Xie, PhD Student, Beihang University, 37 Xueyuan Road, Haidian District, Beijing, 100191, China, xiefangmm@163.com, Zhe Xu

We investigate the resource-constrained discrete time/cost trade-off problem in which the activity costs are stochastic and the objective is to construct a robust baseline schedule that maximizes the probability of completing the project within the given budget. Two algorithms for solving this problem are presented. We compare the two algorithms and analyze the impact of different factors through conducting experiments on a set of instances generated from the PSPLIB.

5 - Project Management And Quality Data Challenges for IoT Systems

Michael Chuang, SUNY - New Paltz, 1 Hawk Dr, New Paltz, United States of America, chuangm@newpaltz.edu, Kuan-Tsae Huang

Internet of Things (IoT) has shown its potentials to be employed to scenarios of Industry 4.0. Caterpillar installs sensors and telematics in its products. AzTron uses embedded sensors to allow for bidirectional communication over production lines. Collected data enable remote repair and service to make appropriate decisions, resulting in increased manufacturing uptime and improved customer service. How to apply project management to manage IoT becomes an important but uncharted topic.

■ WE27

27-Room 404, Marriott

Multicriteria Decision Making II

Contributed Session

Chair: Gang Wang, Assistant Professor, UMass Dartmouth, 285 Westport Road, Room 214, CCB, North Dartmouth, MA, 02747, United States of America, gwangl@umassd.edu

1 - A Game Theoretic Approach to Energy Policy Making with Multiple Objectives

Busra Keles, University of Miami, 1251 Memorial Drive, Department of Industrial Engineering, Coral Gables, FL, 33146, United States of America, bxk96@miami.edu, Murat Erkoc, Nurcin Celik, Mahide Kucuk, Yalcin Kucuk

We develop a two-stage decision making model on how a governmental agency can build and incentivize its energy policy across service providers. The agency, as the Stackelberg leader, has multiple objectives related to economic concerns, environment, and energy surety. The agency sets penalties and limits to which the power companies respond by choosing their investment and production strategies. We develop a model that integrates the Successive Weighted Sum method into the policy making game.

2 - A Heuristic Based on Qualitative Information for Territorial Partitioning Problems

Salem Chakhar, Dr, Portsmouth Business School, Portland Building, Portland Street, Portsmouth, PO1 3AH, United Kingdom, salem.chakhar@port.ac.uk, Maria Barbati, Carmela Piccolo, Giuseppe Bruno

This presentation proposes a heuristic to solve territorial partitioning problems. It uses as input a tree data structure, previously constructed based on qualitative information. This qualitative evaluation is grounded on several criteria and takes the form of a qualitative scale with a finite set of evaluation levels. The heuristic is illustrated using real-world data relative to Ile-de-France region in France.

3 - A Bi-Level Decentralized Programming for Setting Differential Subsidy Rate of Taiwan's Waste Printer

Jiun-Yu Yang, Master Student, Tamkang University, 151 Yingzhuang Rd., New Taipei, 25137, Taiwan - ROC, jiunyu.yang@gmail.com, Hsu-shih Shih

This study uses bi-level decentralized programming for setting differential subsidies on the recycling plants in Taiwan. The case of waste printers is illustrated. The results show that the differential subsidies on recycling plants can achieve a higher recycling rate.

4 - Markov Method for Assessing Utility Functions

Baback Vaziri, Purdue University, 315 N. Grant St., West Lafayette, IN, United States of America, bvaziri@purdue.edu, Yuehwen Yih, Tom Morin, Mark Lehto

Multiatribute value functions are a useful tool for decision makers. Many methods directly obtain information from the decision maker regarding the preferences of attributes. We propose an alternative approach, which will reverse engineer the weights of the value function. We use the results of the preferences of alternatives in conjunction with a Markov-based ranking method to develop a rating vector of attributes.

5 - Operations Scheduling in Reverse Supply Chains: Delivery Deadlines and Identical Demand

Gang Wang, Assistant Professor, UMass Dartmouth, 285 Westport Road, Room 214, CCB, North Dartmouth, MA, 02747, United States of America, gwangl@umassd.edu, Angappa Gunasekaran

This study addresses an integrated operations scheduling problem of reverse supply chains with delivery deadlines. The problem is to determine shipping quantities from collectors to the manufacturer and the assignment of demand points, subject to the capacity constraints of both the collectors and the manufacturer.

■ WE29

29-Room 406, Marriott

Big Data: Inference and Prediction

Sponsor: Analytics

Sponsored Session

Chair: Rob Lantz, Senior Manager Of Operations Analysis, Novetta Solutions, 8618 Westwood Center Drive, Suite 315, Vienna, VA, 22182, United States of America, rlantz@novetta.com

1 - Detecting Unknown Threats through Social Network Analysis

Matt Teschke, Senior Quantitative Consultant, Novetta, 7921 Jones Branch Drive, 5th Floor, McLean, VA, 22102, United States of America, mteschke@novetta.com, Jennifer Stave

A common impediment to the analysis of networks is the determination of risk relative to particular actors within the network. Using insights from the field of SNA in addition to an understanding of the challenges faced by the analyst, entities can be prioritized for investigation. This network-centric approach assigns risk based on an assessment of an entity's characteristics and activity using an eigenvector centrality algorithm, of which Google's PageRank algorithm is one application.

2 - Use the Whole Buffalo: Binary Classification which Encounters Diverse Data Types

David Elkind, National Security Consultant & Statistical Modeler, Novetta Solutions, 1320 N Veitch St, Arlington, VA, 22201, United States of America, delkind@novetta.com

Contemporary data collection gathers many different data formats, yet conventional analysis views data from a flat perspective in which an observation is a single unit type. This perspective leaves some data types unexploited when they cannot be made to fit a single paradigm. We propose to use model stacking to make predictions informed by all available data types. We accomplish this by using several SVMs, each of which has a kernel function appropriate to the subset of features it is learning.

3 - Big Data and Causality

Xuan Wang, Graduate Student, Louisiana State University - ISDS Department, 2200 Business Education Complex, Nicholson Extension, Baton Rouge, LA, 70803, United States of America, xwang35@lsu.edu, Helmut Schneider

In the past decade, Big Data Analytics has mainly focused on data mining to make better predictions. This research explores analytical techniques to discover causal relationships and focuses on challenges of interpreting correlational relationships in big data and discusses methods that help to distinguish between correlational and potential causal effects.

WE30

30-Room 407, Marriott

Information Systems IV

Contributed Session

Chair: Shalini Wunnava, Assistant Professor, SUNY Potsdam, 44 Pierrepont Avenue, 209 Dunn Hall, Potsdam, NY, 13676, United States of America, wunnavss@potsdam.edu

1 - Crowdsourcing and Project Management

Michael Chuang, SUNY, 1 Hawk Dr, New Paltz, NY, United States of America, mikeychuang@gmail.com

Crowdsourcing has been increasingly employed in today's projects, and has become a phenomenon. Issues of crowdsourcing also demonstrate in various facets, such as innovation and technology. However, there lacks a comprehensive understanding of crowdsourcing's potentials for projects. To bridge the gap, this research aims at conducting a systematic review of literature, in hopes of better understanding crowdsourcing for project management.

2 - The Effect of Project Artifacts, Ambidexterity, and Social Network on Open Source Project Success

Ram Kumar, Professor, UNC-Charlotte, 203B Friday Building, 9201 University City Boulevard, Charlotte, NC, 28223, United States of America, rlkumar@unccl.edu, Orcun Temizkan

Open Source Software (OSS) development is a rapidly emerging, yet poorly understood type of software development with extremely high project failure rates. We present a model of OSS project success by integrating multiple theories from social networking, innovation, and organizational theory. Our results illustrate that ambidexterity along with artifact development success and social network characteristics influences project success and highlight the bridging role of ambidextrous developers

3 - Leveraging On-demand Markets to Manage a Hybrid Workforce for IT Service Delivery

Su Dong, Assistant Professor, Fayetteville State University, School of Business and Economics, 1200 Murchison Road, Fayetteville, NC, 28311, United States of America, sdong@uncfsu.edu, Monica Johar, Ram Kumar

Organizations increasingly have access to temporary workers through markets for on-demand workers. We present a model of a hybrid workforce in which organizations effectively assign tasks to a mix of full-time and on-demand workers. Full-time workers have to perform assigned tasks. Temporary (on-demand) workers bid for tasks that are beneficial to them. Issues relating to pricing, task allocation and knowledge management are explored.

4 - Designing Quality Control Tools for Enhanced Cyber-security in Manufacturing

Ahmed Elhabashy, Graduate Student, Virginia Tech, 114 Durham Hall, 1145 Perry Street, Blacksburg, VA, 24061, United States of America, habashy@vt.edu, William Woodall, Lee Wells, Jaime Camelio

Manufacturing relies heavily upon the use of Quality Control tools to detect quality losses and to ensure high quality parts production. However, current tools are not designed to detect the effects of cyber-attacks, as they are based on assumptions (sustained shifts, rational sub-grouping, etc.) that may no longer be valid under the presence of an attack. The goal of this research is to design/adapt current Quality Control tools by adopting principles from the Information Technology domain.

5 - Biometrics: Adoption and Attitudes

Shalini Wunnava, Assistant Professor, SUNY Potsdam, 44 Pierrepont Avenue, 209 Dunn Hall, Potsdam, NY, 13676, United States of America, wunnavss@potsdam.edu

Biometrics has become ubiquitous on present day digital devices; although the usage is not very widespread currently, it is expected to see exponential growth in the near future. What attitudes are fueling the adoption of biometrics? This research question will be examined using the lenses of protection motivation theory and technology acceptance model.

WE31

31-Room 408, Marriott

Statistical Roles in Stochastic Decision-Making

Sponsor: Data Mining

Sponsored Session

Chair: Victoria Chen, The University of Texas at Arlington, Dept. of Ind., Manuf., & Sys. Engr., Campus Box 19017, Arlington, TX, 76019, United States of America, vchen@uta.edu

1 - A Data-driven Optimization of Price, Promotion, Display, and Feature at Product Category Level

Durai Sundaramoorthi, Lecturer In Management, Washington University in St. Louis, One Brookings Drive, Olin Business School, St. Louis, MO, 63131, United States of America, sundaramoorthi@wustl.edu, Seethu Seetharaman

Data Mining can be broadly classified into two groups: supervised learning and unsupervised learning. Supervised learning is the subject of interest in this research as we deal with predicting the units of category-level products sold in stores of a grocery chain. The goal of this research is two-fold. First, prediction models are developed to predict demand. Second, optimum vector X is determined to maximize the profit made by the chain.

2 - High-dimensional Adaptive Dynamic Programming with Mixed Integer Linear Programming

Zirun Zhang, University of Texas, Arlington, 500 West First Street, Arlington, TX, 76019, United States of America, zhang.zirun@gmail.com, Victoria Chen, Jay Rosenberger

This study addresses the optimization of a real world, complex, dynamic system. The objective is to control the environmental impact of aircraft deicing activities at the Dallas-Fort Worth International Airport. To overcome the complexities such as nonlinear transitions, non-convex objective function, and high-dimensional decision space, an ADP method is introduced using treed regression and MILP. The proposed ADP approach is also compared with a reinforcement learning approach.

3 - Efficient Simulation-based Sampling for Approximate Dynamic Programming

Danilo Macció, National Research Council of Italy (CNR-ISSIA), Via De Marini 6, Genova, 16153, Italy, ddmach@ge.issia.cnr.it, Victoria Chen, Cristiano Cervellera

We propose a method to generate efficient state sample points for the solution of continuous-state finite-horizon approximate dynamic programming problems. The method is based on the notion on F-discrepancy, which measures how closely a set of points follows a given distribution. The proposed algorithm can be used as an alternative to uniform random sampling when it is difficult to define a priori the state boundaries. Simulation results confirm in practice the effectiveness of the method.

4 - Continuous-state Adaptive Dynamic Programming

Prashant Tarun, Associate Professor, Missouri Western State University, Craig School of Business, 4525 Downs Drive, St. Joseph, MO, 64507, United States of America, ptarun@missouriwestern.edu, Victoria Chen, Huiyuan Fan

We present a sequential state space exploration (SSSE) approach to adaptively adjust the state space ranges for the experimental design while also sampling useful data for the statistical model. The SSSE approach is coupled with an adaptive value function approximation (AVFA) algorithm that gradually grows the complexity of the statistical model as more data are observed.

■ WE32

32-Room 409, Marriott

Data Mining in Manufacturing

Contributed Session

Chair: Weihong Guo, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48105, United States of America, graceguo@umich.edu

1 - Deterioration Monitoring of Ultrasonic Welding Tools Based on High-order Decomposition

Yaser Zerehsaz, PhD Student, University of Michigan, Ann Arbor, MI, 48105, United States of America, yzereh@umich.edu,
Chenhui Shao, Jionghua (Judy) Jin

Ultrasonic welding has been used for joining lithium-ion battery cells in electric vehicles. The geometric change of tool surfaces severely affects the weld quality. A new monitoring scheme based on a high-order decomposition method is suggested for the purpose of detecting the tool wear. A classification approach is used to determine the wear level of tools, which is helpful in finding the assignable causes of the extraordinary tool wear.

2 - Predictive Analytics of Semiconductor Chip Quality under Data Imbalance Situations

Jin Soo Park, Mr., Korea University, Anam-Dong, Seongbuk-Gu Korea University, Innovation Hall #816, Seoul, 136-713, Korea, Republic of, pjs0078@gmail.com, Seoung Bum Kim

The quality prediction of the semiconductor industry has been widely recognized as important and critical for quality improvement. The main objective of this paper is to predict the final quality of semiconductor chips by solving data imbalance problems. Our proposed method is generating more synthetic data near the decision boundary in order to specify the minority class region. We demonstrate the usefulness and applicability of the proposed method using real data from a semiconductor industry.

3 - Identifying Key Factors Affecting Knowledge Absorptive Capacity of Automobile Industry

Guohua Qiu, School of Economics and Management, Tongji University, No.1239 Siping Road, Shanghai, China, 2298900836@qq.com, Yixi Xue, Jianxin You

Knowledge absorptive capacity is essential for the R&D of automobile firms. Thus, identifying key factors affecting this capacity is important which, however, is ignored by much research. This paper firstly builds a two-level factor framework which contains four dimensions in the first level and 16 factors in the second level. Interval valued intuitionistic fuzzy and DEMATEL model are then constructed to identify key factors based on expert interview. Finally, some suggestions are proposed.

4 - Decision Support Information System Based on Rough Set to Telecom Churn Management

Mihrimah Özmen, University of Erciyes, Muhendislik Fakultesi Endustri Muh Bolum, Kayseri, 38039, Turkey, mihrimah@erciyes.edu.tr, Emel Kizilkaya Aydogan

In this study a rough set based heuristic algorithm is developed enabling data selection, filtering and aggregation. And then, in order to identify the customers with churning tendency, a relatively novel and popular algorithm is proposed. This cost-based particle swarm optimization algorithm is particularly efficient in analyzing high dimensional data aggregate stacks with high accuracy.

5 - Multi-stream Profile Monitoring and Fault Diagnosis via Sensor Fusion

Weihong Guo, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48105, United States of America, graceguo@umich.edu, Jionghua (Judy) Jin, S. Jack Hu

When multiple signals are acquired from different sources, sensor fusion and data dimension reduction are two major issues to achieve a better comprehension of the process. A method for analyzing multi-stream profiles based on uncorrelated multilinear discriminant analysis and ensemble learning is proposed in this research for the purpose of profile monitoring, fault detection, and fault diagnosis. The proposed method is compared with other solutions with both simulated and real data.

■ WE33

33-Room 410, Marriott

Scheduling in Residency Rotational Medical Programs

Sponsor: Health Applications

Sponsored Session

Chair: Ruben Proano, Associate Professor, Rochester Institute of Technology, 81 Lomb Memorial Drive, Rochester, NY, 14623, United States of America, rpmeie@rit.edu

1 - Constructing Annual Block Schedules for Family Medicine Residents

Jonathan Bard, Professor, University of Texas, 204 E. Dean Keeton St., C2200, Austin, TX, 78712, United States of America, jbard@mail.utexas.edu, Zhichao Shu, Douglas Morrice, Ramin Poursani, Luci Leykum

This paper presents a mathematical model that can be used to help construct annual block schedules for Family Medicine programs. Starting with the current rotation templates our goal was to redesign them to concurrently (i) balance the number of outpatients that can be seen in the clinic during each half-day session, and (ii) minimize the changes to the current template assignments. Computations are illustrated with data provided by the University of Texas School of Medicine in San Antonio.

2 - Decision Support for Duty- and Workstation Rostering Subject to Fairness and Preferences

Jens Brunner, University of Augsburg, Universitätsstraße 16, Universität Augsburg, WiWi, Augsburg, De, 86159, Germany, jens.brunner@unikat.uni-augsburg.de, Andreas Fögener

We consider a practical physician scheduling problem at hospitals. We formulate two mixed integer linear programming models for duty- and workstation assignments. The duty-roster model assigns physicians to 24h- and late-duties whereas the workstations-roster model assigns physicians to actual workstations for each regular working day. To promote for job satisfaction we take into account fairness and preferences. We present the status of the software development and an evaluation of our models.

3 - A Multi-objective Optimization Approach to the Resident Rotation Scheduling Problem

Akshit Agarwal, Rochester Institute of Technology, 81 Lomb Memorial Drive, Rochester, NY, 14623, United States of America, aa9425@rit.edu, Ruben Proano

Resident rotation scheduling is a complex process, which makes it challenging for schedulers to develop yearlong rotation schedules that not only adhere to the various managerial and legal restrictions but also balance resident workload and the quality of their education experience. We propose a multi-objective mixed integer programming approach and evaluate its performance on a multi-criteria scorecard based on AHP.

4 - Models and Approaches for Residents' Annual Rotation Schedules

William Pozehl, Research Specialist, University of Michigan, 1075 Beal Avenue, Suite 3246, Ann Arbor, MI, 48109, United States of America, pozewil@umich.edu, Amy Cohn, Ed O'Brien

Building annual resident rotation schedules requires not only meeting resident education and service coverage requirements, but also fulfilling a variety of requests to improve training quality and resident satisfaction. Priorities and constraint complexity vary by program, but the underlying models and scheduling approaches share fundamental similarities. We present our experiences in building pediatric and surgical rotation schedules.

■ WE35

35-Room 412, Marriott

Public Health

Contributed Session

Chair: Gina Dumkrieger, ASU, 1151 S. Forest Avenue, Tempe, AZ, 85281, United States of America, gina.dumkrieger@asu.edu

1 - Rapid Vaccination Response to a Deadly Disease Outbreak

Rebecca Scott, University of North Carolina Wilmington, 601 S. College Road, Wilmington, NC, 28403, United States of America, scottra@uncw.edu, Gayle Prybutok, Victor Prybutok

Rapid vaccination response is developed for Ebola using a contextualized newsvendor model. A network model that allows evaluating the importance of decision making factors is both posited and tested. Implications are reported that provide insights for increasing the ability to respond in a populated urban area.

2 - Effect of Meat Price on Health Outcomes

Allison Pitt, Graduate Student, Stanford University, 475 Via Ortega, 212I, Stanford, CA, 94305, United States of America, alpitt@stanford.edu, Eran Bendavid

We simulate the changes in obesity prevalence, mortality, and quality of life of adults in the United States from a sustained shift in meat price such as those that may result from volatility in global food markets or from policies. We highlight the differential impact across subpopulations defined according to race and gender.

3 - Fear as Contagion: The Ebola Crisis and Public Fear Networks a System Dynamics Approach

Nasser Sharareh, Binghamton University, 99 Schubert, Binghamton, NY, 13905, United States of America, nsharar1@binghamton.edu, Nasim Sabounchi

The most important problems during a period of crisis in any country is how to respond to the public's fear. There has been a lot of research investigating epidemic diseases. However, a few of these have employed a system dynamics (SD) approach to demonstrate the relationships between pandemics and the public response to fear, and the public perception of epidemic. In this study, an SD model has been developed to study the hidden relations that spread the disease.

4 - Is it a Solution? Findings from HIMMS Data

Liuliu Fu, PhD Candidate, Old Dominion University, 5413 Walton Avenue, Norfolk, VA, 23508, United States of America, luna.foe@gmail.com, Ling Li, Li Xu

Our research uses the HIMSS 2014 analytics database to identify the implementation of IT on US hospitals as well as the impact of IT on these hospitals. SEM models are constructed. Research questions: 1) What are the influential factors of hospital performance? 2) Whether Information System plays a role to improve hospital performance? If so, what's the mechanism that IS influence the performance? And 3) For different type of hospitals, whether IS affects the performance differently? If so, Why?

5 - Blood Inventory Performance Improvement via Substitution Order Optimization

Gina Dumkrieger, ASU, 1151 S. Forest Avenue, Tempe, AZ, 85281, United States of America, gina.dumkrieger@asu.edu

When allocating limited resources of a substitutable, perishable good, such as blood, substitution order is important. Research shows that by optimizing the blood type substitution order arrival of the first unserved patient can be delayed.

WE36

36-Room 413, Marriott

Optimization in Cyber and Physical Systems

Sponsor: Public Sector OR

Sponsored Session

Chair: Justin Yates, Professor, Francis Marion University, 4822 E Palmetto St, Florence, SC, United States of America, jyates@fmarion.edu

1 - Network Models for Nuclear Facility Security

Justin Yates, Professor, Francis Marion University, 4822 E Palmetto St, Florence, SC, United States of America, jyates@fmarion.edu, Sambridhi Bhandari, Sergiy Butenko

Security practices are based on traditional risk equations relying heavily on expert opinion and estimation. The proposed model measures the strength rating of a facility based on current and available detection and delay components to effectively allocate/improve security resources. Testing is conducted on a various facility models that mimic real-world structure.

2 - Data Fusion Methods for Emergency Logistics

Robert Pavur, Professor, University of North Texas, 1307 West Highland Street, College of Business, Denton, TX, 76201, United States of America, Robert.Pavur@unt.edu, Huguette Tran

Data fusion methods, based on Shannon's Entropy, are often employed in emergency logistics. Implementation of these techniques to estimate casualties or survivors has to be carefully considered. These methods may yield results equivalent to standard statistical estimators. Shannon's entropy, invariant to permutations of values of discrete variables, makes the formulation of the estimator inefficient if enough categories are not selected. We compare traditional and entropy-based procedures.

3 - Proactive Cost-effective Risk Mitigation in a Supply Chain using Fault-tree Analysis

Michael Sherwin, Mississippi State University, 1767 Independence Way, Valencia, PA, 16059, United States of America, mdsherwin@gmail.com, Hugh Medal, Steven Lapp

Fault-tree analysis (FTA) is a well-accepted methodology in reliability engineering for analyzing risks within a system. In this paper we present an approach for constructing a fault-tree to assess risk within a supply chain. The top-level event of interest is the delay in delivering a product to a customer and lower-level events represent the causes and associated probabilities of disruptions within the supply-chain for the product being studied.

4 - A Computational Approach to Determine Damage in Infrastructure Systems from Outage Reports

Huy Nguyen, Research Assistant, Rensselaer Polytechnic Institute, 110 8th Street, Troy, NY, 12180, United States of America, nguyeh7@rpi.edu, Thomas Sharkey

We consider the problem of determining damaged components in an infrastructure system given outage reports from customers. This is important in the context of cyber attacks on the information/control systems of the infrastructures since these attacks can induce incorrect information about the status of components. We develop an integer programming approach that iteratively determines a set of components to inspect whose damage would best replicate the outage report.

5 - Blastoff: A Stochastic MILP Approach to Satellite Orbital Maneuvers to Collect Forest Fire Data

Aaron Hoskins, PhD Student, Mississippi State University, Industrial & Systems Engineering, Starkville, MS, United States of America, abh318@msstate.edu, Hugh Medal

Forest fires cause considerable loss of life and property each year, but more data being available to fire crews can help to mitigate the loss. Satellite data is a data source that is under utilized due to the fact that the satellite's orbit can preclude it from collecting the most valuable data. This research applies a MILP approach to the altering of satellite trajectories to improve the data collected by a satellite of a forest fire.

WE37

37-Room 414, Marriott

Health Care Strategy and Policy III

Contributed Session

Chair: Jessye Bemley, North Carolina A&T State University, 1601 East Market St., McNair Hall 419, Greensboro, NC, 27409, United States of America, jlbemley@gmail.com

1 - Risk Adjustment and Low Income Subsidy Distortions in Medicare Part D

Daniel Miller, Assistant Professor, Clemson University, Dept. Economics, 228 Sirrine Hall, Clemson, SC, 29670, United States of America, dmille7@g.clemson.edu

This paper reveals distortions in the largest health exchange, Medicare Part D, related to the design of the Low Income Subsidy program and the three "Rs" of Part D's risk adjustment sharing mechanism (risk adjustments, risk corridors, reinsurance). I document price distortions, biases in risk adjustments, and evidence of insurers and drug suppliers price discriminating to exploit these biases. In conclusion, I discuss policy considerations for designing health exchanges.

2 - Causes and Consequences of Telemedicine Adoption in Clinics with Clinical Decision Support System

Xiaojin Liu, University of Minnesota, 321 19th Ave S, Minneapolis, MN, 55455, United States of America, liux1591@umn.edu, Susan Goldstein, Karen Soderberg, Kingshuk Sinha

Telemedicine, the technology-enabled remote delivery of clinical care, is one potential means to improve patient access to health care services. Yet, little is known on antecedents and consequences of current adoption. We investigate how geographical, socioeconomic and organizational characteristics determine the adoption, and examine how telemedicine impacts clinical care effectiveness.

3 - For-profit Vs. Nonprofit: Strategies for Competition and Collaboration in Continuing Care

Chengcheng Fan, Stanford University, 44 Olmsted Rd, #408, Stanford, CA, 94305, United States of America, fanc@stanford.edu

For-profit organizations have risen as a new form of entrepreneurship in healthcare industry. In this paper, I first examine the impact of ownership status on occupancy rate, price, and resident satisfaction in continuing care industry through an empirical study in California. Second, I set up a two-sided market framework to model the competition between for-profit and nonprofit CCRCs. The results provide new insights to understand the increase of for-profits' market share in healthcare.

4 - Modeling Individual Consumer Food Contamination Progression

Jessye Bemley, North Carolina A&T State University,
1601 East Market St., McNair Hall 419, Greensboro, NC, 27409,
United States of America, jlbemley@gmail.com, Lauren Davis

Food-borne illness affects nearly 48 million individuals a year resulting in hospitalizations and deaths. United States public health departments reported that 1,527 food outbreaks occurred between 2009 and 2010 of which 7.8% resulted in deaths. The purpose of this research is to develop models that will help to quantify consumer morbidity, consider the impact of various characteristics on the consumer, spread of contamination and consider interventions.

WE38

38-Room 415, Marriott

Optimization Combinatorial IV

Contributed Session

Chair: Mohsen Momeni Tabar, K.N.Toosi University of Technology, Tehran, Iran, mohsenmt40@gmail.com

1 - Semidefinite and Copositive Relaxation of Polynomial Optimization by using Symmetric Tensors

Xiaolong Kuang, Lehigh University, 14 Duh Drive, Apt. 324,
Bethlehem, PA, 18015, United States of America,
kuangxiaolong0731@gmail.com

We study relaxation of general polynomial optimization problem over the cone of positive semidefinite and completely positive tensors, which are natural extensions of the cones of positive semidefinite and completely positive matrices. Then we characterize the relationship between Lagrangian bounds, semidefinite bounds and copositive bounds of polynomial optimization.

2 - A Three-Operator Splitting Scheme and its Optimization Applications

Damek Davis, Graduate Student, University of California, Los Angeles, Department of Mathematics, Los Angeles, CA,
90095-1555, United States of America, damek@math.ucla.edu,
Wotao Yin

In this talk, we introduce a new splitting scheme that extends the Douglas-Rachford and forward-backward splitting schemes to monotone inclusions with three operators, one of which is cocoercive. We discuss why this algorithm works, derive several special cases, including a simple three-block ADMM algorithm, and introduce an acceleration that achieves the optimal rate of convergence for strongly monotone inclusions. Finally, we discuss several applications and future research directions.

3 - Moment Problem and its Applications to Risk Assessment

Ruilin Tian, Associate Professor Of Finance, North Dakota State University, 244 Richard H. Barry Hall, NDSU Dept 2410, Fargo, ND, 58108-6050, United States of America,
ruilin.tian@gmail.com, Samuel Cox, Luis Zuluaga

We discuss how to solve univariate moment problems with different function forms for risk assessment through three methods; namely, the semidefinite programming method, the moment-matching method, and a linear approximation method. We show that for practical purposes, these methods provide numerically equivalent results. Also, we propose a simpler formulation for the unimodal bounds on $E[L(x \leq K)]$ compared to existing formulations of the moment problem in the literature.

4 - Calculating the Number of Optimal Server in Queue M/M/s/K

Mohsen Momeni Tabar, K.N.Toosi University of Technology, Tehran, Iran, mohsenmt40@gmail.com, Zhila Dehdari Ebrahimi, Mahyar Ejlaei

Nowadays, economical systems play an important role in reducing costs. In this paper, mathematical modeling and calculation of optimal server queue $M / M / s / K$ have been investigated and numerical analysis method was used. The goal of this paper, base on two criteria to minimize costs and maximize the level of service is built. Finally, analyzed this paper done by maple 12 software.

WE39

39-Room 100, CC

Supply Disruption, Price Competition, and Quality

Cluster: Operations/Marketing Interface

Invited Session

Chair: Chao Liang, Assistant Professor, Cheung Kong Graduate School of Business, Main Campus, Oriental Plaza, E2, 1 East Chang An Ave, Beijing, China, cliang@ckgsb.edu.cn

1 - Impact of Variety Seeking Behavior on Service Competition under Price Commitment

Ying Wei, Associate Professor, Jinan University, Rm 722, Huiquan Building, Huangpu Avenue West 601#, Tianhe Dist., Guangzhou, 510632, China, yingwei@jnu.edu.cn, Liyang Xiong, Yulan Wang

Variety seeking is modeled as a decrease in the willingness to pay for the product purchased on the previous purchase occasion. With a two-stage Hotelling-type model, we show that under symmetric competition, the presence of variety seeking induces centralization effect, meaning firms tend to make the same price and service levels; while under asymmetric competition, the presence of variety seeking induces polarization effect meaning firms' price and service decisions tend to be different.

2 - Uniform Pricing in Service Systems as an Efficient Way of Improving Quality

Xin Geng, Sauder School of Business, University of British Columbia, Vancouver, BC, Canada Xin.Geng@sauder.ubc.ca

We look at a firm with heterogeneous servers who provide quality-differentiated services, where quality can be improved based on servers' experience. The commonly used pricing scheme that posts a price on each server suffers from a pitfall that the low quality servers usually improve slowly, impeding the future revenue increase. To resolve this issue, we propose another pricing scheme, which is essentially probabilistic selling, and analytically establish its superiority in long-run revenue.

3 - Does Traceability Help Product Quality?

Chao Liang, Assistant Professor, Cheung Kong Graduate School of Business, Main Campus, Oriental Plaza, E2, 1 East Chang An Ave, Beijing, China, cliang@ckgsb.edu.cn

In a supply chain with one manufacturer and one supplier, we study how traceability impacts the manufacturer and the supplier's incentive to improve product quality. Interestingly, we find that traceability may reduce the final product's quality.

WE40

40- Room 101, CC

Operations Management/Marketing Interface IV

Contributed Session

Chair: Sung Wook Yun, Yonsei University, Sinchon-dong, Seodaemun-gu, Seoul, Korea, Republic of, giantguard@naver.com

1 - Product Differentiation under Uncertain Market Conditions

Xingxing Chen, Washington University in St. Louis, Campus Box 1133, St. Louis, MO, 63130, United States of America, xingxing.chen@wustl.edu

We study a competition model between two firms facing uncertain market conditions where they engage in a product design competition with these uncertainties and then engage in a price competition after uncertainties are resolved. We try to characterize price and product design equilibrium and see how uncertainties in the market affect the equilibrium outcome.

2 - The Antecedents and Consequences of Automotive Recall Decision Making

Chelsey Hill-Esler, Drexel University, 730 Gerri LeBow Hall, 3220 Market Street, Philadelphia, PA, 19104, United States of America, chh35@drexel.edu, Chaojiang Wu

In the automotive industry, when a safety defect or noncompliance issue is discovered, automakers must make many important decisions. This research considers two decisions: action and initiation. Using primary and secondary recall data between 2004-2014, the authors utilize a two-stage modeling approach investigating the factors influencing recalls and the effect of recall decisions on market share.

3 - Institutional Logics Change and Firm Attention: Sustainability Logic in the Apparel Industry

Yoojung Ahn, University of Massachusetts Amherst, MA,
121 Presidents Drive, Amherst, MA, 01003,
United States of America, yoojung@som.umass.edu

This paper explores how change in institutional logics impacts firm attention to this logic to create self-regulatory institutions. I examine the “sustainability logic” in the apparel industry to understand the different ways firms attend to this logic, and whether attention patterns contribute differently to participating in a self-regulatory institution. I deploy content analysis and event history analysis methods.

4 - Development of Predictive Model for Moviegoers using Multi Regression Analysis and Movie Scheduling

Sung Wook Yun, Yonsei University, Sinchon-dong,
Seodaemun-gu, Seoul, Korea, Republic of,
giantguard@naver.com

This paper is about a practical decision-making approach to a film screening in a multiplex movie theater. Our ultimate objective in this paper is to maximize the number of moviegoers by allocating movies to a limited number of screens that have different number of seats. We specifically devised a movie schedule model that determine which movies will be played on which screens with the consideration of an exchange screening and a double booking based on the Movie forecasting.

■ WE43

43-Room 103A, CC

Pricing and Inventory Control

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Izak Duenyas, John Psarouthakis Professor, University of Michigan, Ross School of Business, Ann Arbor, MI, 48109, United States of America, duenyas@umich.edu

1 - Dual-metric Segmentation for Creating Airline Forecast Groups

Wei Wang, Scientist, PROS, Inc., 3100 Main Street, Suite #900,
Houston, Tx, 77002, United States of America,
weiwang@pros.com

For airlines, forecast groups created based on various flight attributes can improve forecast accuracy and provide sponsorship (especially to new markets), however frequently the segmentation uses load factor (LF) as the only metric. We present a two-metric and two-step approach where the segmentation is guided by both revenue and LF.

2 - Analysis of Self-adjusting Controls for Dynamic Pricing with Unknown Demand Parameters

George Chen, Stephen M. Ross School of Business, University of Michigan, 701 Tappan Ave, Ann Arbor, MI, United States of America, georgeqc@umich.edu, Izak Duenyas, Stefanus Jasini

We study the network-RM pricing problem with unknown demand function parameter. We develop a joint learning and dynamic pricing heuristic that combines MLE and self-adjusting price control and show that the best attainable revenue loss rate in the general setting can be achieved without re-optimization. A much sharper rate can also be achieved when demand are well-separated using the proposed self-adjusting heuristic.

3 - Data-driven Algorithms for Nonparametric Multi-product Inventory Systems

Weidong Chen, University of Michigan, Industrial and Operations Engineering, Ann Arbor, MI, 48109, United States of America, aschenwd@umich.edu, Cong Shi, Izak Duenyas

We propose a data-driven algorithm for the management of stochastic multi-product inventory systems with limited storage as well as production cost uncertainty. The demand distribution is not known a priori and the manager only has access to past sales data. We measure performance of our proposed policy through regret and characterize the rate of convergence guarantee of our algorithm.

4 - Dynamic Pricing and Inventory Management under Network Externalities

Renyu Zhang, Doctoral Student, Olin Business School, Washington University in St. Louis, Campus Box 1133,
1 Brookings Drive, St. Louis, MO, 63130,
United States of America, renyu.zhang@wustl.edu, Nan Yang

We study a periodic-review joint pricing and inventory management model with network externalities. The product is a network product so that the customers' willingness-to-pay and, thus, the potential demand of the product are increasing in the network size. We characterize the optimal policy and analyze the impact of network externalities upon the optimal price and inventory decisions. We also propose effective strategies to exploit network externalities.

■ WE44

44-Room 103B, CC

New Approaches in Dynamic Pricing and Revenue Management

Sponsor: Revenue Management and Pricing

Sponsored Session

Chair: Yonatan Gur, Stanford GSB, 655 Knight Way, Stanford, CA, 94305, United States of America, ygur@stanford.edu

1 - Randomized Markdowns and Online Monitoring

Ken Moon, PhD Candidate, Stanford GSB, 655 Knight Way,
Stanford, CA, 94305, United States of America,
kenmoon@stanford.edu, Kostas Bimpikis, Haim Mendelson

Using data tracking customers of a North American retailer, we present empirical evidence that consumers are forward-looking and that monitoring products online associates with successfully obtaining discounts. Developing a structural model relating consumers' dynamic behavior to their monitoring costs, we find substantial heterogeneity, with opportunity costs for an online visit ranging from \$2 to \$25 in inverse relation to price elasticities. We show implications for retail operations.

2 - Agent Behavior in the Sharing Economy: Evidence from Airbnb

Antonio Moreno-Garcia, Northwestern University,
2001 Sheridan Rd, Evanston, IL, 60208, United States of America,
a-morenogarcia@kellogg.northwestern.edu, Jun Li, Dennis Zhang

Using data from Airbnb, we study the behavior of non-professional agents in two-sided platforms.

3 - Implications of Choice Paralysis on Operational Decision Making

Rene Caldentey, NYU, 44 W 4th St, New York, NY, 10012,
United States of America, rcaldent@stern.nyu.edu,
Srikanth Jagabathula, Anisha Patel

We empirically investigate the notion of choice paralysis (i.e., too many options can paralyze a consumer and make them more prone to not purchasing) and study its implications on assortment and inventory decisions. We propose a modification to the nested logit model to incorporate the choice paralysis effect.

4 - Doing While Learning and Adapting to a Changing Environment

Yonatan Gur, Stanford GSB, 655 Knight Way, Stanford, CA,
94305, United States of America, ygur@stanford.edu,
Omar Besbes, Assaf Zeevi

Multi Armed Bandit (MAB) problems are building blocks of many RM&P problems. We study a MAB formulation that allows for a broad range of temporal uncertainties in the rewards. We characterize the complexity of this class of problems, mapping the “budget” of allowable variation to the minimal achievable regret relative to a dynamic oracle. We study the price of universality: the additional complexity associated with not knowing variation budget, over the one embedded in a known budget.

■ WE45

45-Room 103C, CC

Reducing the Carbon Footprint

Contributed Session

Chair: Emre Berk, Bilkent University, Management Faculty, 06800 Bilkent, Ankara, Turkey, eberk@bilkent.edu.tr

1 - Real Options Portfolio Strategies for Cloud Infrastructure Expansion

Yunpeng Pan, Assistant Professor, South Dakota State University,
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United States of America, yunpeng.pan@sdstate.edu

Cloud services are powered by capital-intensive, energy-hungry data centers. The temporal and spatial choices of data center deployment must be made judiciously to best satisfy customer needs while keeping economic and environmental costs in check. To this end, we propose a real options framework for evaluating the desirability of candidate sites under the complex dynamics of electricity rate, customer demand, etc.; we develop strategies for portfolio selection and option exercise.

2 - Design of Financial Incentive Programs to Promote Net Zero Energy Buildings

Alireza Ghalebani, Doctoral Candidate, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, Alireza@mail.usf.edu, Tapas K. Das

Promoting net zero energy buildings (NZE) is among key carbon emissions reduction approaches in the U.S. and in the EU countries. We present a mixed integer programming (MIP) model to aid determining the minimum thresholds of financial incentives that would spur growth in NZEBs. The results indicate the threshold values of the incentive program parameters, and show that these thresholds are highly influenced by the leveled cost of electricity from RE and are independent of load profiles.

3 - Environmental Consequences of Inventory Stockout Decisions

Hongyan Liang, Kent State University, 800 E Summit Street, Kent, OH, 44240, United States of America, hliang@kent.edu, Alfred Guiffreda, Eddy Patuwo

The literature on sustainable inventory management has focused on the carbon footprint with inventory management decisions. Emergence orders are issued to correct a stockout occurrence. The majority of emergency orders involve transportation by motor carriers, which impacts the environment through the carbon footprint. Models for examining the decision to backorder do not address environmental concerns, hence a research opportunity exists to reexamine the decision to backorder or stockout.

4 - A Multi-modal Inventory System with Lead Time Dependent Demands

Emre Berk, Bilkent University, Management Faculty, 06800 Bilkent, Ankara, Turkey, eberk@bilkent.edu.tr, Ozgur Toy, Onurcan Ayas

We consider an inventory system facing slow moving demand with multi-modal transport opportunities. Customers have waiting time tolerances in cases of stockouts and societal-impact considerations (e.g., carbon emission sensitivities) for the units they purchase. We investigate mode selection and service contract design. We provide some structural results and numerical examples.

5 - On Variability of Global Annual Mean Temperature

Xiaoyue Jiang, Tulane University, Department of Computer Science, New Orleans, LA, 70118, United States of America, xjiang@tulane.edu, Brent Venable, Leiwen Jiang

A “model-free” analysis of global annual mean temperature anomalies (HadCRUT4, from 1850-2014) is developed. By capturing the maximum variability across all time scales covered by the dataset, this envelope-based characterization confirms some widely accepted, in the meantime, strongly disputed understandings and offers new and objective insights and interpretation to future climate change trajectory.

WE46

46-Room 104A, CC

Studies in Customer Queuing Behavior

Sponsor: Manufacturing & Service Oper Mgmt/Service Operations
Sponsored Session

Chair: Robert Batt, Asst. Professor, Wisconsin School of Business, UW-Madison, 975 University Ave., Grainger Hall, 5279, Madison, WI, 53706, United States of America, rbatt@bus.wisc.edu

Co-Chair: Laurens Debo, Associate Professor, Dartmouth College, 100 Tuck Hall, Hanover, NH, 03755, United States of America, laurens.g.debo@tuck.dartmouth.edu

1 - Managing Customer Expectations and Priorities with Delay Announcements

Gad Allon, Professor, Kellogg School of Management, Northwestern University, 2001 Sheridan Road, Evanston, IL, 60201, United States of America, g-allon@kellogg.northwestern.edu, Achal Bassamboo, Qiuping Yu

We study in a service environment, how to manage customers' expectations and to prioritize customers appropriately to maximize the firm's profits. Specifically, we focus on a setting where the firm uses only delay announcements and study the opportunities and limitations of this mechanism. We are particularly interested in when and how the customers can be influenced by delay announcements.

2 - Searching for Better Quality and a Shorter Wait

Luyi Yang, Doctoral Student, University of Chicago Booth School of Business, Chicago, IL, United States of America, luyi.yang@chicagobooth.edu, Laurens Debo, Varun Gupta

We consider a many-server queueing system in which servers have different qualities. The customer does not know either the quality of the server or its queue length in advance, and is thus engaged in a costly sequential search. We characterize the equilibrium search behavior. We find that reducing the search cost may increase the expected waiting time while increasing the arrival rate may decrease it.

3 - Observational Learning in Congested Environments with Multiple Choice Options

Chen Jin, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, chenjin2011@u.northwestern.edu, Laurens Debo, Mirko Kremer, Seyed Iravani

We study human choice behavior in a congested multi-location system with quality variation among locations and information asymmetry among sequentially arrived customers, i.e. some customers are informed and know the quality of all locations while others don't (uninformed). Customers all observe the queue length at each location upon arrival. We specify conditions under which uninformed customers join longest queue and join shortest non-empty queue. We also test the results in the laboratory.

WE47

47-Room 104B, CC

Consumer Returns Management in Retailing

Sponsor: Manufacturing & Service Oper Mgmt/Sustainable Operations

Sponsored Session

Chair: Guangzhi Shang, Assistant Professor, Florida State University, College of Business, RBB354, Tallahassee, FL, 32306, United States of America, gshang@business.fsu.edu

1 - Does a Better Customer Experience Reduce Consumer Returns? An Empirical Study using Data Analytics

Necati Ertekin, Texas A&M University, Mays Business School, College Station, TX, 77840, United States of America, nerteikin@mays.tamu.edu, Michael Ketzenberg, Gregory Heim

This study contributes to the understanding of consumer return behavior by examining the association between in-store customer experience (i.e. product quality, service quality, and customer satisfaction) during a purchase and a subsequent return. Our analysis reveals surprising findings for retailers. For instance, we demonstrate that retail efforts such as increasing salespeople competence and improving store environment that are so long believed to prevent returns may indeed induce returns.

2 - Intertemporal Pricing and Return Policies in the Presence of Strategic Consumers

Wenbo Selina Cai, Assistant Professor, New Jersey Institute of Technology, cai@njit.edu, Ying-ju Chen

Pricing and return policies are crucial decisions that affect online retailers' profitability when dealing with strategic consumers. We develop a model that considers heterogeneous consumer valuations, valuation uncertainties, and strategic purchasing behaviors, and derive the optimal joint pricing and return policy for a retailer in a dynamic pricing framework. We discuss the implications of a generous return policy, and show that returns can help retailers facilitate market segmentation.

3 - An Empirical Investigation of Return Drivers: Reducing Consumer Returns in the Era of Generous Refunds

Guangzhi Shang, Assistant Professor, Florida State University, College of Business, RBB354, Tallahassee, FL, 32306, United States of America, gshang@business.fsu.edu, Mark Ferguson, Michael Galbreth

We empirically study drivers of whether and when to return. Our results informs retailers' return management along two dimensions: 1) how to target buyer assistance, and 2) how to customize return time window.

■ WE49

49-Room 105B, CC

Facility Location II

Contributed Session

Chair: Utku Kunter, Research Assistant, Middle East Technical University, ODTU Kampusu Endüstri Mühendisliği Bolum, Oda 325 Cankaya, Ankara, 06801, Turkey, kunter@metu.edu.tr

1 - Identifying Stadium Locations for the Qatar 2022 Fifa World Cup

Agha Iqbal Ali, Professor And Chairman, University of Massachusetts-Amherst, Isenberg School of Management, 121 Presidents Dr., Amherst, MA, United States of America, aiali@isenberg.umass.edu, Ahmed Ghoniem

The number of venues for the twenty FIFA World Cups since 1930 has ranged from 3 to 20 and the number of participating teams has grown from 13 to 32. Due to the compactness of Qatar, the logistical impacts of different numbers and locations of venues can be significant for the Qatar 2022 FIFA World Cup. These impacts are studied in a scenario analysis using mathematical programming.

2 - Modeling Transportation Cost Uncertainty in City Logistics Systems

Utku Kunter, Research Assistant, Middle East Technical University, ODTU Kampusu Endüstri Mühendisliği Bolum, Oda 325 Cankaya, Ankara, 06801, Turkey, kunter@metu.edu.tr, Cem Iyigun, Haldun Sural

City Logistics (CL) deals with freight transportation in urban areas. We consider the fixed charge facility location problem under transportation cost uncertainty in a CL setting. The optimization problem has been framed as a two-stage stochastic MIP. Locations are chosen in the first stage; capacity allocations are made in the second. We propose an evolutionary solution algorithm with local search. The algorithm performs well when compared with exact solution methods in the literature.

3 - Optimizing Hospital Closures

H A Eiselt, University of New Brunswick, Fredericton, NB, Canada, haeiselt@unb.ca, Joyendu Bhadury, Mark L. Burkey, Hunkar Toyoglu

We examine the effects of hospital closures on some major indicators concerning service level, including the average access time and the proportion of potential patients who are able to access a health care facility within 30 minutes driving time. Results of extensive computations are provided and discussed.

■ WE50

50-Room 106A, CC

Empirical Studies in Supply Chain Risk Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Jun Li, Assistant Professor, Ross School of Business, University of Michigan, 701 Tappan St, Ann Arbor, 48103, United States of America, junwli@umich.edu

1 - Supply Chain Network Structure and Firm Returns

Wu Jing, University of Chicago Booth School of Business, 5050 S Lake Shore Dr 3417S, Chicago, IL, United States of America, wujing@chicagobooth.edu, John Birge

Using data on the relationships of public US firms, we investigate the effects of supply chain connections on firm performance, as reflected in stock returns, at two interaction levels, first-order from direct connections and second-order from systemic exposures through the network.

2 - An Empirical Model of Inventory Rationing Game

Robert Bray, Northwestern University, Evanston, IL, United States of America, robertlbray@gmail.com, Oliver Yao, Achal Bassamboo

We study inventory rationing in a one-DC, 80-retailer supply chain. We model the stores' inventory policies as a dynamic discreet choice game. We estimate whether the stores increase or decrease their order quantities when the threat of DC stock out increases. Increasing order quantities indicate inventory gaming—stores squabbling over upstream inventories—whereas decreasing order quantities indicate supply chain coordination—stores preserving upstream inventories for those most in need.

3 - A Structural Estimation of the Bullwhip Effect using Supply Network Data

Vishal Gaur, Cornell University, 321 Sage Hall, Ithaca, NY, 14850, United States of America, vg77@cornell.edu, Maximiliano Udenio, Jan Fransoo

We estimate a two-stage structural model of inventory decisions using financial data for 6,040 unique supplier-customer dyads for the years 1984-2013 to investigate downstream inventory adjustments and their influence on upstream firms. Our results show that inventory cost ratios are dynamic, and a significant cause of the bullwhip effect in supply chains.

■ WE51

51-Room 106B, CC

Facilities Planning and Design

Contributed Session

Chair: Begün Efeoglu, Research Assistant, Middle East Technical University, ODTÜ Kampüsü Endüstri Mühendisliği, Oda 324 Çankaya, Ankara, 06800, Turkey, beguneefeoglu@gmail.com

1 - A Markov Decision Process Model for the Dynamic Block Stacking Problem

Hueon Lee, PhD Student, University of Arkansas, Dept. of IE, 4207 Bell Engineering Center, 1 University of Arkansas, Fayetteville, AR, 72701, United States of America, hueonlee@uark.edu, John A. White, Shengfan Zhang

The block stacking problem involves determining the depth of a storage row for unit loads that minimizes the sum of space and travel cost. A conventional block stacking problem assumes static row depths and deterministic demand. We allow row depths to change (by relocating product) and demand to be random. The problem is formulated as a Markov decision process and the optimal lane depth is determined for each inventory level. Results obtained provide useful insights for designers.

2 - A Heuristic Method for Storage Location Assignment Problem for a Distribution Center

Zeynep Turgay, Solution Architect, Migros IT, Atasehir, Istanbul, 34758, Turkey, zeynept@migros.com.tr, Necati Aras

Storage location assignment of products is an important research topic in warehouse design. We solve storage location assignment problem for a distribution center providing day-to-day service for a retail chain. Ordered items and quantities are random. Order pickers collect the products ordered by the stores from their addresses and deliver to the order shipment area. The objective is to optimize the total effort spent by the order pickers in terms of the total traveling distance.

3 - Impact of Demand Stochasticity on Distributed Layouts

Begün Efeoglu, Research Assistant, Middle East Technical University, ODTÜ Kampüsü Endüstri Mühendisliği, Oda 324 Çankaya, Ankara, 06800, Turkey, beguneefeoglu@gmail.com, Haldun Sural, Melih Celik

The facility layout problem is to assign departments to locations. Recent studies show that functional layout configurations do not meet the needs of multiproduct enterprises. We investigate the effect of the stochastic demand and the layout cost on the choice of a layout type in a dynamic environment. Using a two-stage stochastic integer programming, we simulate its results in order to study system trade-off and present our experimental results.

■ WE52

52-Room 107A, CC

Productivity and Competitiveness

Contributed Session

Chair: Misuk Lee, Assistant Professor, Salisbury University, Perdue School of Business, Salisbury, MD, 21804, United States of America, mxlee@salisbury.edu

1 - Two Sides of the Same Coin: A Meta-analysis of Cohesion in Organizational Contexts

Angelo Solarino, City Univeristy of Hong Kong, Chee Avenue, Kowloon, Hong Kong, Hong Kong - PRC, mgangelo@cityu.edu.hk, Frederik Von Briel

Cohesion is one of the most important determinants of group performance; it is reflected through a socio-emotional (i.e., group members' liking for one another) and a task-oriented (i.e., group members' shared task commitment) dimension. Exclusively focusing on organizational contexts we conduct a meta-analysis of the cohesion-performance relationship to clarify the effect of individual dimensions, thereby identifying group type and country as contingencies that moderate the relationship.

2 - Foreign Cuisine or Local Delicacies? A Study on Overseas and Domestic M&A by Chinese Listed Firms

Daitian Li, PhD Candidate, Bocconi University, Via Roentgen, 1, Milan, 20136, Italy, daitian.li@phd.unibocconi.it

This paper explores how sectoral difference and firm heterogeneity affect the link between mergers and acquisitions (M&A) and productivity. I hypothesize that overseas M&A tend to increase firms' productivity in high-tech sectors, while domestic M&A tend to increase firms' productivity in low-tech sectors. Above relationships are affected by firm heterogeneity in terms of prior productivity levels. The hypotheses are tested with data on M&A conducted by Chinese listed firms in 2000-2011.

3 - Joint Price Differentiation and Inventory Decisions for a Risk-tolerant Firm with Demand Leakage

Syed Asif Raza, Assistant Professor, Qatar University, College of Business and Economics, Qatar University, Doha, QC, 2713, Qatar, syedar@qu.edu.qa, Mohd. Nishat Faisal

We present a model for an optimal joint price differentiation and inventory decisions for risk-tolerant firm. It is assumed that the firm divides its market demand into two segments using a differentiation price and sell almost the same or slightly distinguished products. However, this differentiation leads an imperfect segmentation causing a demand leakage from the full price market segment to the discounted price segment. We assess the impact of risk-aversion on a firm profitability.

4 - A New Statistical Approach to Multi-Channel Inventory Allocation

Misuk Lee, Assistant Professor, Salisbury University, Perdue School of Business, Salisbury, MD, 21804, United States of America, mxlee@salisbury.edu

All revenues in different channels are not created equal with different distribution costs and different market prices. We develop a new statistical model to find a more profitable, yet achievable channel mix. By estimating multivariate normal demand, we capture correlations of demand among channels and compute the expected channel mix. We incorporate the estimation process with demand seasonality identified through clustering, which results in more business-reasonable allocation.

WE53

53-Room 107B, CC

Environmental Operations

Contributed Session

Chair: John J Liu, Professor, City U of Hong Kong, Tat Chee Avenue, Kowloon, Hong Kong - PRC, johnliu@cityu.edu.hk

1 - The Impact of Changing Discharge Standards on the Wastewater Treatment Process

Bingxiong Lu, Tsinghua University, South 615A Shunde Building, Beijing, China, lubx13@mails.tsinghua.edu.cn, Simin Huang, Xiangyuan Du

We used derivative-free optimization to optimize the wastewater treatment process at different discharge standards, and obtained the 'optimal treatment scenarios' with minimal treatment cost. The life cycle impact of 'optimal treatment scenarios' were calculated using life cycle assessment. The results show that the life cycle impact increases with increasingly stringent discharge standard, and the marginal life cycle impact varies with different categories of water pollutant.

2 - Export Restrictions or Boundary Adjustments? A Technology Choice and Social Welfare Based

Sam Aflaki, HEC Paris, 1 Rue de la Liberation, Jouy en Josas, 78350, France, aflaki@hec.fr

In this paper, we study the legislations concerning e-waste export restrictions such as Basel convention and compare them with alternative schemes such as boundary adjustment methods involving taxation. We characterize the Nash equilibrium of a Stackelberg game between a regulator and a monopolistic firm and analyze the influence of these schemes on the technology choice for recycling, remanufacturing quantity and social welfare.

3 - Industrial Emissions: Corporate Social Liability and Responsibility

John J Liu, Professor, City U of Hong Kong, Tat Chee Avenue, Kowloon, Hong Kong - PRC, johnliu@cityu.edu.hk, Hao Leo Li

We theorize that industrial emissions represent an unavoidable social liability that has not been unaccounted for in the POM research, and develop an emission transduction model of production energy dissipation to characterize and measure individual industrial emissions as liable "bads" (bad output) inevitably transduced together with the "goods" produced by a production system. The model is validated with empirical tests.

WE54

54-Room 108A, CC

Service Science III

Contributed Session

Chair: Sina Ansari, Northwestern University, 2145 Sheridan Road Room C210, Evanston, IL, 60208, United States of America, sina.ansari@u.northwestern.edu

1 - Value Co-creation and Resource Consumption: Towards an Operational Model of SD Logic

Christoph Heitz, Zurich University of Appl. Sciences, Postfach, Winterthur, 8401, Switzerland, christoph.heitz@zhaw.ch

We study a service system with two actors (e.g. service provider and customers) which may integrate their resources for mutual value creation. We derive a formal model that takes into account not only the value creation but also the resource consumption of both actors. We assume that both actors have limited resources, and the choices of how to use these resources determine their behavior in the service relationship. The model leads to general insights on the behavioral options of the actors.

2 - NSF Funding Opportunities for Human-centered Smart Service Systems

Alexandra Medina-Borja, Program Director, National Science Foundation/ UPRM, 2507 Fowler St, Falls Church, VA, 22046, United States of America, amedinab@nsf.gov

NSF program directors will discuss funding opportunities at the intersection of behavioral Sciences/ Human Factors and mathematical modeling. This research work is expected to enable smart service systems of the future. Requirements and recommendations will be discussed

3 - Task Variety in Professional Service Work: When it Helps and When it Hurts

Emmanouil Avgerinos, PhD Candidate, University College London, Gower Street, London, WC1E6BT, United Kingdom, emmanouil.avgerinos.10@ucl.ac.uk, Bilal Gokpinar

In many professional service firms, individuals perform a variety of tasks with significant opportunities for learning but also tend to enjoy more discretion in managing when and how they perform their tasks. In light of these observations, we investigate task allocation strategies that may enhance or inhibit individual learning. Using a dataset of 3,275 coronary artery bypass surgeries we examine the effect of concurrent and non-concurrent exposure to task variety on individual productivity.

4 - Barriers to Productizing Services

Sukruth Suresh, Rensselaer Polytechnic Institute, Troy, NY, 12180, United States of America, suress@rpi.edu, T. Ravichandran

We extend the existing product service systems classification, to include productized service offerings. These are a well-defined, well-packaged bundle of distinct services with a defined scope, delivered to address a specific set of needs. We posit that firm status; maturity and extent of modularity of the offering and, market size influence the propensity of firms productizing their offerings. These are mobility barriers rather than entry barriers as the transition is within the industry.

5 - Waiting Time and Customer Satisfaction Improvement in Emergency Departments

Sina Ansari, Northwestern University, 2145 Sheridan Road Room C210, Evanston, IL, 60208, United States of America, sina.ansari@u.northwestern.edu, Seyed Iravani, Laurens Debo

Excessive wait time is the most common reason patients become unsatisfied and leave the emergency department before being treated. In this study, we aim to determine the possibilities of improvement in patient's waiting times (both actual and perceived) in Northwestern Memorial Hospital ED and consequently help ED managers to achieve higher patient satisfaction.

■ WE55

55-Room 108B, CC

Design Engineering

Contributed Session

Chair: Jayash Koshal, Bloomberg LP, 425 Washington Blvd, Jersey City, NJ, 07310, United States of America, jayashkoshal@gmail.com

1 - Performance Improvement of Average Access Time and Cache Memory Access Time

Mohammad Shamsu Alam, Assistant Engineer, ADN Telecom, 17, Red Crescent Concord, Tower, Mohakh, 121/1&2, Tejkon Para, Tejgaon, Dhaka, 1215, Bangladesh, shiblyshamsul@gmail.com, Mirza Moazzem Hossain, Jamal Uddin Ahmed

The cache is a small amount of high speed memory. Cache is placed between the CPU and main memory. In this view, we consider in this paper to optimize the cache memory access time which eventually optimizing the average access time and also if the cache memory size doubled then the cache memory access time should also double but cache memory access time will only increase 10% from the previous value.

2 - The Thermal Contact Resistance Testing Method Study of Thin Film Materials

Xiaogang Li, BUAA, Rm 318, Weimin Building, 37 Xueyuan Rd., Haidian Dist., Beijing, China, lxxg@buaa.edu.cn

As there are many factors affecting the thermal contact resistance, In engineering application, the thermal contact resistance of the solid interfaces is usually obtained by testing. In this paper, the method of measuring the thermal contact resistance of the thin film materials is presented. According to this method, we use copper heat flux meter, graphite columnar specimens and graphite thin film sample to measure the thermal contact resistance between the graphite thin film material

3 - Data-enhanced Prediction of Marketing Strategies: Does Product Repairability Play a Role?

Mostafa Sabbaghi, Graduate Research Assistant, University at Buffalo, SUNY, 437 Bell Hall, Buffalo, NY, 14260-2000, United States of America, mostafas@buffalo.edu, Sara Behdad

The existing manufacturers' policies in making products difficult and expensive to repair and not adequately share the repairing information with end-users and independent repair businesses make repair a challenging process. This paper aims to characterize the product sales rate and post purchase usage behavior to investigate the impact of product reparability on consumers' future purchase decisions and the long-term profitability of manufactures.

4 - Response Surface Modeling Approaches for Multi-response Design Parameter Optimization Problems

Gölsen Güğayaz, Research Assistant, Middle East Technical University, Industrial Engineering Department, Ankara, Turkey, ggulten@metu.edu.tr, Gulser Koksall

Performances of response surface modeling approaches such as Ordinary Least Squares, Weighted Least Squares, Generalized Least Squares, Multivariate Regression, and Seemingly Unrelated Regression are analyzed for multiple-response design parameter optimization problems. Weaknesses are discussed and improvements are suggested.

5 - Maximum Entropy Utility Function Assessment using Renyi Entropy

Jayash Koshal, Bloomberg LP, 425 Washington Blvd, Jersey City, NJ, 07310, United States of America, jayashkoshal@gmail.com, Vijitashwa Pandey

Maximum entropy methods, used to assess probability distributions, can also be used for assessing utility. When utility values are known for discrete values of the attributes, a problem arises of fitting a curve to these points. We use Renyi entropy instead of Shannon's entropy to allow different weighting of different regions of utility functions. We show how Maximum Renyi Entropy formulation can be used for utility functions and compare the results with Maximum Shannon Entropy functions.

■ WE56

56-Room 109A, CC

Manufacturing III

Contributed Session

Chair: Hossein Badri, PhD Student, Wayne State University, Industrial and Systems Engineering Dep, Detroit, MI, 48201, United States of America, hossein.badri@wayne.edu

1 - A Spatiotemporal Outlier Detection Framework for Diagnostic Quality Monitoring of Image Sequences

Mohammad Abed Motasemi, UTSA, 6685 UTSA Blvd., San Antonio, TX, 78249, United States of America, abed.motasemi@gmail.com, Adel Alaeddini

Statistical quality monitoring has mainly remained with less attention in images and high dimensional data application. We propose a novel spatiotemporal outlier detection framework for monitoring the quality of image sequences. Extensive analysis based on a real application in a manufacturing facility is conducted to demonstrate the performance of our proposed methodology in detecting various types of outliers.

2 - The Cause and Effect of Material Handling Systems on Operational Performance

Yunjung Suh, PhD Candidate, Kyungpook National University, 102-1001 Maechunro 2Gil, 19, Bukgu, Daegu, 702-793, Korea, Republic of, yunjusuh@knu.ac.kr, Jaewoo Chung

This study investigates the causal relationships among actual firm's motives, degrees of material handling automation systems(MHS) and operational performance based on surveys in Korea. The study classifies and measures the usage of MHS and identifies actual firms' motives to introduce MHS with a fit to the firm's business strategy. The result presents that there is an associative relationship among firm's strategy, MHS and operational performance with the mediating effect of MHS.

3 - Shifting Bottleneck Heuristic for Stochastic Job Shop Scheduling Problems

Hossein Badri, PhD Student, Wayne State University, Industrial and Systems Engineering Dep, Detroit, MI, 48201, United States of America, hossein.badri@wayne.edu, Milad Zafarnezhad, Kai Yang

Job shop scheduling problems are among the hardest known combinatorial optimization problems. In this research a shifting bottleneck heuristic algorithm is developed for stochastic job shop scheduling problems. To evaluate the performance of the developed algorithm, the heuristic is tested with randomly generated instances. The results indicate that the developed heuristics performs very well for minimizing makespan in stochastic job shop problems.

■ WE57

57-Room 109B, CC

Stochastic Methods Applied to Power System Operations

Sponsor: ENRE – Energy I – Electricity

Sponsored Session

Chair: Zhi Zhou, Argonne National Laboratory, 9700 South Cass Ave. Bldg 221, Lemont, IL, 60437, United States of America, zzhou@anl.gov

1 - Two-stage Robust SCUC with Mixed-integer Recourse

Lei Wu, Clarkson University, 8 Clarkson Ave, Potsdam, United States of America, lwu@clarkson.edu

This talk presents a two-stage robust SCUC approach to adaptively and securely respond to continuous load/wind uncertainty intervals and discrete N-K contingency security criteria. Corrective capabilities of both non-quick-start and quick-start units are formulated. The proposed model is solved by the combination of modified BD method and C&CG algorithm. Case studies illustrate the effectiveness of the proposed robust SCUC approach.

2 - Flexible Operation of Batteries in Power System Scheduling with Renewable Energy

Audun Botterud, Argonne National Laboratory, 9700 S Cass Ave, Lemont, IL, United States of America, abotterud@anl.gov, Nan Li, Emil Constantinescu, Canan Uckun, John Birge, Kory Hedman

We present a two-step framework to evaluate the value of energy storage in power systems with renewable generation. First, we formulate a stochastic unit commitment model with wind power forecast uncertainty and energy storage. Second, we derive a flexible schedule for energy storage in economic dispatch with limited look-ahead horizon. A case study demonstrates the benefits of battery storage in systems with renewable resources and the effectiveness of the proposed operational strategy.

3 - Optimal Coordination of Power Generation Scheduling with an EV Support Service System

Yuping Huang, 12800 Pegasus Dr. RM 320, Orlando, FL, 32817,
United States of America, ypnghuang@gmail.com, Qipeng Zheng

As electric vehicles become more mainstream, the capacitated electric vehicles can be connected to the local electric grids and employed to reduce the variability of renewable energy by scheduling electric vehicles charging/discharging. We develop a price-based unit commitment model in support of the hourly operations of a personal transit system. A two-stage stochastic mixed integer programming model is formulated to optimize the coordinated operations of power generation and electric vehicles.

4 - Stochastic Optimization for Unit Commitment and Electricity Market Operation: A Review

Zhi Zhou, Argonne National Laboratory, 9700 South Cass Ave.
Bldg 221, Lemont, IL, 60437, United States of America,
zzhou@anl.gov

We present a comprehensive review of the application of stochastic programming to the UC problem and associated electricity market operations. The review discusses different characteristics of stochastic UC formulations. Moreover, we compare the performance of stochastic and deterministic UC models reported in the literature. Finally, the review summarizes the current status and prospects for industrial adaptation of stochastic methods in electricity market operations.

WE58

58-Room 110A, CC

Bi- and Multi-Level Optimization in Energy Systems

Sponsor: ENRE – Energy II – Other (e.g., Policy, Natural Gas, Climate Change)

Sponsored Session

Chair: Qipeng Zheng, Assistant Professor, University of Central Florida,
12800 Pegasus Dr., P.O. Box 162993, Orlando, FL, 32817,
United States of America, Qipeng.Zheng@ucf.edu

1 - Boundedly Rational User Equilibrium Models for Electricity Consumer Market Studies in Smart Grid

Guanxiang Yun, PhD Student, University of Central Florida, 8112
Pamlico St, Orlando, FL, 32817, United States of America,
ygx8822@gmail.com, Qipeng Zheng

We proposed a boundedly rational model for the user's consumption of energy schedule with the smart grid. Under this principle, the total cost of the system can vary between a lower and upper bound. In order to decrease the upper bound we introduce perturbations for the unit price of the energy to control the user's behavior. We use multiple methods to calculate. And it is interesting to find that the result of lagrangian method have strong duality even in the non-convex feasible region.

2 - Renewable-based Generation Expansion under A Green Certificate Market

Salvador Pineda, Associate Professor, Department of
Mathematical Sciences, University of Copenhagen,
Universitetsparken 5, Copenhagen, 2100, Denmark,
spinedamorente@gmail.com, Andreas Bock

Green energy certificates represent a policy instrument to incentive renewable-based electricity generation. In this talk we present a family of generation expansion problems (GEP) to determine the optimal capacity of renewable generation including both an electricity and a certificate market. The GEP is first formulated as a complementarity problem assuming perfect competition. If producers compete a la Cournot, the GEP is reformulated as a mathematical problem with equilibrium constraints.

3 - An Integrated Economic Equilibrium Model for Electricity Markets

Lihui Bai, University of Louisville, Speed School of Engineering,
Louisville, 40292, United States of America,
lihui.bai@louisville.edu, Swapna Sri Pothabathu,
Qipeng Zheng, Andrew Liu

We consider an integrated economic equilibrium model for an electricity market system consisting of electricity consumers, power generators, grid owners, coal producers, natural gas producers and pipeline owners. In this equilibrium model, each individual player optimizes its own subsystem while market-clearance conditions are satisfied wherever players interact with each other. This model can assist decision making and planning for energy policies. Numerical results will be reported.

4 - A Bi-level Decision Dependent Stochastic Programming Model for Facility Investment Planning

Yiduo Zhan, PhD Student, University of Central Florida, 12800
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States of America, yzhan@knights.ucf.edu, Qipeng Zheng

A two-stage bilevel decision dependent stochastic model is proposed to tackle the facility investment planning problems. This model addresses both exogenous and endogenous uncertainties. The upper-level focuses on a long-term generation planning problem. The lower-level represents an electricity pricing problem that addresses the market clearing consideration with local transmission network.

WE59

59-Room 110B, CC

Technology Management

Contributed Session

Chair: Bruce Pollack-Johnson, Villanova University, 800 Lancaster
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1 - Equilibrium Structure of Fixed-cost-reducing Alliances in New Technology Development

Hiroki Sano, Student, McCombs School of Business, The
University of Texas at Austin, 2110 Speedway Stop B6500,
Austin, TX, 78712-1277, United States of America,
hiroki.sano@phd.mcombs.utexas.edu, Edward Anderson

Motivated by alliance formation between semiconductor manufacturers in new technology development, we study how competing firms' cooperative decisions in a new market entry opportunity can be stabilized from a game-theoretic perspective. We discuss the equilibrium alliance structure when firms can be asymmetric in their individual cost efficiency and relative market power. We also address social efficiency of alliance formation assuming that an alliance incurs an additional cost of cooperation.

2 - Product Architecture and Trade-ins for Managing Sequential Innovation

Houcai Shen, Nanjing University, No 22 Hankou Road,
Nanjing, China, hcshen@nju.edu.cn, Zican Luo

Science and technology advances drive firms to continually enhance their product's performance and launch sequentially improving offerings. In this paper, we study the product design issue for the durable product when it is sequentially improved and the tradein policy is used, i.e. the integral architecture or the modular architecture?

3 - Putting the Genie to Work: Positioning Firms in the Value Chain to Profit from 3D Printing

Anshuman Tripathy, Indian Institute of Management Bangalore,
Bannerghatta Road, Bangalore, India, atripathy@iimb.ernet.in,
Harsh Ketkar, Onkar Kulkarni

We posit that 3D printing makes radical innovation at the product level more feasible. Additionally, it makes manufacturing more knowledge-intensive and customer-oriented. Firms can profit from this technology by deploying non-imitable complementary assets and developing unique capabilities. Through our detailed study of a 3D Printing firm, we provide definitive frameworks for analysing business models in 3D printing and finding a niche in which a firm may enter so as to profit from 3D printing.

4 - A Structural Equation Model of the Analytics Investment Decision

Bruce Pollack-Johnson, Villanova University, 800 Lancaster
Avenue, Villanova, PA, 19085, United States of America,
bruce.pollack-johnson@villanova.edu, Matthew Liberatore,
Suzanne Clain

The purpose of this research is to model the relationships between the progression for the development of a firm's analytics capabilities, firm size, organizational slack, and industry competitiveness as they affect the decision to invest in analytics. Structural equation modeling is used to investigate the relationships. This study draws on data obtained from firms that participated in a series of intensive workshops held by IBM.

■ WE60

60-Room 111A, CC

Operations/Economics Interface III

Contributed Session

Chair: Cigdem Gizem Korpeoglu, PhD Candidate, Carnegie Mellon University Tepper School of Business, 5700 Bunkerhill Street, Apt 804, Pittsburgh, PA, 15206, United States of America, cpala@andrew.cmu.edu

1 - Targeted Advertising and Privacy Concerns in Online Advertising Markets

Nabita Penmetsa, Assistant Professor, University of Utah, Eccles School of Business, Salt Lake City, UT, 84112, United States of America, nabita@business.utah.edu

We analyze the nature of competition between online advertising platforms in order to understand how privacy concerns of users influence the competitive outcome. The presence of heterogeneity in the user and the advertiser populations leads to differentiation between the platforms in the level of privacy protection that they offer to users and in the targeting capabilities that they offer to advertisers. This differentiation leads to segmentation of both the user and the advertiser markets.

2 - Asymmetric Trade Liberalization, Comparative Advantage and Heterogeneous Firms

Wenxing Nie, Tongji University, 1239 Siping Road, Shanghai, P.R. China, Shanghai, China, nienwenxing@tongji.edu.cn, Yingzhe Gu

Asymmetric trade liberalization occurs when a country suddenly slashes or soars its trade barriers. When this happens, the country which takes initiative in reducing trade barriers would suffer from net job destructions but enjoy better welfare and higher factor rewards. The country which remains the same trade barriers would benefit from net job creations but have lower welfare and factor rewards. The comparative advantage industries have relatively higher factor rewards and job destructions.

3 - Consumer Unions: Blessing or Curse?

Cigdem Gizem Korpeoglu, PhD Candidate, Carnegie Mellon University Tepper School of Business, 5700 Bunkerhill Street Apt 804, Pittsburgh, PA, 15206, United States of America, cpala@andrew.cmu.edu

We study whether coalitions of consumers are beneficial to consumers when producers have market power. We refer to coalitions of consumers as consumer unions and the number of consumers in a union as union size. We establish that consumer welfare decreases with union size when the union size is above a threshold. We also prove that consumer unions discourage producers' investments, which may have repercussions for long-term consumer welfare.

■ WE61

61-Room 111B, CC

Operations/Economics Interface II

Contributed Session

Chair: Yunbin Shen, PhD Student, Tongji University, 1239th Siping Road, Shanghai, China, sybfamily@163.com

1 - Judgment Error in Lottery Play: When the Hot-hand Meets the Gambler's Fallacy

Qingxia Kong, Universidad Adolfo Ibáñez, Santiago, Santiago, Chile, q.kong@uai.cl

We demonstrate that lottery markets can exhibit the "hot-hand" phenomenon, where past winning numbers tend to have greater share of the betting proportion in future draws, even though past and the future events are independent. We use two sets of lottery game data to show that both the gambler's fallacy and hot-hand fallacy can prevail under different gaming environments, contingent on the design (e.g., prize structures) of the lottery games.

2 - Oligopoly Pricing with Reference-price Effects

Paola Labrecciosa, Monash University, Wellington Road, Clayton Campus, Melbourne, Australia, paola.labrecciosa@monash.edu, Luca Colombo

We propose an infinite-horizon continuous-time model of oligopolistic competition with differentiated products and reference-price effects. We derive open-loop and closed-loop pricing strategies. We show that: (i) reference-price effects are pro-competitive; (ii) the equilibrium price can be either increasing or decreasing over time; (iii) when the speed of adjustment of the reference price becomes instantaneous, the stationary equilibrium price converges to the marginal cost.

3 - The Effect of Industry-Specific Exchange Rate Movements on the Manufacturing Productivity in China

Yunbin Shen, PhD Student, Tongji University, 1239th Siping Road, Shanghai, China, sybfamily@163.com, Yingzhe Gu, Yulin Fu

The industry-specific real effective exchange rate (IREER) is more useful than the aggregate exchange rate on analyzing the effect of exchange rate movements on the total factor productivity (TFP). We use the product-level China customs data to calculate the IREER of 30 industries. The results of quantile regression shows that IREER has a significant impact on the TFP and many industries exhibit a downward sloping quantile regression curve, which means the selection effect and scale effect exist.

■ WE62

62-Room 112A, CC

Resilience in Power Systems

Cluster: Energy Systems: Design, Operation, Reliability and Maintenance

Invited Session

Chair: Feng Qiu, Argonne National Laboratory, 9700 S. Cass Ave., Argonne, IL, 60439, United States of America, fqiu@anl.gov

1 - Enhancing Resilience of Power Systems with Renewables Integration

Yunhe Hou, Assistant Professor, The University of Hong Kong, Room 522, CYC Building, Hong Kong, Hong Kong - PRC, yhhou@eee.hku.hk, Zhijun Qin

Resilience is well identified as one of the key functionalities of the future energy delivery systems. The overall functionality requirements for a resilient power grid will be discussed first. The systematic solution to improve the self-healing capability, the key function of resilience, will be discussed in detail. Especially, the method to involve the contribution of renewables during self-healing process will be discussed.

2 - Electric Distribution Resilience – Asset vs. System Resilience to Extreme Weather Events

Julia Phillips, Argonne National Laboratory, 9700 S Cass Ave, Argonne, IL, United States of America, phillipsj@anl.gov

With the increase in awareness and concern surrounding extreme weather events due to climate change, resilience of the Nation's critical lifeline infrastructure is paramount. Capturing resilience of a single asset can be complicated, while resilience for the system increases complexity dramatically. We focus on capturing system resilience of electric distribution infrastructure to extreme weather events, to include intangible resilience activities, such as planning, training and exercising.

3 - Assessing and Improving the Operational Resilience of Interdependent Energy Infrastructure Systems

David Alderson, Associate Professor, Naval Postgraduate School, 1411 Cunningham Rd, Monterey, CA, 93943, United States of America, dlalders@nps.edu, W. Matthew Carlyle, Michael Dickenson

We formulate and solve a model of interdependent fuel and electric power infrastructure systems that includes the fuel required to run electric power generators and the power required to pump fuel. Our model determines a set of fuel and power flows that yield minimum operating cost of both systems. We contrast solutions for individual system operation with a global solution for the combined system, and consider both worst-case disruptions and best possible mitigations to the combined system.

4 - Accident Risk Assessment in Fossil Energy Chains using a Bayesian Model Averaging Approach

Matteo Spada, Senior Researcher, Paul Scherrer Institut, OHSA/D19, Villigen PSI, AG, 5232, Switzerland, matteo.spada@psi.ch, Peter Burgherr

This study analyzed the risk, and its uncertainty, for fatal accidents within full fossil energy chains, collected in the Energy-related Severe Accident Database (ENSAD), through the application of a Bayesian Model Averaging. The proposed approach provides a unified framework that comprehensively covers accident risks in energy chains, and allows calculating specific risk indicators, including their uncertainties, to be used in a holistic evaluation of energy technologies.

■ WE63

63-Room 112B, CC

Operations/Finance Interface

Contributed Session

Chair: Bo Li, Doctoral Candidate, Texas A&M University, 4217 TAMU, College Station, TX, 77843, United States of America, bli@mays.tamu.edu

1 - A Change-of-Variables Approach to Simulating Conditional Expectations

Guiyun Feng, University of Minnesota, 1006 27th Avenue SE,, Minneapolis, MN, 55414, United States of America, fengx421@umn.edu, Guangwu Liu

We introduce a change-of-variables approach to simulating conditional expectations. A key of the proposed approach is the construction of a one-to-one mapping such that a conditional expectation can be represented as an ordinary expectation by using change-of-variables technique. This new representation leads to an efficient estimator of the conditional expectation. Application to Greek estimation for financial options will be discussed.

2 - Optimal Procurement, Pricing, and Hedging under Cost and Demand Uncertainty

Max Friedrich Schoene, WHU - Otto Beisheim School of Management, Burgplatz 2, Vallendar, 56179, Germany, max.schoene@whu.edu, Stefan Spinler, John Birge

Commodity price volatility is an important factor to consider in corporate risk management. In this article, we study the joint pricing, inventory control, and hedging problem of a risk-averse industrial firm, facing uncertain commodity prices and stochastic demand. We solve the firm's decision problem under realistic commodity price dynamics using regression-based Monte Carlo methods. Our findings show that optimal pricing, procurement, and hedging decisions are interconnected.

3 - Lead-Time Reduction, Capital Structure, and Optimal Investment Policies

Isik Bicer, Post Doctoral Researcher, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Vaud, 1015, Switzerland, isik.bicer@epfl.ch, Ralf W. Seifert

We consider a manufacturing firm that places a production order in the face of demand uncertainty. It also has an option to raise capital and invest in reducing lead times. We analyze the optimal investment policy and derive closed-form expressions that quantify the impact of lead time on the firm value, the optimal leverage ratio, and the cost of capital. We show that firms can significantly increase their profits by using external funds and capitalizing on the value of lead-time reduction.

4 - Inventory, Random Capacity, and Firm Valuation by the Financial Market

Bo Li, Doctoral Candidate, Texas A&M University, 4217 TAMU, College Station, TX, 77843, United States of America, bli@mays.tamu.edu, Antonio Arreola-Risa

Companies want to maximize their value on the financial market; however, their inventory decisions may dis-serve this goal. We consider a firm that purchases from a supplier with random available capacity, faces a newsvendor-type decision and aims to maximize its own value. Employing the Capital Asset Pricing Model, we explore how randomness in both customer demand and supplier capacity impacts the optimal inventory decision and firm value.

■ WE64

64-Room 113A, CC

Advances in Decision Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Manel Baucells, Darden School of Business, P.O. Box 6550, Charlottesville, VA, 22906-6500, United States of America, BaucellsM@darden.virginia.edu

1 - Measuring Discounting Without Measuring Utility

Han Bleichrodt, Erasmus University, P.O. Box 1738, Rotterdam, 3000DR, Netherlands, bleichrodt@ese.eur.nl, Peter P. Wakker, Arthur E. Attema, Zhenxing Huang, Yu Gao

We introduce a new method for measuring the temporal discounting of money. Unlike preceding methods, our method requires neither knowledge nor measurement of utility. It is easier to implement and clearer to subjects, and requires fewer measurements than preceding methods did.

2 - Do We Discount Time As We Discount Money?

Cédric Gutierrez, HEC Paris, 1 Rue de la Libération, Jouy en Josas, 78351, France, cedric.gutierrez-moreno@hec.edu, Mohammed Abdellaoui, Emmanuel Kemel

While intertemporal choice of money has been studied extensively, very few studies have analyzed the way people discount time, despite the fact that it is a scarce and valuable resource. We investigate this issue in a laboratory experiment where consequences are measured in units of money or time. We report significant differences between discounting of time and of money. For instance, there is a higher heterogeneity in discounting behaviors and a stronger present-bias for time than for money.

3 - Multiperson Utility Without The Appearance of Dictatorship

Manel Baucells, Darden School of Business, P.O. Box 6550, Charlottesville, VA, 22906-6500, United States of America, BaucellsM@darden.virginia.edu, Lloyd Shapley, Dov Samet

We take the multiperson utility setup (coalitions are endowed with incomplete VNM preferences satisfying the extended Pareto rule) and assume a mild condition on individual preferences (avoiding the appearance of dictatorship). We prove that whenever certain smaller but overlapping coalitions have complete preferences, then the group necessarily has complete preferences. The smaller coalitions are not restricted to be pairs, thus generalizing previous results.

■ WE65

65-Room 113B, CC

Rail Transportation

Contributed Session

Chair: Bahar Zarin, PhD Candidate, University of Maryland, College Park, MD, United States of America, bzarin@umd.edu

1 - Integration of Passenger and Freight Rail Scheduling with Minimal Tardiness

Liang Liu, University of Southern California, Los Angeles, CA, United States of America, liangliu@usc.edu, Maged Dessouky

We present a methodology to integrate passenger and freight train scheduling to reduce train tardiness when they travel on the same trackage. The research highlights the control policy of resource allocation in a complex railway network. We develop a dual objective optimization model which minimizes the freight train flow time and passenger train tardiness. Simulation of the railway system is conducted given the control policy from the optimization model solution.

2 - A Multi-Period Multi-Class High Speed Rail Passenger Revenue Management Problem

Ying Qin, Doctoral Student, Tongji University, No. 1239, Siping Road, Shanghai, 200092, China, qinying915@139.com, Zhe Liang

We study a multi-period multi-class rail passenger revenue management problem in which the unsatisfied demand can be recaptured by the alternative product. To formulate the problem, we first propose a basic model (BM), but it suffers from the intractable computation complexity. Therefore, we propose a two-stage heuristic by solving a restricted BM based on the solutions of a leg-based decomposition model and the heuristic provides nearer optimal solutions than the BM in much shorter time.

3 - Capacity Allocation in Vertically Integrated Railway Systems: A Sequential Bargaining Game Approach

Bo Zou, University of Illinois at Chicago, 2095 Engineering Research Facility, 842 W. Taylor Street (M/C 246), Chicago, IL, 60607-7023, United States of America, bzou@uic.edu, Ahmadrza Talebian

We propose a game-theoretic approach to model the bargaining process for rail line capacity allocation. A public passenger rail agency negotiates on schedule and price with a host freight railroad to obtain train paths. Each side alternately offers schedule/price and decides whether to accept or reject the other side's offer. Both perfect and incomplete information cases are investigated analytically with numerical analysis offering further insights.

4 - Investigating the Trade-off Between Level of Service and Capacity Parameters in Train Scheduling

Hamed Pouryousof, Michigan Technical University, 819 Dow, CEE Dept., 1400 Townsend DR, Houghton, MI, 49931, United States of America, hpouryou@mtu.edu, Pasi Lautala

Maximizing the capacity utilization while maintaining adequate level of service (LOS) are important for any railroad. This research investigates the use of an analytic model called "hybrid optimization of train schedules" (HOTS) for train rescheduling and for evaluating its impact on train stop patterns and maximum and total dwell times. One research finding revealed that changes in max dwell time (especially within the spectrum of 6-15 min) have high impact on other LOS and capacity parameters.

5 - Movement Planner Algorithm for Dispatching Trains

Bahar Zarin, PhD Candidate, University of Maryland, College Park, MD, United States of America, bzarin@umd.edu, Seshadri Srinivasa Raghavan, Golnush Amoli, Arezoo Samimi, Ali Asadabadi

Train Dispatching Problem (TDP) is an important and crucial optimization problem in the railway industry. The objective of our study is to develop a new optimization formulation to solve the problem more efficiently with less computational time. A Genetic Algorithm (GA) based heuristic is also developed to solve the formulated problem and the performance of the algorithm is evaluated using a TOY problem data set.

WE66

66-Room 113C, CC

Aviation Revenue Management

Sponsor: Aviation Applications

Sponsored Session

Chair: Dirk Sierag, CWI, Science Park 123 1098 XG, Amsterdam, Netherlands, dirk@cwi.nl

1 - Dynamic Channel Control in Revenue Management

Weidi Wang, Tongji University, No.1239 Siping Road Yangpu District, Shanghai, 200092, China, wangweidi.dunelm@gmail.com

In the study of revenue management, channel effect is always ignored in inventory control. However in the reality, selling the same flight ticket in different channels will make different profits for airline company. In our study, we develop a DP model which integrated inventory control and channel control in single leg.

2 - Robust Solution Method for Single-leg Choice-based Revenue Management

Dirk Sierag, CWI, Science Park 123 1098 XG, Amsterdam, Netherlands, dirk@cwi.nl

This talk provides a robust solution method for revenue management models with general choice-models. The robust solution method optimises the worst-case scenario, providing a trade-off between risk and average reward. The uncertain parameters of a choice model (e.g., from estimation errors) are modelled using f-divergence uncertainty sets. Numerical results for a single-leg problem show that the robust solution method outperforms the nominal solution by up to 2% when using estimated parameters.

WE67

67-Room 201A, CC

Topics in Transport II

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Mohammad Ghane-Ezabadi, Oregon State University, Corvallis, WA, United States of America, United States of America, ghanezm@onid.oregonstate.edu

1 - A 3D Container Loading Problem for Very Large Tires

John Ye, JDA, John.Ye@jda.com, Phillippe Grangier, Louis-Martin Rousseau, Michel Gendreau, Fabian Le Huede

Tire manufacturers are currently spending a lot of time and effort on manually planning the load of delivery trucks. The problem we are dealing with is a 3D container loading problem for agricultural tires. Such tires are much bigger and heavier than tires for passenger cars. As such, there exist many rules to ensure that the loading will remain stable. We have developed a approach that relies on a custom algorithm to locate those tires.

2 - The Load Planning Problem for Double Stacked Intermodal Trains

Nitish Umang, GE Global Research, Schenectady, NY, United States of America, nitishumang86@gmail.com, Emma Frejinger, Teodor Gabriel Crainic

In this research, we study the load planning problem considering several new constraints including dimensional restrictions, technical constraints, weight capacities and center of gravity restrictions for double stacked platforms. We propose an ILP formulation with the objective to minimize the number of cars required to load a given set of containers. The results based on a set of artificial instances inspired from real data suggest that the proposed methodology can lead to significant savings in the operating cost of loading trains.

3 - Integrated Intermodal Transportation Network Design using a Decomposition Approach

Mohammad Ghane-Ezabadi, Oregon State University, Corvallis, WA, United States of America, United States of America, ghanezm@onid.oregonstate.edu, Hector A. Vergara

The expected growth of intermodal transportation demand increases the importance of strategically designing intermodal logistics networks. In this research, load route and transportation mode selection problems are integrated with the hub location problem in a mathematical formulation. A composite variable formulation was developed in which the complete route for a load from origin to destination was considered as a single composite variable. A decomposition approach was applied to find solution for the proposed mathematical formulation. Computational experiments were completed to evaluate the performance of the proposed mathematical model and solution approach.

4 - Distribution, Routing and Fleet Design Strategy for an E-commerce Provider in Santiago Chile

Cristian Cortés, Universidad de Chile, Associate Professor, Department of Civil, Chile, ccortes@ing.uchile.cl, Jaime Miranda, Pablo Rey, Pablo Saintard

A simulation approach is proposed to analyze and quantify the cost of different configurations and operational schemes of a e-commerce provider in the city of Santiago, Chile. Strategies involve delivery of products within promised time windows and a potential implementation of a new depot location. A routing strategy is also proposed to simulate new strategies of unobserved distribution policies.

WE68

68-Room 201B, CC

Routing Problems with Uncertainty II

Sponsor: Transportation, Science and Logistics

Sponsored Session

Chair: Stacy Voccia, FedEx Express, 3610 Hacks Cross Rd, Bldg. H, 2nd Floor, Memphis, United States of America, stacy.voccia@fedex.com

1 - A Dynamic Load-dependent Vehicle Routing Schedule for Minimizing Risk in Medical Waste Collection

Masoumeh Taslimi, University at Buffalo (SUNY), 342 Bell Hall, Buffalo, NY, United States of America, masoumeh@buffalo.edu, Rajan Batta, Changhyun Kwon

Medical waste service companies aim to create safe, responsible, and customized programs to collect medical waste from medical centers. Thus, the companies and customers agree on a schedule for collection services. In order to find a mutually less risky and more beneficial schedule, we propose a dynamic load-dependent capacitated vehicle routing problem that captures minimization of both occupational and transportation risks. A column generation heuristic approach is developed to handle the computational difficulties in solving real world problems.

2 - A Probabilistic Model for Vehicle Scheduling based on Stochastic Trip Times

Yindong Shen, Professor, School of Automation, Huazhong University of Science and Technology, 1037 Luoyu Road, Wuhan, 430074, China, yindong@hust.edu.cn

We study the vehicle scheduling problem in public transport based on stochastic trip times instead of fixed ones. A novel probabilistic model and its enhanced model featuring delay propagation are proposed, while a solution method is developed. Experiments show the models can considerably enhance the on-time performance of resulting schedules.

3 - Same-Day Delivery for Online Purchases

Stacy Voccia, FedEx Express, 3610 Hacks Cross Rd, Bldg. H, 2nd Floor, Memphis, United States of America, stacy.voccia@fedex.com, Barrett Thomas, Ann Campbell

Same-day delivery for online purchases is a recent trend in online retail. We introduce a dynamic pick-up and delivery problem with time windows that incorporates key features associated with same-day delivery logistics. In order to make better-informed decisions, our solution approach incorporates information about future orders into routing decisions. We present results that demonstrate the value of the approach.

4 - Decomposition Method for Revenue Management Problem of Multi-period Multi-class High Speed Rail

Hasan Manzour, Industrial & Systems Engineering, University of Washington, Box 352650, Seattle, WA, 98195-2650, United States of America, hmanzour@uw.edu, Zhe Liang, Ying Qin, W. Art Chaovalitwongse

We study a multi-period multi-class rail passenger revenue management (MPMC-RPRM) problem in which the unsatisfied demand from a previous period can be recaptured by the later periods. The original MIP model is hard to solve. Therefore, we present a Benders decomposition solution approach incorporating some heuristics. In addition, Benders cuts are strengthened to facilitate faster convergence and improved computational efficiency. We perform the analysis on a real case study.

■ WE69

69-Room 201C, CC

Intelligent Traffic Signal Control

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: K. Larry Head, University of Arizona, Tucson, AZ, United States of America, larry@sie.arizona.edu

1 - Smart Signal Systems for Urban Road Networks

Stephen F. Smith, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, sfs@cs.cmu.edu, Gregory J. Barlow, Zachary B. Rubinstein, Isaac Isukapati, Xiao-Feng Xie

Traffic optimization in urban environments presents special challenges, due to issues of scale, uncertainty, and competing, time-varying dominant flows. We formulate and analyze a decentralized approach to signal control in this setting, where each intersection optimizes locally sensed traffic in real-time and exchanges plans with neighbors to achieve coordinated behavior.

2 - Intelligent Traffic Control in a Connected Vehicle Environment

Yiheng Feng, University of Arizona, Tucson, AZ, yihengfeng@email.arizona.edu, Mehdi Zamanipour, Shayan Khoshmashgham, K. Larry Head

An intelligent traffic control framework in a connected vehicle environment is proposed. A phase allocation algorithm optimizes the signal timing based on different objectives considering both mobility (delay) and safety (dilemma zone protection). Additional constraints from signal priority are integrated into the same framework.

3 - Unified Section Level Priority and Intelligent Traffic Signal Control

Byunho Beak, University of Arizona, Tucson, AZ, United States of America, beak@email.arizona.edu, Mehdi Zamanipour, K. Larry Head, Yiheng Feng, Shayan Khoshmashgham

An integrated priority control and adaptive signal control model is developed that can intelligently consider connected vehicles and priority eligible vehicles at both intersection level and section level. The model coordinates optimal priority strategies between two or more consecutive intersections and also guarantees connected vehicles progression within the intersections.

4 - Solving Simultaneous Route Guidance and Traffic Signal Optimization Problem using Space-time-phase Hypernetwork

Pengfei Li, Xuesong Zhou, Pitu Mirchandani

This talk addresses the simultaneous route guidance and traffic signal optimization problem. A space-time-phase hypernetwork is used to explicitly represent the traffic signal control mechanism and time-dependent paths. We develop a Lagrangian-relaxation-based problem decomposition framework, and the subproblems are solved using finite-horizon dynamic programming algorithms.

■ WE70

70-Room 202A, CC

Vehicle Routing IV

Contributed Session

Chair: Ozgun C. Demirag, Penn State Erie, Black School of Business, Erie, PA, United States of America, ozcl@psu.edu

1 - A Fast Algorithm for Solving the Static Rebalancing Problem in Bike Sharing Systems

Aritra Pal, Doctoral Student, University of South Florida, Tampa, Tampa, FL, 33612, United States of America, aritra1@mail.usf.edu, Yu Zhang

We present a hybrid nested large neighborhood search with variable neighborhood descent algorithm for solving the Static Rebalancing Problem in

Bike Sharing Systems. Computational experiments on a set of benchmark instances previously used in the literature, demonstrate that the presented algorithm is both more effective and more efficient than a tabu search algorithm and highly competitive with exact algorithms previously reported in the literature.

2 - Trip Generation Models for Medellin Metropolitan Area

Ivan Sarmiento, Associate Professor, Universidad Nacional de Colombia at Medellin, Calle 65 No.78 - 28, M1-201, Medellin, Colombia, irsarmie@unal.edu.co, Ivan Sanchez-Diaz, Jose Holguin-Veras, Carlos A. Gonzalez-Calderon

A freight survey with a sample of 2,984 commercial establishments in Medellin, Colombia was conducted in 2012 to characterize the cargo movements and patterns in the city. Based on the survey, a series of trip generation models are estimated. A complete analysis of the variables and their influence on trip generation are considered along with the characteristics of the freight movements in the area

3 - Continuum Approximation Modeling of Freight Distribution Systems

Mahour Rahimi, Assistant Professor, University of Massachusetts, Amherst, Department of Civil & Environmental Eng., 130 Natural Resources Road, Amherst, MA, 01003, United States of America, gonzales@umass.edu, Eric Gonzales

This study presents a continuous approximation model for truck deliveries which relate the operating parameters to the characteristics of the service and network, service area, and demand rate. The objective of this study is to minimize the total cost of distributing multicommodity freight from an origin to randomly distributed points, with or without transshipments, and within a limited amount of time. Two different distribution methods are considered: peddling, and peddling with transshipment.

4 - Tabu Search Heuristic for the Heterogeneous Vehicle Routing Problem on a Multigraph

Ozgun C. Demirag, Penn State Erie, Black School of Business, Erie, PA, United States of America, ozcl@psu.edu, Janny Leung, David S.w. Lai

We study a time-constrained heterogeneous vehicle routing problem on a multigraph. We formulate the problem as a mixed-integer linear programming model and develop a tabu search heuristic that efficiently addresses computational challenges due to parallel arcs. Numerical experiments show that the heuristic is highly effective.

■ WE71

71-Room 202B, CC

Transportation- Public

Contributed Session

Chair: Subasish Das, Research Associate, University of Louisiana at Lafayette, P.O. Box- 44886, Lafayette, LA, 70504, United States of America, subasishsn@gmail.com

1 - Bus Bunching Modeling for Mixed Traffic in Delhi

Hemant Suman, Research Scholar, IIT Delhi, Hauz Khas, New Delhi, 110016, India, hemantmn@gmail.com, Nomesh Bolia

In Delhi the buses often arrive at bus-stops in clusters that causes long waiting time as well as more variations in headways. Due to clustering of buses, the average waiting time for public bus users in Delhi is often more than 30 minutes. Due to this high and uncertain waiting time, bus commuters are face issues with punctuality. This work addresses the problem of lack of punctuality associated with the existing bus system by reduced bus bunching in the mixed traffic conditions of Delhi. The approach, if used, can provide significant benefits in the mean as well as variability of travel time.

2 - Dynamic Transit Service Network Design under Capacitated User Equilibrium Conditions

Jiangtao Liu, Arizona State University, Ira A. Fulton Schools of Engineering, Tempe, AZ, United States of America, jliu215@asu.edu, Xuesong Zhou

This talk will discuss how to address emerging modeling issues in transit service network design such as time-dependent capacitated user equilibrium, system-wide impact of dynamic service line scheduling under equilibrium conditions. We will develop a single level model with a Lagrangian relaxation based approximation method to rapidly find close-to-optimal solution subject to budgetary, UE and capacity constraints.

3 - Use of Analytics to Investigate Crash Related Risk Factors

Dursun Delen, Oklahoma State University,
408 Business Building, Stillwater, OK, United States of America,
Dursun.Delen@okstate.edu

Investigation of the risk factors that contribute to the injury severity in motor vehicle accidents has proved to be an interesting and challenging problem. In this study, employing a data-driven predictive analytics methodology along with information fusion-based sensitivity analyses, we identified the relative importance of the crash related risk factors as they relate to varying levels of injury severity.

4 - Real-time Schedule Recovery in Liner Shipping with Regular Uncertainties and Disruption Event

Chen Li, Dr. Hong Kong University of Science and Technology,
Dept of IELM, Clear Water Bay, Hong Kong, Hong Kong - PRC,
cliad@connect.ust.hk, Dongping Song, Xiangtong Qi

We study real-time schedule recovery policies for liner shipping under regular uncertainties and the emerging disruption. One important contribution is to distinguish two types of uncertainties, and propose different strategies to handle them. For regular uncertainties, we address the problem as a stochastic control problem, and develop the structural results; then we show how an emerging disruption changes the control policies. Numerical studies demonstrate the advantages of control policies.

5 - Cyber Physical Allocation to Make Efficient Bike Sharing Programs

Subasish Das, Research Associate, University of Louisiana at
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United States of America, subasishsn@gmail.com

Real-time allocation helps making the bike sharing programs efficient and productive. Cyber physical network of any bike sharing program will provide real-time status of the bike kiosks and user location. The bike sharing program can turn these information into real-time data product app. Users can use the app for the real-time info and make plan accordingly. This paper develops simulation tool to verify the research findings.

WE72

72-Room 203A, CC

Physical and Computer Experiments

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Matthew Plumlee, University of Michigan, 1
205 Beal Avenue, Ann Arbor, MI, 48109, United States of America,
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1 - Partial Aliasing Relations in Mixed Two- and Three-Level Designs

Arman Sabbaghi, Assistant Professor Of Statistics, Purdue
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Indicator functions are constructed under the orthogonal polynomial parameterization of contrasts, and applied to the study of partial aliasing, for mixed two- and three-level designs. The algebra behind calculation of indicator function coefficients is proven to be a product of individual algebraic operations for the different types of factors. Conditions for estimable interactions in mixed-level designs are established by means of this equivalence.

2 - Local Calibration of Computer Models

Arash Pourhabib, Assistant Professor, Oklahoma State University,
322 Engineering North, Stillwater, OK, 74078, United States of
America, arash.pourhabib@okstate.edu, Rui Tuo, Jianhua Huang,
Yu Ding

We propose a framework for the local calibration of parameters when a computer model is used to approximate a physical process. The proposed framework, non-parametric local calibration, acknowledges the functional dependency of parameters on control variables. We present the model in terms of a regularized optimization problem and solve it using a representer's theorem. We also prove the consistency of the estimator obtained via this approach.

3 - Maximum Projection Designs for Computer Experiments

Evren Gul, PhD Student, Georgia Institute of Technology,
251 10th Street NW, THB 504, Atlanta, GA, 30318,
United States of America, egul3@gatech.edu

Space-filling properties are important in computer experiments. Maximin and minimax distance designs consider only space-filling in the full-dimensional space; this can result in poor projections onto lower-dimensional spaces, which is undesirable when only a few factors are active. Latin hypercubes can improve one-dimensional projections but cannot guarantee good space-filling in larger subspaces. We propose maximum projection designs that maximize space-filling properties in all subspaces.

4 - Smoothing The Bumps: Sigmoidal Versus Localized Basis Functions in Gaussian Process Modeling

Daniel Apley, Professor, Northwestern University,
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United States of America, apley@northwestern.edu

In Gaussian process (GP) modeling of computer simulation data, common covariance models have localized basis functions, which can result in a bumpy fitted response surface. We propose a new class of covariance models that can be viewed as incorporating an integrator into any stationary GP (akin to the integrator in an ARIMA model), thereby resulting in sigmoidally-shaped basis functions. We contrast local versus sigmoidal basis functions and argue the advantages of the latter in GP modeling.

WE73

73-Room 203B, CC

Reliability Test Design

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Edward Pohl, University of Arkansas, Department of Industrial Engineering, Fayetteville, United States of America, epohl@uark.edu

1 - Algorithms for Optimal Allocation of Resources in Reliability Growth Testing

Kelly Sullivan, Assistant Professor, University of Arkansas,
Fayetteville, AR, 72701, ksullivan@uark.edu,
Mohammadhossein Heydari

Reliability growth testing seeks to identify and remove failure modes in order to improve the reliability of a product entering the market. We develop and test a suite of exact and heuristic algorithms for allocating limited testing resources within a series-parallel system in order to maximize the resulting system's reliability.

2 - Application of Markov Decision Processes for Optimization of Reliability Growth

Tom Talafuse, Graduate Student, University of Arkansas,
Fayetteville, AR, 72701, United States of America,
tom.talafuse@gmail.com, Shengfan Zhang, Edward Pohl

Reliability growth occurs when failure modes are identified and corrective actions taken to improve system reliability. Planning methods allow construction of idealized growth curves to estimate the time and resources needed to reach a desired level of reliability. Since developmental testing results often deviate from this idealized curve, we propose a Markov Decision Processes approach to optimally allocate resources to improvement efforts to minimize deviation from idealized growth.

WE74

74-Room 204A, CC

Reliability IV

Contributed Session

Chair: Minjae Park, Hongik University, 72-1 Sangsu-Dong,
Mapo-Gu, Business School, Seoul, 121-791, Korea, Republic of,
mjpark@hongik.ac.kr

1 - Optimal Condition-based Imperfect Maintenance Policy for Systems Subject to Multiple Competing Risks

Sara Ghorbani, American Express, 33 Hudson Street, Jersey City,
NJ, 07302, United States of America, saraghorbani21@gmail.com,
Elsayed A. Elsayed, Hoang Pham

We develop a generalized threshold-type condition-based maintenance (CBM) policy for a system subject to multiple competing risks including degradation process and sudden failure. This model extends the existing research by considering imperfect maintenance. Furthermore, a special case of a system subject to two independent competing risks, degradation and sudden failure is studied and the numerical optimization analyses are presented.

2 - Simulation-based Reliability Evaluation of Multi-stage Multi-state Manufacturing Systems

Seyed Niknam, Western New England University,
1215 Wilbraham, Springfield, MA, 01119, United States of
America, seyed.niknam@wne.edu, Rogerio Peruchi

This research investigates the reliability analysis of a multi-stage multi-state manufacturing system. The proposed model provides a sensible measure to assess the system situation against the best-case scenario of a production line. The proposed model incorporates not only failures that stop production but also deals with partial failures where the system continues to operate at reduced performance rates. A simulation model is developed to define the possible states in the system.

3 - Optimal Maintenance Policy with Repair Time under Warranty

Minjae Park, Hongik University, 72-1 Sangsu-Dong,
Mapo-Gu, Business School, Seoul, 121-791, Korea, Republic of,
mjpark@hongik.ac.kr

This study formulates a warranty cost model for the repairable products when an age replacement policy is adopted in cooperation with the renewing minimal repair-replacement warranty and studies the optimal choice of the preventive replacement age. Under the renewing minimal repair-replacement warranty, either minimal repair or replacement is performed depending on the length of repair time when the product failures occur during the warranty period.

WE76

76-Room 204C, CC

Simulation and Optimization Applications

Contributed Session

Chair: Hossein Hashemi, Graduate Research Assistant, Southern Methodist University, 3101 Dyer Street, Dallas, TX, 75205, United States of America, shashemi@smu.edu

1 - Mathematical Analysis for Tomato Spotted Wilt Virus Transmission

Yan Kuang, Kansas State University, Manhattan, KS, 66502, United States of America, ykuang@ksu.edu, Songinan Zhao, David Ben-ariel, Chih-hang Wu

Tomato spotted wilt virus (TSWV) is a plant infecting virus and impacts many food and ornamental crops in both quantity and quality aspects, resulting in crop disease epidemics of worldwide economic significance. TSWV is transmitted particularly by thrips, the most efficient of which is West Flower Thrip (WFT). This research is aimed to use mathematical models to study the disease transmission effects. Through the preliminary results, we discuss the impacts of potential mitigation strategies.

2 - A Farmers Markets Location Allocation Framework for Enhanced Public Health

Hoyoung Na, University of Arizona, 8131 N Midnight Way, Tucson, AZ, 85741, United States of America, nh4201@email.arizona.edu, Sojung Kim, Young-jun Son, Langelier Brent

The goal of this study is to propose a new location allocation framework of farmers markets (FMs) to enhance public health, by introducing FMs into food deserts which have a limited access to healthy food resources. The proposed framework adopts the theory of planned behavior (TPB) under an agent-based simulation (ABS) platform for food choice behavior modeling of individuals. The framework is demonstrated via AnyLogic/ABS software with the 2007 Food Attitudes and Behaviors Survey dataset.

3 - A Network Size-Reduction Methodology for Stochastic Prediction of Wildfire Propagation

Mohammad Hajian, PhD, Northeastern University, Dept. of Mechanical and Industrial Eng., 360 Huntington Avenue, Boston, MA, 02115, United States of America, mhajian@coe.neu.edu, Peter Kubat, Emanuel Melachrinoudis

Each year, thousands of wildfire events throughout the US threaten life and property. In a fire event, it is important to make the most effective decision under time pressure. This requires a fast and accurate prediction of the fire propagation, taking into account uncertain factors such as wind. In this research, we model the wildfire propagation as stochastic shortest path and present a network reduction methodology to effectively predict the wildfire traversal time.

4 - An Enhanced Global Optimization Method for a PV-Diesel-Battery Hybrid Power System

Siew Fang Woon, Universiti Utara Malaysia, 06010 Sintok, Kedah, Malaysia, woonsiewfang@yahoo.com, Sie Long Kek, Muhammad Nazri Abu Bakar

Non-linear constrained discrete-valued optimal control problems are known to have multiple local optima that require global optimization methods to find the best solution. We developed a global optimization method by embedding an improved discrete filled function technique into a computational optimal control algorithm. This proposed method improves the computational efficiency in determining a near global optimal solution for the operating cost of a PV-diesel-battery hybrid power system.

5 - Multi-agent Learning Approach for Online Calibration of Real-time Traffic Network Management System

Hossein Hashemi, Graduate Research Assistant, Southern Methodist University, 3101 Dyer Street, Dallas, TX, 75205, United States of America, shashemi@smu.edu, Khaled Abdelghany

The paper introduces a novel formulation and a solution methodology for the problem of online calibration of simulation-based Dynamic Traffic Assignment (DTA) models. The methodology calibrates the model considering multiple inconsistency sources including the time-dependent demand pattern and the traffic flow propagation models. It adopts a reinforcement learning approach to determine an efficient activation schedule for the different model adjustment modules.

WE77

77-Room 300, CC

Decision Analysis for Supply Chains

Contributed Session

Chair: Robert Inman, General Motors, MC 480-106-RE1, 3 0500 Mound Road, Warren, MI, 48090, United States of America, robert.inman@gm.com

1 - The Nexus between GDP, Population Growth/fuel Prices in the United States

Fesseha Gebremikael, PhD Student, UGPTI, P.Box 6050, Fargo, ND, 58102, United States of America, fesseha.gebremikael@ndsu.edu, Joseph Zmerekovsky, Karen Froelich, En Sue Lee

The linkage between GDP and VMT, population growth, and fuel prices, has been strong for quite some time, irrespective of the ups and downs of the national economics of the developed societies, particularly the United States. Linear regression model will be used to test empirically the nexus between VMT and the related variables. Data will be collected from the World Bank, BEA, EIA and other relevant sources /compiled to gauge the change over time.

2 - An Integrated Model of Location and Safety Stock Placement

Liwen Cui, PhD Candidate, Tsinghua University, Room 615, Shunde Building, Beijing, 100084, China, cui-liwen0512@126.com, Zuo-jun Max Shen

We study the integrated location and safety stock placement problem, and design an efficient dynamic programming algorithm to solve the problem. From analytical analysis and numerical studies on real supply chain data, we obtain some interesting managerial insights.

3 - Performance Outcomes and Success Factors of Healthcare Industrial Vending Solutions

John Kros, Professor Of Marketing And Supply Chain Management, East Carolina University, 3205 Harold Bate Building, Greenville, NC, 28590, United States of America, krosj@ecu.edu

Healthcare firms face considerable pressure to efficiently and effectively manage their inventory. Industrial vending machine solutions, a specific form of VMI, are one solution. IVM includes automated drug distribution systems and medical supply dispensing systems (e.g., Pyxis). Two-hundred nine healthcare supply chain managers were used to test the theoretical model. Results show complex interactions of the enablers with one another and in their relationship with perceived success.

4 - Ordering Problems with Demand Forecast Updating and Supply Constraints

Meimei Zheng, Nanyang Technological University, 50 Nanyang Avenue, Singapore, 639798, Singapore, meimeizheng2009@gmail.com, Kan Wu

This paper investigates an extension of the newsvendor model with demand forecast updating under supply constraints. The retailer prefers to postpone the order for improved demand accuracy. However, the postponement is associated with a price to the supplier and thus is limited. In this situation, we investigate the optimal ordering decisions based on demand forecast updating, increased purchasing cost, and restrictions on the ordering time and quantity.

5 - Product Complexity and Supply Chain Design

Robert Inman, General Motors, MC 480-106-RE1, 3 0500 Mound Road, Warren, MI, 48090, United States of America, robert.inman@gm.com, Dennis Blumenfeld

Assembling a product requires each and every part. Compared to assemblers of simple products, manufacturers of complex products are much more sensitive to supply chain delays. This heightened vulnerability to supply chain disruptions should lead complex product assemblers to design less risky supply chains. This paper models how product complexity drives the likelihood of production disruption and provides insights for supply chain design.

■ WE78

78-Room 301, CC

New Product Development

Contributed Session

Chair: Semco Jahanbin, University of Bath, School of Management, Claverton Down, Bath, BA27AY, United Kingdom, Semco.jahanbin@gmail.com

1 - Continuous Development of Multiple Game Series in a Video Game Company

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We often see that video game companies produce a number of game series and focus mainly on developing sequels in the existing series rather than introducing new series. We propose a restless bandit dynamic programming model to manage the development of sequels in a video game company with limited resources.

2 - Improving the Front End Innovation – Systems Engineering Approach

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The aim of this research is to achieve a sustainable innovation performance through establishing a framework for the early stage activities within the innovation process (i.e. “Front End Innovation” or “Fuzzy Front End”). The framework should support the choice of knowledge sourcing strategy (e.g. exploration, exploitation, or hybrid) by adopting a dynamic multi-dimensional perspective.

3 - Collaboration Strategies to Design New Products

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Managing collaboration with multiple stakeholders is a significant challenge for companies today. In this empirical study, the question is: How can an organization manage collaboration with multiple stakeholders in the new product design process? We first reviewed the literature to come up with a series of research propositions. We then conducted 15 semi-structured interviews with managers whose companies engage in 2nd and 3rd -stage wood processing in Quebec.

4 - How Change in Consumer Preferences Can Influence New Product Sales Forecasting Methods

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Customer preferences are not stable, especially where a consumer needs to make a complex or unfamiliar decision. This is, to some extent connected with the theory of bounded rationality, which asserts that decision-makers have a limited capability to process information. In this research, the instability of consumer preferences and its influence on choice based conjoint analysis as a new product sales forecasting method are examined.

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SB51	Retail Operations	SC27	MCDM Methods and Applications
SB52	Uncertainty and Performance of Service Processes	SC28	Market Design
SB53	From Behavioral/Experimental Economics to Behavioral Operations: Opportunities and Challenges	SC29	Joint Session Analytics/CPMS: Panel Discussion on OR vs Analytics: Experts Weigh in on the Case for Change
SB54	Pricing Inspired by Data and Practice	SC30	Creating and Sustaining an Analytics Advantage
SB55	Airline Revenue Management and Customer Choice	SC31	Interactions Between Learning and Decision Making
SB56	Location Applications	SC32	Special Topics in Supervised Learning: Variable Selections and Dimension Reductions
SB57	Electricity Market Models	SC33	Statistics and Optimization Methods for Pain Management
SB58	Smart Grids and Demand Response	SC34	Design and Analysis of Adaptive Health Interventions
SB59	Underground Mining	SC35	OR and Homeland Security: Social and Organizational Concerns
SB60	Case Competition I	SC36	Threats to Life and Limb
SB61	Dimensionality Reduction Techniques for Generation Capacity Expansion Problems with Intermittent Resources	SC37	Health Care Modeling and Optimization III
SB62	Modeling, Analysis, and Management of Water-Centric Systems	SC38	Panel Discussion: Relevant OM / MS Research: Why? What? How?
SB63	Doing Good with Good OR I	SC39	New Directions in Marketing - Operations Interface
SB64	Applications of Decision Analysis & Large-Scale Data Analytics	SC40	Behavioral Operations I
SB65	Quantifying Uncertainty in Decision Analysis Practice	SC41	Joint Session MSOM-Health/HAS/Practice: Operations Management of Emergency Services II
SB66	Aviation Applications Section: Best Student Presentation Competition I	SC42	Joint Session MSOM-Health/HAS: Healthcare Analytics and Optimization
SB67	Working Towards the Physical Internet	SC43	Joint Session RMP/PPSN: Socially Responsible Revenue Models
SB68	Joint Session TSL/Public Sector: Transportation Issues in Emergency Response	SC44	Revenue Optimization and Related Methodologies
SB69	Routing Problems with Uncertainty I	SC45	Revenue Management in Online Advertising
SB70	RAS Problem Solving Competition 2015	SC46	Managing Professional Services
SB71	Traffic State Estimation Methods and Data	SC47	Incentives and Investment in Renewable Energy and Energy Efficiency
SB72	QSR Student Introduction and Interaction and Best Student Poster Competition	SC48	Energy and Commodity Merchant Operations
SB73	Data Analytics for Quality Control and Improvement II	SC49	Operations Management and Marketing
SB74	QSR Refereed Research Session	SC50	Procurement and Management of Complex Goods and Services
SB75	Advanced Manufacturing I	SC51	MSOM Student Paper Competition Finalists - I
SB76	Efficient Learning in Stochastic Optimization	SC52	Social Network Analysis
SB77	Supply Chain Management II	SC53	Bounded Rationality, Social Preferences, and Risk Management in Behavioral Operations
SB78	Supply Chain Practice and Empirics	SC54	Uncertainty in Demand Response? Identification, Estimation, and Learning
SB79	Software Demonstration – Simia/Forio Simulation	SC55	Applications of DEA

Sunday, 1:30pm- 3:00pm

SC01	Military O.R. and Applications I	SC56	New Directions in Locational Analysis
SC02	Cyber-Physical Protection Models and Analysis.	SC57	Energy Technology, Climate Change, and Uncertainty
SC03	Contemporary Scheduling	SC58	Resiliency and Reliability Optimization of Electric Power Systems
SC04	Gender Inspired Research	SC59	Just the Facts: Empirical Patterns in Strategy
SC05	Extracting Business Value from Social Media Analytics: Techniques and Applications	SC60	Case Competition II
SC06	Computational Methods in Options Pricing and Portfolio Selection	SC61	Optimal Power Flow in Electric Power Systems I
SC07	Big Risks, Big Data	SC62	Biofuel Supply Chain and Market Analysis
SC08	Topics in Telecommunications	SC63	Doing Good with Good OR II
SC09	Managing Innovation: Products, Services, Employee Attributes and Organizational Performance	SC64	Joint Session DAS/ENRE: Decision Analysis Applications in Oil and Gas
SC10	Online Consumer Conversion and Developer Strategy	SC65	Systems Engineering and Decision Analysis
SC11	Joint Session OPT/OPT Under Uncertainty: IP Methods for Stochastic Optimization	SC66	Aviation Applications Section: Best Student Presentation Competition 2
SC12	Mixed Integer Programming and Location Routing Problem	SC67	Advances in Network Design
SC13	Multi-armed Bandits and Online Optimization	SC68	Joint Session TSL/Public Sector: Transportation Disruption Management
SC14	New Developments in Robust and Adaptive Optimization	SC69	Facility Logistics I
SC15	Nonlinear Optimization Methods with Stochastic and Second Order Information	SC70	RAS Roundtable: Part I Railroad Operations Efficiency
SC16	Efficient Algorithms for Large-Scale Convex Games		

and Recovery
 SC71 Public Transportation Modeling
 SC72 Panel Discussion: IoT-enabled Data Analytics:
 Opportunities, Challenges and Applications
 SC73 Quality Engineering
 SC74 IEEE Intelligent Systems Invited Panel Discussion on
 Healthcare Intelligence
 SC75 Advanced Manufacturing Systems and Planning
 SC76 Design of Experiments and Statistical Analysis for Simulation
 SC77 Supply Chain Management III
 SC78 Supply Chain Risk Management I
 SC79 Software Demonstration – Provalis Research/
 SAS Education Practice

Sunday, 4:30pm-6:00pm

SD01 Military O.R. and Applications II
 SD02 OR and Homeland Security 1: Data Driven Decisions
 SD03 Application of Scheduling Theory
 SD04 Special Panel on 20th Year Anniversary of WORMS:
 Strategies for Advancing Women in OR/MS
 SD05 Tutorial: Collecting and Analyzing Twitter Data with Python
 SD06 Asset Returns and Portfolio Management
 SD07 Systemic Risk in Financial Networks
 SD08 Surveillance
 SD09 Joint Session TIME/NPD: Meet The Editors
 SD10 Digital Platform and New Economy
 SD11 Recent Theoretical and Computational Advances in
 Mixed Integer Programming
 SD12 Strong Relaxations and Computations for Mixed
 Integer Nonlinear Programs
 SD13 Uncertainty in Energy and Natural Resource Systems
 SD14 Topics in Dynamic Programming
 SD15 Nonlinear Optimization Algorithms
 SD16 New Optimization Modeling and Effective Techniques
 SD17 Transportation Network Modeling and Optimization
 SD18 Theory and Applications of Coordinate Descent and
 Alternating Direction Methods
 SD19 Computational Data Analytics
 SD20 Queueing with Redundancy for Cloud Computing
 SD21 Natural History Modeling for Medical Decision Making
 SD23 Queues in Heavy-Traffic: Approximations and Control
 SD24 Meet the Editors
 SD25 Online Search, Social Network and Advertisement
 SD26 Industry Job Search Panel
 SD27 MCDM in Agriculture
 SD28 Advances in Auction Theory
 SD29 Baseball Analytics
 SD30 “Speed Networking” Coordination of Subdivisions’ Interests
 SD31 Data Analytics and Statistical Learning
 SD32 Computational and Statistical Challenges in Big Data Genomics
 SD33 Operations Research/Management for Women’s Health
 SD34 Medical Decision Making
 SD35 OR in Public Policy: From Healthcare to Food Banks
 SD36 Public and Nonprofit Sector Applications
 SD37 Health Care Modeling and Optimization IV
 SD38 Big Data III
 SD39 Pricing and Consumer Behavior in Retail and
 Service Operations
 SD40 Behavioral Operations II
 SD41 Healthcare Capacity and Patient Flow Analytics
 SD42 Patient Scheduling under Resource Constraints
 SD43 Data-Driven Revenue Management
 SD44 Algorithmic Revenue Management with Strategic Customers
 SD45 Pricing — Examples of Collaboration Between Academia
 and Industry
 SD46 Empirical Operations Management: Services
 SD47 Topics in Remanufacturing and Consumer Product Returns

SD48 Empirical Topics on OM/Finance Interface
 SD49 Service Process Design
 SD50 Retail Operations
 SD51 MSOM Student Paper Competition Finalists II
 SD52 Designing Services: Marketing and Operations
 Inter-related Issues I
 SD53 2015 INFORMS BOM Section Best Working Paper Awards
 SD54 Robust Optimization, Risk Ambiguity
 SD55 Analysis of Infrastructure using DEA
 SD56 Location Models
 SD57 Joint Session with all ENRE Clusters: The Energy, Natural
 Resources, and Environment Awards Session
 SD58 Funding Opportunities within CMMI
 SD59 Small Firms, Mobility, and Entrepreneurial Spawning
 SD60 Publications in Education
 SD61 Decision Analysis IV
 SD62 Transportation
 SD63 Nicholson Student Paper Competition II
 SD64 Value of Information
 SD65 Decision Analysis in Procurements and Procurement Auctions
 SD66 Aviation Applications Section: Award Finalists
 SD67 Container-based Logistics
 SD68 Electric Vehicles I
 SD69 Facility Logistics II
 SD70 RAS Roundtable: Part II Railroad Operations Efficiency
 and Recovery
 SD71 Alternative Fuel Vehicles and Sustainable Transportation I
 SD72 IIE Transactions
 SD73 Multicriteria and Multiobjective Models in Risk, Reliability
 and Maintenance
 SD74 Panel Discussion: Funding Opportunities
 SD75 Software Demo – IBM
 SD76 Emerging Development in Simulation and Optimization
 SD77 Supply Chain Management IV
 SD78 Supply Chain Risk Management II
 SD79 Software Demonstration – Artelys/Grms Development Corp.

Monday, 8:00am-9:30am

MA01 Military O.R. and Applications III
 MA02 Game Theory in Practice for Homeland Security
 MA03 Teaching Modern Project Management
 MA05 Applying Advanced Analytics to Social Media Data
 MA06 Financial Engineering
 MA07 Systemic Risk Measurement: Data and Algorithmic Aspects
 MA08 Topics in Innovative and Entrepreneurial Operations
 MA09 Understanding Knowledge Sources and Politics in
 Technology Management
 MA10 Economics of Digital Channels
 MA11 Convexification Techniques in Mixed-Integer Programming
 MA13 Distributionally Robust Optimization
 MA14 Stochastic Optimization Applications to Renewable
 Energy Integration
 MA15 Radiation Therapy Optimization
 MA16 Conic Convex Optimization: New Algorithms and Results
 MA17 Network Optimization under Uncertainties
 MA18 The Reborn of Traditional OR Methods in the Era of Big Data
 MA19 Distributed and Parallel Optimization
 MA20 Resource Allocation in Cloud Computing
 MA21 Public Health and Health System Modeling
 MA22 New Advances in Stochastic Networks
 MA23 Queues: Approximations and Control
 MA24 Social Media Analytics and Big Network Data
 MA25 Examining the Social Crowd
 MA26 2015 INFORMS Special Session for JIPE and IJOR
 MA27 Theory and Applications of the Analytic Network Process
 MA28 Matching Markets and Their Applications
 MA29 Applied Analytics Across Industries

MA30	2015 Edelman Finalists Reprise	MB10	Economics of Digital Goods and Services
MA31	Retail Analytics	MB11	Discrete Decision Making and Computation
MA32	George B. Dantzig Dissertation	MB12	Recent Algorithmic Developments in Deterministic Global Optimization
MA33	Polycymaking in Public Health	MB13	Distributed Stochastic Optimization for Large-Scale Machine Learning
MA34	Managing Healthcare Services	MB14	Statistical Optimization
MA35	Health Policy	MB15	Unconstrained and Bound-Constrained Optimization
MA36	Resilient Public Health Supply Chains	MB16	Trends in Optimization
MA37	Health Care Modeling and Optimization VI	MB17	Cliques and Clique Relaxations
MA38	Applied Probability I	MB18	Big Data Analytics: Methodology and Applications
MA39	Topics in Mental Accounting, Newsvendor and Pricing	MB19	OR and AI
MA40	Investigating Mobility Dynamics within Markets and Organizations	MB20	Decision Analytics in Cloud
MA41	Joint Session MSOM-Health/HAS: Data-Driven Modeling in Healthcare II	MB21	Re-Designing the (US) Healthcare System
MA42	Modeling Healthcare Provider and Processes Interaction	MB22	Learning and Random Graphs
MA43	Game Theoretic Models in Revenue Management I	MB23	Role of Information in Large-scale Stochastic Resource Allocation Problems
MA44	Data Driven Pricing	MB24	Data Mining and Network Inference for Social and Health Application II
MA45	RM in Practice	MB26	Data Analytics Applications for Smart Industries
MA46	Healthcare Operations	MB27	Advances in Multiobjective Programming
MA47	MSOM Sustainability and Energy	MB28	Economic Models of Auctions
MA48	Supply Chain Finance and Risk Management	MB29	Joint Session Analytics/MIF/HAS: Healthcare Analytics
MA49	Energy Operations and Sustainability	MB30	Practice Presentations by INFORMS Roundtable Companies I
MA50	The Role of Behavioral Modeling Features in Revenue Management	MB31	Data Mining and Predictive Analytics in Health Care
MA51	Models for Fashion Operations Management	MB32	Big Data Analytics in Genomics
MA52	Designing Services: Marketing and Operations Inter-related Issues II	MB33	Joint Session HAS/MSOM-Healthcare: Health Care Operations
MA53	Behavioral Issues in Coordination and Pricing	MB34	Supply Chain Analytics: Public Food Safety Applications
MA54	A Practical Guide to Ranking and Selection Methods	MB35	Relief Distribution Management
MA55	Innovative Uses of DEA	MB36	Community-Based Operations Research I
MA56	Facility Location and Supply Chain Network Design	MB37	Health Care Modeling and Optimization V
MA57	Optimization for Wind Energy	MB38	Applied Probability II
MA58	Analytics in the Petrochemical and Petroleum Industries I	MB39	Contracts, Quality, and Pricing for OM-Marketing
MA59	Strategy, Innovation, and Entry	MB40	Nonmarket Strategy
MA60	Enabling Business Students to Use OR	MB41	New Development in Health Care Operations
MA61	Transmission and Generation Expansion Planning	MB42	Joint Session MSOM-Health/HAS: Designing Healthcare Systems to Improve Patient and Provider Experience
MA62	OR Models for Ocean and River Energy	MB43	Innovation, Technology Management and Networks
MA63	Daniel H. Wagner Prize Competition I	MB44	Joint Session RMP/HAS: Health Care Pricing
MA64	Joint Session DAS/HAS: Dependencies in Pharmaceutical Portfolio Management: Challenges and Pragmatic Approaches	MB45	Dynamic Pricing: Learning, Personalization, Equilibrium, and Consumer Benefit
MA65	From Value of Information to Sensitivity Analysis	MB46	The Economics and Operation of Vehicle Sharing
MA66	Air Traffic Management and Airline Operations	MB47	Environmentally Responsible Operations
MA67	City Logistics and Sustainable Urban Freight Systems - II	MB48	Operations and Finance Interface
MA68	Electric Vehicles II	MB49	Sustainability in Supply Chains
MA69	Facility Logistics III	MB50	Supply Chain Risk Management Strategies
MA70	Rail Safety and Risk Analysis	MB51	Behavior-driven Operations Management
MA71	Alternative Fuel Vehicles and Sustainable Transportation II	MB52	Best Paper Award
MA72	2015 QSR Best Student Paper Competition	MB53	Social Media, Sales and Pricing
MA73	IEEE T-ASE Invited Session: Healthcare and Service Systems Automation	MB54	Markov Decision Processes
MA74	Data Analytics for Quality Control and Improvement I	MB55	Applications of DEA II
MA75	New Research Topics on Innovation	MB56	Recent Advances in Location Analysis
MA76	Simulation Optimization and Ranking and Selection	MB57	Optimization of Power Systems Planning and Operation
MA77	Supply Chain Management V	MB58	Analytics in the Petrochemical and Petroleum Industries II
MA78	Supply Chain Risk Management III	MB59	Panel Discussion: The Impact of the Value-Based Approach on the Field of Strategy
MA79	Software Demonstration - SAS JMP Division/AnyLogic	MB60	Cases in the Undergraduate OR Curriculum
		MB61	Stochastic and Robust Optimization Models in Electric Power Systems
		MB62	Optimization Approaches for Invasive Species and Pest Management
		MB63	Daniel H. Wagner Prize Competition II
		MB64	Joint Session DAS/ENRE: Environmental Decision Analysis: Theory and Applications
		MB65	Risk Attitudes in Decision Analysis
		MB66	Air Traffic Management Decision Support: Learning from History
		MB67	The Role of Information in Transportation Models
		MB68	Green Vehicle Routing
		MB69	Facility Logistics IV

Monday, 11:00am-12:30pm

MB01	Military O.R. and Applications IV	MB62	Optimization Approaches for Invasive Species and Pest Management
MB02	MAS Tutorial: A Brief Introduction To Predictive Analytics	MB63	Daniel H. Wagner Prize Competition II
MB03	Supply Chain Scheduling	MB64	Joint Session DAS/ENRE: Environmental Decision Analysis: Theory and Applications
MB04	Panel: Topics for PhD students	MB65	Risk Attitudes in Decision Analysis
MB05	Tutorial: Analyzing Social Media with LIWC	MB66	Air Traffic Management Decision Support: Learning from History
MB06	Tutorial in Financial Services	MB67	The Role of Information in Transportation Models
MB07	Assessing Systemic Risk	MB68	Green Vehicle Routing
MB08	Green Business Models	MB69	Facility Logistics IV
MB09	Best Dissertation Award Finalists – Technology, Innovation Management and Entrepreneurship Section		

MB70	Joint Session RAS/TSL/AAS: Real-Time Decision Support Practice
MB71	Mobility Choices in Urban Transportation
MB72	Journal of Quality Technology (JQT) Invited Session
MB73	Game-theoretical Models in Maintenance and Reliability
MB74	Sustainable Operations in the Manufacturing Industry
MB75	Managing Search and Problem Solving in Innovation Settings
MB76	Simulation Optimization and Input Uncertainty
MB77	Supply Chain Management VI
MB78	Shipping and Transportation for Supply Chains
MB79	Software Demonstration – AMPL/Gurobi Optimization

Monday, 12:30pm - 2:30pm

Poster Session

Monday, 1:30pm-3:00pm

MC01	Military O.R. and Applications V
MC02	Logistics and Transportation Security
MC03	Innovative Scheduling Applications
MC04	Joint Session JFIG/MIF: Department Chair Panel Discussion on Tenure and Promotion
MC05	Predictive Models of Human Behavior in Social Media
MC06	INFORMS Section on Finance Student Paper Competition
MC07	Modeling and Quantification of Risk
MC08	Empirical Perspectives on Business Model Innovation
MC09	Collaborative Innovation
MC10	Social Media and E-Commerce
MC11	Symmetry and Extended Formulations in Integer Programming
MC12	Global Optimization: Algorithms and Applications
MC13	Robustness in Optimization, Complementarity, and Queueing Systems
MC14	Optimization Award Session
MC15	Theory and Applications of Convex Optimization
MC16	Advances in Infinite-Dimensional Linear Programming
MC17	Network Flows and Combinatorial Optimization
MC18	Optimization Metaheuristics
MC19	Tools for Optimization Modeling
MC20	Modeling and Optimization of Big Data Systems
MC21	Pierskalla Award Finalists
MC22	Message Passing for Inference
MC23	Optimal Control of Stochastic Systems
MC24	Network Modeling and Analysis
MC25	Data-Driven Research on Economics of Digitization
MC26	Academic Job Search Panel
MC27	Multi-objective Design Problems
MC28	Auctions and Trading Agents
MC29	Joint Session Analytics/CPMS: Panel Session: Extending the Reach of Certification: The New Associate Certified Analytics Professional
MC30	Practice Presentations by INFORMS Roundtable Companies II
MC31	Data Mining in Healthcare
MC32	Statistical Innovations in Computational Biology and Genomics
MC33	Topics in Health Systems
MC34	Joint Session HAS/MSOM-Managing Healthcare Operations
MC35	Practice-Based Research in Humanitarian Operations Management
MC36	Community-Based Operations Research II
MC37	Health Care Modeling and Optimization VII
MC38	Dynamic Programming and Control I
MC39	Branding and Bundling
MC40	Micro-Underpinnings of Mobility, Knowledge, and Performance in Groups and Organizations
MC41	Joint Session MSOM-Health/HAS/Analytics: Data-Driven Modeling in Healthcare III
MC42	Joint Session MSOM-Health/HAS/Analytics: Healthcare Analytics

MC43	Game Theoretic Models in Revenue Management II
MC44	Empirical and Data-Driven Research in Revenue Management and Pricing
MC45	From Store to Omni-Channel: Choice-Driven Pricing Models
MC46	Pricing and Strategic Behavior in Queueing Systems
MC47	Energy Operations and Energy Efficiency
MC49	Emerging Topics in Supply Chain Management
MC50	Retail Supply Chain: From Demand Forecast to Order Fulfillment
MC51	Dynamic Contracts in Operations Management
MC52	Analytics for IT Services
MC53	Opportunities and New Directions for Behavioral OM
MC54	Equilibrium Routing and its Paradoxes
MC55	Efficiency in the Higher Education and Banking Sectors
MC56	Location Analytics
MC57	Policy Issues in Energy Markets
MC58	Analytics in the Petrochemical and Petroleum Industries III
MC59	Strategy and Geography
MC60	Project Based Learning
MC61	Nonconvex and Stochastic Electricity Pricing
MC62	Operations Management with Carbon Restrictions: Environmental Concerns
MC63	Advanced Manufacturing II
MC64	Behavioral Decision Analysis
MC65	Joint Session DAS/MAS:Game Theory, Decision Analysis, and Homeland Security, Part A
MC66	Ongoing Challenges in Airline Operations Planning
MC67	Integrated Vehicle Routing Problems I
MC68	Logistics and Supply Chain under Disruption and Disasters
MC69	Facility Logistics V
MC70	International Rail Freight
MC71	Shared Mobility Analysis and Optimization
MC72	Panel Discussion on "Publishing in Quality and Reliability: The Editor's Perspective"
MC73	Modeling and Analysis of Data with Quantitative and Qualitative Variables
MC74	Modern Monitoring Applications
MC75	Innovations in Healthcare Products and Services
MC76	Accounting for Input Uncertainty in Stochastic Simulations
MC77	Supply Chain Management VII
MC78	Integer Programming Applications in Energy
MC79	Software Demonstration – AIMMS/MOSEK ApS

Monday, 4:30pm-6:00pm

MD01	Military Applications Society Awards
MD02	Cyber Security
MD03	Scheduling with Applications
MD04	Panel Discussion: International Academia Career Opportunities
MD05	Predicting Customer Behavior using Facebook Data
MD06	Finance and Risk Management
MD07	Quantitative Methods for Financial Applications
MD08	Mobile-Based Business Model Innovations
MD09	TIMES Distinguished Speaker
MD10	IT-Enabled Competitive Strategies
MD11	Convex Relaxations for Structured Integer Programs
MD12	Surrogate-Based and Derivative-Free Optimization II
MD13	Stochastic Integer Programming
MD14	Robust Optimization in Radiation Therapy Planning
MD15	Distributed Convex Optimization
MD16	Application of Linear and Conic Programs with Complementarity Constraints
MD17	Modeling Social Influence in Networks
MD18	Methodologies in Text Mining for Big Data
MD19	Application of Nonlinear Optimization using Sequential Linear Programming Techniques with Xpress
MD20	Stochastic Models and Analysis for Cloud Computing
MD21	Stochastic Models in Healthcare
MD22	Joint Session Prize/CPMS: 2015 Informs Prize Winner

MD23 Markov Lecture
MD24 Latent Variable Models in Biomedical Informatics
MD25 Economics of IS & OM
MD26 Analytics Maturity Model
MD27 Spatial Multi-Criteria Decision Analysis
MD28 Auctions for Spectrum
MD29 Joint Session Analytics/CPMS: 2015 Innovative Applications
in Analytics Award Winner Reprise
MD30 Practice Presentations by INFORMS Roundtable Companies III
MD32 Big Biological Data: Computational and Analytical Challenges
MD33 Radiation Therapy Optimization: Algorithms and
Biological Effects
MD34 Decision Models for Women's and Children's Health
MD35 Joint Session PPSN/Analytics: Pro Bono Analytics
Panel Discussion
MD36 Modeling Broader Policy Impacts at the Local Scale
MD37 Health Care Modeling and Optimization VIII
MD38 Dynamic Programming and Control II
MD39 Innovative Strategies in the Interface of Operations
and Marketing
MD40 Gender, Leadership, and Governance
MD41 High-dimensional Data Models for Cost-effective Healthcare
MD42 Joint Session MSOM-Health/HAS:
Operations Research/Management for Public Health:
Data-Driven and Dynamic Decision-Making
MD43 Empirical Revenue Management
MD44 Pricing and Information in Innovative Business Models
MD45 Revenue Management and Learning II
MD46 Equilibrium Models and Pricing of Queues
MD47 Sustainability and Transportation
MD48 Operations/Corporate Finance Interface
MD49 Supply Chain Operations
MD50 Procurement, Auction, and Pricing
MD51 Applications of Operations Management to Pharmaceutical
and Healthcare Industry
MD53 Behavioral Studies in Supply Chains and
Revenue Management
MD54 Computational Optimization and Statistical Methods for
Big Data Analytics: Applications in Neuroimaging
MD55 Environmental Application and Computational Aspects
of Efficiency and Productivity Analysis
MD56 Spatial Analysis
MD57 Planning Models in Electric Power Systems
MD58 Multi-Agent Decision-Making for Smart Grids Operation II
MD59 Forest & Timber Management
MD60 Panel Discussion: Encouraging Professionalism
in the Classroom
MD61 Multilevel Optimization Problems in Energy
MD62 Spatial Optimization and Conservation Reserve Design
MD63 Daniel H. Wagner Prize Competition III
MD64 Decision Analysis Society Awards Session
MD65 Freight Transportation
MD66 Aviation Applications Section: Keynote Presentation
MD67 Integrated Vehicle Routing Problems II
MD68 Joint Session TSL/Public Sector: Resilience in
Transportation Infrastructure Systems
MD69 Arc Routing Problems and Applications
MD70 Railway Analytics
MD71 Transportation Network Modeling and Design
MD72 Panel Discussion on Big Data Science - Opportunities
and Challenges
MD73 Data Analytics in Manufacturing and Service Industries
MD74 Advanced Maintenance Modeling
MD75 Deep Dive on Open Innovation - Papers and Discussants
MD76 Simulation in Healthcare
MD77 Supply Chain Management VIII
MD78 Optimization under Uncertainty with Energy Applications
MD79 Software Demonstration – LINDO Systems Inc./Do Analytics

Tuesday, 8:00am-9:30am

TA01 Military Manpower and Force Management
TA02 Optimization Applications in Homeland Security
TA03 Scheduling in Practice
TA04 Panel Discussion: Journal Publication Tips
TA05 Social Media and Networks in Business
TA06 Systemic Risk
TA07 Pricing and Risk Modeling in Financial Engineering,
Operations Research
TA08 e-Business Models
TA09 Using Big Data Analytics for Technology Intelligence:
Methods and Cases to Gather Intelligence on
Technological Innovations
TA10 Contextual Factors Affecting eBusiness Initiatives
TA11 Online Optimization with Integer Applications
TA12 Convexification-based Algorithms for Solving Quadratic
and Polynomial Programs
TA13 Optimizing Sharing Service/Economy Under Uncertainty
TA14 Data-driven Optimization
TA15 Patient Scheduling in Health Care
TA16 Disjunctive Conic and Optimization Problems
TA17 Network Resilience and Applications
TA18 Scientometric Data Analytics
TA19 Computational Integer Optimization
TA20 Cloud Services and Applications
TA21 Medical Decision Making in Cancer Care
TA22 Two-Sided Matching Markets
TA23 Asymptotic Optimality in Processing Networks
TA24 Intelligent Heuristics and Systems
TA25 Online Information Intermediaries
TA26 Optimal Sourcing, Procurement Design, and Eco-label System
in Supply Chain Management
TA27 Application-motivated Theories and Methods for
Multiobjective Optimization
TA28 Auctions for Ad Space
TA29 Applications of Analytics I
TA30 Sports and Entertainment
TA31 Financial Applications of Data Mining and Machine
Learning Techniques
TA32 Principles in Applied Probability
TA33 Medical Decision Making in Chronic Disease Screening
and Treatment
TA34 Operations in Emergency Medicine
TA35 Panel Discussion: Infusing Learning from Hospitality and
Service Design to Healthcare: A Panel Discussion
TA36 Innovations on Disaster Response Logistics
TA37 Health Care Modeling and Optimization IX
TA39 Supply Chain Management and Marketing Interface
TA40 Behavioral Operations III
TA41 Studies in Healthcare Productivity
TA42 Operational Decision Making in Healthcare
TA43 Measurement and Optimization in Online Advertising
TA44 Pricing Issues in Revenue Management
TA45 Social Learning and Revenue Management
TA46 Empirical Research in Supply Chains and Service Management
TA47 Sustainability in Food Supply Chains
TA48 Managing Contracts and Financial Flow in Supply Chain
TA49 Uncertainty in Sourcing and Procurement
TA50 Operations Management and Marketing Interface
TA51 Economics of Innovation in Supply Chains
TA52 Consumer-driven Management Science
TA53 Behavior in Operational Contexts
TA54 Applying Machine Learning in Online Revenue Management
TA55 Extensions of DEA
TA56 Execution Mode Choices for NPD
TA57 Applications of Stochastic and Dynamic Programming
in Energy
TA58 Topics in Oil, Natural Gas, and Alternative Fuels
TA59 Fire Management I: Suppression

TA60	Education I
TA61	Sustainability in Energy Sector: Policy Analysis and Technology Assessment
TA62	Reliability and Random Factors in Power Systems
TA63	KINFORMS Sponsored Session
TA64	The Journey to Organizational Decision Quality (ODQ)
TA65	Recent Findings and Experiences in Probability Elicitation
TA66	Airline/Airport Operations Management
TA67	Advanced Routing Models
TA68	Joint Session TSL/Public Sector: Resilience in Interdependent Infrastructure System
TA69	Maritime Logistics
TA70	Advanced Analytics in Tactical Decision Making
TA71	Managing Uncertainties and Outages in the Aviation System: Models and Methods
TA72	DDDAS for Industrial and System Engineering Applications I
TA73	Functional Data Analysis
TA74	System and Process Informatics in Additive Manufacturing (I)
TA75	IBM Research Best Student Paper Award I
TA76	Advances in Simulation-based Optimization I
TA77	Green Supply Chain Management
TA78	Big Data and Energy
TA79	Software Demonstration – Sigma LX/Mathworks

Tuesday, 11:00am-12:30pm

TB01	Cyber and Logistics Applications
TB02	Homeland Security Decision Making
TB03	New Topics in Scheduling
TB04	The Business of Music and Emotion in Social Media
TB05	Social Media in Business
TB06	Engineering Approaches in Finance
TB07	Quantitative Risk Measurement and Modeling
TB08	Sharing Economy and Peer-to-Peer Marketplaces
TB09	Ecosystem Analytics & Visualization
TB10	Frontiers in IS Research
TB11	Machine Learning under a Modern Optimization Lens
TB12	Nonlinear Programming in Stochastic and Multilevel Problems
TB13	Stochastic Approximation
TB14	Joint Session OPT/ICS: Stochastic Programming: Progressive Hedging and Related Methods
TB15	Recent Advances in Nonlinear Programming
TB16	Various Aspects of Mixed Integer Conic Optimization
TB17	Network Modeling and Design
TB18	Data Mining for Different Type of Big Data
TB21	Bundled Payment Systems
TB22	Learning High-dimensional/Sparse Models
TB23	New Advances in Production Planning and Scheduling
TB24	Urban Data Analytics and Mining
TB25	Software-Driven Innovation and Business Strategies
TB26	Retailer Pricing
TB27	Multiple Criteria Decision Aiding
TB28	Empirical Market Design
TB29	Applications of Analytics II
TB30	Intelligent Agents and Systems
TB31	Connected Vehicle Analytics
TB32	Business Analytics in Higher Education Industry
TB33	Joint Session HAS/MSOM-Healthcare: Modeling Applications for Emergency Departments
TB34	Data-driven Modeling and Analysis of Health Care Systems
TB35	Using Technology to Enhance Guest Experiences and Performance in Hospitality Management
TB36	Disaster Relief and Humanitarian Logistics
TB37	Health Care Modeling and Optimization X
TB38	Queueing Models I
TB39	Risks Management in Operations/Marketing
TB40	Operations/Sustainability
TB41	ED Operations Management

TB42	Joint Session MSOM-Health/HAS: Global Health Delivery
TB43	Choice Modeling and Assortment Optimization
TB44	Machine Learning in Operations
TB45	Revenue Management for Marketing
TB46	Service Models in MSOM
TB47	Supply Chain Social Responsibility
TB48	Operational Issues in Agriculture
TB49	Retail Operations
TB50	Value Chain Innovations in Developing Economies
TB51	Procurement Mechanisms
TB52	Marketing and Optimal Control
TB53	Behavioral Issues in the OM / Marketing Interface
TB54	Approximations of Queueing Performance for Rapid Systems Design
TB55	Stochastic Methods in Efficiency Analysis
TB56	Multiple Stakeholders in NPD
TB57	Assorted Topics in Renewable Energy
TB58	Topics in Nuclear Energy
TB59	Fire Management 2: Landscape & Modeling
TB60	Education II
TB61	Economics of Reverse Logistics and Sustainable Operations
TB62	Aviation Applications
TB64	Panel Discussion: A Heated Discussion on Decision Analysis and Systems Engineering
TB65	Modeling in Decision Analysis
TB66	Delay Propagation and Robust Airline Operations
TB67	Advances in Vehicle Routing Problem and its Variants
TB68	TSL Invited Cluster Keynote Address
TB69	Joint Session TSL/Public Sector: Health-care, Education, and Emergency Applications of Logistics
TB70	Yard and Terminal Simulation
TB72	DDDAS for Industrial and System Engineering Applications II
TB73	Joint Session QSR/Energy: Data Analytics in Energy Systems
TB74	System and Process Informatics in Additive Manufacturing (II)
TB75	IBM Research Best Student Paper Award II
TB76	Advances in Simulation-based Optimization II
TB77	Logistics I
TB78	Planning and Scheduling in Energy Applications
TB79	Software Demonstration – Statistics.com/River Logic

Tuesday, 12:30pm - 2:30pm

Poster Session

Tuesday, 1:30pm-3:00pm

TC01	Logistics and Operations Research
TC02	Network Applications in Homeland Security
TC03	Inventory Management I
TC04	Social Media Analytics Best Papers Finalist Competition
TC05	Social Media Impact
TC06	Dynamics and Information in Commodity Markets
TC07	Systemic Risk: Methods and Models
TC08	Different Facets of Innovation: Product, Technology and Business Models
TC09	Crowd Innovation
TC10	e-Media and Health Care Practices
TC11	Advances in Discrete Optimization
TC12	Optimization Integer Programming I
TC13	Stochastic Combinatorial Optimization
TC14	Stochastic Financial Optimization
TC15	Optimization Models in Radiotherapy Treatment Planning
TC16	Game Theory I
TC17	Network Analysis I
TC19	Modeling and Optimization for Sustainable Cloud Computing
TC20	Financial Engineering and Optimization
TC21	Innovations in Healthcare Operations
TC22	Analysis and Control of Queues

TC23	Stochastic Modeling and Control of Production Systems
TC24	Search Across Disciplines: Artificial Intelligence and Operations Research
TC25	Online Crowds: Crowdfunding and Social Media
TC26	Gray Market, Sustainability, Competition, and Diffusion
TC27	Evolutionary Bilevel Optimization
TC28	New Frontiers in Market Design
TC29	Joint Session Analytics/HAS: Analytics Innovations in Healthcare and Medicine
TC30	Decision Support Systems I
TC31	Joint Session DM/QSR: Quality and Statistical Decision Making in Health Care Applications
TC32	Decision Support Systems for Data Mining
TC33	Appointment Scheduling in Healthcare
TC34	Optimal Cancer Therapy
TC35	Disaster and Emergency Management I
TC36	Humanitarian Applications III
TC37	Kidney Allocation and Exchange
TC38	Queueing Models II
TC39	Distribution Channel Management
TC40	Marketing I
TC41	Joint Session MSOM-Health/HAS: Healthcare Operations
TC42	Joint Session MSOM-Health/HAS: Workarounds, Errors and Interruptions in Healthcare
TC43	Joint Session RMP/MSOM: Choice Models: Estimation and Optimization
TC44	Pricing in Online Markets
TC45	Behavioral Issues in RM
TC46	Issues Related to Supply Chain Management
TC47	Topics in Remanufacturing and Recycling
TC48	Managing Finances and Risk in Supply Chains
TC49	Multi-Echelon Inventory Modeling
TC50	Operations Economics
TC51	Online Retailing
TC52	Machine Learning Applications in Marketing
TC53	Grab Bag of Behavioral Papers
TC54	Discrete Optimization Models for Homeland Security and Disaster Management
TC55	Outsourcing I
TC56	Commercialization of New Technologies
TC57	Long-Term Electric Power System Planning Models
TC58	Electricity and System Resilience
TC59	Impacts of Climate Change
TC60	Disruption Management
TC61	Sustainable and Responsible Supply Chain Management
TC62	Optimization in Bio-energy
TC63	Operations Management I
TC64	Panel Discussion: Analytics and Decision Analysis
TC65	Joint Session DAS/MAS:Game Theory, Decision Analysis, and Homeland Security, Part B
TC66	Managing Airport Arrival Flows
TC67	Consolidation in Transport
TC68	TSL Prize Session
TC69	Multimodal Traffic Signal Control in a Connected Vehicle Environment
TC70	Predictive Analytics in Railway - Practice
TC71	Transportation Planning I
TC72	DDAS for Industrial and System Engineering Applications III
TC73	Quality Monitoring and Analysis in Complex Manufacturing Processes
TC74	Innovative Methods for System Informatics
TC75	IBM Research Best Student Paper Award III
TC76	Advances in Stochastic Simulation
TC77	Logistics II
TC78	Optimization of Energy Systems
TC79	Software Demonstration – Snycopation Software/ Frontline Systems, Inc.

Tuesday, 4:30pm-6:00pm

TD01	Optimizing Decisions in Conflict, Deterrence, and Peace
TD02	Military Applications
TD03	Inventory Management II
TD04	Economics I
TD05	Social Media Engagement
TD06	Quantitative Finance and Risk Management
TD07	Topics in Optimal Investment
TD08	Tutorial in Financial Services
TD09	Collaborative R&D
TD10	Platform-Based Markets in the Digital Era
TD12	MAS Tutorial: The State of Operations Research in the US Military: A 75th Anniversary Perspective
TD14	Optimization in Energy and Resources Production and Management
TD15	Capacity Management in Healthcare Operations
TD16	Inverse Optimization
TD17	Routing and Multidimensional Assignment Applications
TD18	Recent Advances in First Order Methods for Large-Scale Optimization
TD19	Network Inference
TD20	Banking and Insurance
TD21	Disease Modeling in OR
TD22	Contact Centers
TD23	Markov Decision Models and Approximations for Manufacturing
TD24	Social Network Analytics
TD25	Economic Models and Analysis of Networks and Platforms
TD26	Production and Scheduling I
TD27	Applications of Multi-objective Optimization
TD28	Dynamic Matching Markets
TD29	Joint Session Analytics/HAS:The Emerging Role of Health Systems Engineering and its Impact on Clinical Informatics and Analytics
TD30	Decision Support Systems II
TD31	Time Series Data Mining
TD32	Data Mining
TD33	Decision and Prediction Models in Healthcare
TD34	Joint Session HAS/MSOM-Healthcare: Operational Issues and Information Sharing in Healthcare
TD35	Disaster and Emergency Management II
TD36	Fire and Emergency Medical Services
TD37	Therapy and Treatment
TD38	Probability
TD39	Product brand differentiation and pricing decisions
TD40	Marketing II
TD41	Healthcare Supply Chain Decision Making
TD42	Patients and Practice: Using the Right Resources to Deliver Care
TD43	Revenue Management with Consumer Choice Models
TD44	Recent Trends in Retailing
TD45	Topics in Dynamic Pricing and Revenue Management
TD46	Service Operations
TD47	Sustainable Operations Management
TD48	New Directions at the Interface of Finance, Operations, and Risk Management
TD49	Demand Driven Supply Chains
TD50	Supply Network Management: Collaboration and Competition
TD51	Innovative and Entrepreneurial OM
TD52	Social Media and Internet Marketing
TD53	Inventory and Information Sharing
TD54	Meta-algorithms: From Algorithm Tuning and Configuration to Algorithm Portfolios
TD55	Data Envelopment Analysis (DEA)
TD56	Project Selection, Evaluation and Collaboration
TD57	Modeling the Economics of Low-Carbon Power Systems
TD58	New Insights on Electricity Markets with Uncertain Supply
TD59	Optimal Design and Operation of Smart Electrical Grids
TD60	Performance Measurement

TD61	Environmentally Responsible Operations Management
TD62	Optimization on Power Grid Application
TD63	Operations Management II
TD64	Optimization and Utility Theory
TD65	Near Miss and Threshold Events and Their Influence on Risk Perception and Behavior
TD66	Air Cargo
TD67	Topics in Transport I
TD68	Resilience in Electricity Infrastructure Systems
TD69	Connected and Autonomous Vehicles I
TD70	Tutorial: Railroad Predictive Analytics
TD71	Transportation Planning II
TD72	Design and Analysis of Data with Complex Structure
TD73	Recent Advances in Analyzing Experiments
TD74	Bayesian Applications in Industrial Statistics
TD75	IBM Research Best Student Paper Award IV
TD76	Rare Event Simulation and Network Applications
TD77	Supply Chain Optimization
TD78	Electricity Markets and Utilities
TD79	Software Demonstration – SAS/Responsive Learning Tech

Wednesday, 8:00am-9:30am

WA01	Acquisition and Logistics
WA02	Scheduling I
WA03	Logistics and Inventory Management
WA04	Economics II
WA05	Identifying Sentiment Change and Geographic Location in Social Media
WA06	Modeling and Computations in Financial Engineering
WA07	Risk Management Approaches in Engineering Applications
WA09	Innovation and Technology Management
WA11	Optimization Large Scale II
WA12	Optimization Stochastic I
WA13	Stochastic Integer Programming Methods and Applications
WA14	Advances in Information Modeling
WA15	Monitoring and Prevention of Hospital Acquired Infections
WA16	Game Theory II
WA17	Network Analysis II
WA18	Optimization Combinatorial I
WA19	Computational Optimization for Applied Problems II
WA21	Health Care Operations
WA23	Stochastic Modeling and Analysis with Applications
WA24	Robustness and Approximation in Markov Decision Processes
WA25	Managing Sustained Participation in Online Communities
WA26	Production and Scheduling II
WA27	Multi-objective Optimization and Applications
WA28	Bidding Mechanisms
WA29	Applied Analytics
WA30	Information Systems for E-Business/Commerce
WA31	Data Mining for Environmental and Natural Hazard Applications
WA32	Data Mining with Marketing Applications
WA33	Data-driven Healthcare Operations
WA34	Real World Problems, Innovative Approaches and Implementations at Geisinger Health System
WA36	Joint Session PPSN/TSL: Network Infrastructure Recovery and Resilience
WA38	Bayesian Approach I
WA39	Supply Chain Management with Marketing Considerations
WA40	Marketing III
WA41	Healthcare Operations Management
WA43	Choice Modeling Applications in Revenue Management
WA44	Dynamic Pricing
WA45	Topics in Revenue Management
WA46	Empirical Studies in Public Services: Health Care and Education
WA47	Promoting and Developing Markets for Recycling & Reuse
WA48	Supply Chain Risk Management
WA49	Inventory Problems in Online Retail
WA50	New Models and Algorithms for Exploration and Exploitation

WA51	Tradeoff Optimization
WA52	Analyzing and Managing Incentives
WA53	Retail Management I
WA54	Behavioral Models in Operations Management
WA55	Resource Allocation
WA56	Forecasting
WA57	Operations Management VII
WA58	Electric Transportation Systems Modelling
WA59	Renewables Integration: Market Clearing, Optimal Siting and Energy Storage
WA60	Joint Session ENRE & Integer and Discrete Optimization: Emerging Operational Approaches in Electric Power Systems — Transmission Switching
WA61	Electricity Access in Developing Countries
WA62	Research in Environmentally Sustainable and Socially Responsible Operations
WA63	Energy and Supply Chain Management
WA64	Operations Management III
WA65	Risk-Based Decision Making in Interdependent Systems
WA66	Decision Analysis Applications in Operations Management
WA67	Reducing Impact of Delay through Improved Airport Operations and Recovery Procedures
WA68	Freight Logistics
WA69	Inference and Control in Dynamic Routing
WA70	Connected and Autonomous Vehicles II
WA71	Recent Academic Research in Railway Applications
WA72	Traffic Management
WA73	Design and Analysis of Computer Experiments
WA74	Reliability Analysis of Complex Engineering Systems
WA75	Decision Analysis Approaches and Predictive Modeling to Managing Uncertainty in Manufacturing and Service Systems Design & Operations
WA76	Supply Chain Management IX
WA77	Simulation I
WA78	Supply Chain Closed Loop I
WA79	Energy Applications
WA80	Software Demonstration – Optimization Direct/Maximal Software Inc.

Wednesday, 11:00am-12:30pm

WB01	MAS Tutorial: A Logistics Planning System For Military Contingency Missions
WB02	Scheduling II
WB03	Newsvendor Model and Extensions
WB04	Economics III
WB05	Better Business using Social Media Analytics
WB06	Real Options
WB07	Large-scale Portfolio Risk
WB08	Optimization Nonlinear Programming II
WB09	Venture Capital Funding, Crowd Sourcing, New Product Development, and Supply Chain Transparency
WB10	Openness and IT
WB11	Planning
WB12	Optimization Stochastic II
WB13	Robust Optimization: Theory and Applications
WB14	Risk-Averse Control of Markov Systems
WB15	Healthcare Informatics
WB16	Game Theory III
WB17	Network Optimization and its Applications
WB18	Optimization Combinatorial II
WB19	Retail Analytics and Optimization
WB20	Operations Research Applications in Vaccine Pricing and Distribution
WB21	Queueing Models for Manufacturing and Service Systems
WB22	Modern Market Microstructure: Stochastic Models of Limit Order Books
WB23	Joint Session AI/ICS: Decision Diagrams for Optimization and Artificial Intelligence
WB24	Economics of Information Systems
WB25	

WB26 Production and Scheduling III
 WB27 Applications and Methodological issues on MCDM
 WB28 Economics of Auctions
 WB29 Data Analytics in Pricing and Revenue Management
 WB30 Information Systems I
 WB31 Data Analytics for Manufacturing and Healthcare Enterprise System
 WB32 Data Mining in Health Care
 WB33 Methods and Applications in Disease Detection and Treatment
 WB34 Medical Decision Making
 WB35 Urban Planning
 WB36 Humanitarian Applications IV
 WB37 Modeling and Optimization of Health Care Processes
 WB38 Bayesian Approach II
 WB39 Channel Management and Pricing
 WB40 Operations Management/Marketing Interface I
 WB41 Joint Session MSOM-Health/HAS: Incentives in Healthcare Value Chain for Drugs and Consumables
 WB42 Stochastic Models for Healthcare Applications
 WB43 Revenue Management Problems with Consumer Choice Behaviors
 WB44 Assortment Optimization
 WB45 Sustainability I
 WB46 Role of Information in Service Systems
 WB47 Sustainable Supply Chain
 WB48 Information-Related Issues in Supply Chain Management
 WB49 Supermodularity and Its Applications in Operations Management
 WB50 New Topics in Behavioral Operations
 WB51 Supply Chain Outsourcing
 WB52 Retail Management II
 WB53 Frontiers of Behavioral Operations Research
 WB55 Decision Analysis I
 WB57 Advances in Sustainable Energy and Economic Systems Analysis
 WB58 Non-Convex Equilibrium Problems
 WB59 Strategy/Strategic Planning I
 WB60 Green Manufacturing
 WB61 Integrated Biofuels Supply Chain Design
 WB62 Computational Advances in Power System Modeling
 WB63 Operations Management IV
 WB64 Teaching Methods for Decision Analysis
 WB65 Decision Making: Tradeoffs, Risk Processing and Altruism
 WB66 Aviation Day of Operations and Air Traffic Optimization
 WB67 Ocean Container Transport Logistics
 WB68 Production and Distribution Systems
 WB69 ITS in Public Transportation
 WB70 Vehicle Routing I
 WB71 Transportation Operations I
 WB72 Omni-channel Commerce and Analytics
 WB73 Bayesian Data Analytics for Quality and Reliability Assurance
 WB74 Reliability I
 WB76 Simulation II
 WB77 Supply Chain Closed Loop II
 WB78 Natural Resources
 WB79 Software Demonstration – FICO/IBM Academic Initiative Group

Wednesday, 12:45pm-2:15pm

WC01 Military Cognitive Analysis, Value based Acquisition and Military Recruiting Prediction Models
 WC02 Scheduling III
 WC03 Inventory Management for Supply Chains I
 WC04 Business Applications I
 WC05 Capitalizing on Social Media
 WC06 Financial Institutions
 WC07 Risk Management and Financial Regulation
 WC08 Finance Theory and Empirics
 WC09 Innovation and Entrepreneurship I
 WC10 E-Business/Commerce I
 WC11 Optimization Integer Programming II
 WC12 Optimization Stochastic III
 WC13 Data Driven Optimization and Applications II
 WC16 Game Theory IV
 WC17 Optimization Network
 WC18 Optimization Robust I
 WC19 Heuristics
 WC21 Healthcare Capacity Planning Models
 WC22 Learning and Queues
 WC23 Control of Queues
 WC24 Constraint and Mixed Integer Programming
 WC26 Project Management I
 WC27 Multicriteria Decision Making I
 WC28 Optimization Stochastic V
 WC29 Decision Analytics Applications in the Media Industry
 WC30 Information Systems II
 WC31 Data-driven Operations Management of Energy Systems
 WC32 Data Mining Methodology
 WC33 Health Care Operations Management
 WC34 Joint Session HAS/Analytics: Unleashing the Potential of Big Data using Visualization in Health Care Delivery
 WC35 Global Issues I
 WC36 Modeling Disease Transmissions Using Contact Networks
 WC37 Health Care Strategy and Policy I
 WC38 Optimization Heuristic Programming
 WC39 Operations Management and Marketing Interface
 WC40 Operations Management/Marketing Interface II
 WC41 Healthcare Operations
 WC43 Innovative Pricing Strategies
 WC44 Contemporary Challenges in Pricing and Revenue Management: Repetitive Purchases and Loss Aversion
 WC45 Sustainability II
 WC46 Sustainability and New Business Models
 WC47 Incentive Issues in Sustainable Operations
 WC48 Revenue Management Pricing I
 WC49 Incentive and Compensation Schemes in Supply Chains
 WC50 Non-Profit Operations Management
 WC51 Consolidation and Asymptotics in Inventory
 WC52 Retail Management III
 WC53 Behavioral Issues in Supply Chains Regarding Quality and Competition
 WC54 Service Science I
 WC55 Decision Analysis II
 WC56 Manufacturing I
 WC57 Power System Design and Optimization
 WC58 Optimal Power Flow in Electric Power Systems II
 WC59 Strategy/Strategic Planning II
 WC60 Flexible Manufacturing Systems
 WC61 Optimization under Uncertainty: Integration of Intermittent and Demand Side Resources in Electric Power Systems
 WC62 Distributed Energy Generation
 WC63 Operations Management V
 WC64 Strategic Decision Making
 WC65 Intelligent Transportation Systems
 WC66 Airline Operations
 WC67 Risk in Freight Transport and Logistics

WC68 Traffic Control
 WC69 Innovative Data Sources in Transportation
 WC70 Vehicle Routing II
 WC71 Transportation Operations II
 WC73 Data Analytics for Reliability Evaluation and Maintenance Optimization II
 WC74 Reliability II
 WD76 Simulation III
 WC77 Supply Chain Competition I
 WC78 Auctions/Mechanism Design
 WC79 Software Demonstration – Palisade

Wednesday, 2:45pm-4:15pm

WD01 Operations Research in Military Medicine and Healthcare
 WD02 Scheduling IV
 WD03 Inventory Management for Supply Chains II
 WD04 Business Applications II
 WD05 The Social Impacts of Social Media Analysis
 WD06 Portfolio Analysis I
 WD07 Risk Analysis I
 WD09 Innovation and Entrepreneurship II
 WD10 E-Business/Commerce II
 WD11 Optimization Integer Programming III
 WD12 Optimization Stochastic IV
 WD13 Stochastic Programming
 WD14 Data Driven Optimization and Applications I
 WD15 Optimization Methodology I
 WD16 Game Theory V
 WD17 Networks and Graphs I
 WD18 Optimization Robust II
 WD19 Core Algorithms and Techniques for Computational Optimization
 WD21 Operations Research Methodologies to Improve Healthcare Operations
 WD22 Stochastic Processes I
 WD23 Queueing Approximation and Simulation
 WD24 Artificial Intelligence I
 WD25 Joint Session AI/ICS: AI Planning and Operations Research
 WD27 Optimization Nonlinear Programming I
 WD28 Decision Analysis V
 WD30 Information Systems III
 WD31 Data Mining in Medical and Sociological Decision Making
 WD32 Data Mining and Optimization
 WD35 Global Issues II
 WD36 Humanitarian Operations Management Applications
 WD37 Health Care Strategy and Policy II
 WD38 Optimization Combinatorial III
 WD39 Marketing/Operations Management
 WD40 Operations Management/Marketing Interface III
 WD41 Scheduling in Healthcare Operations
 WD43 Pricing & Revenue Management with New Ingredients
 WD44 Revenue Management and Pricing in Social Networks
 WD45 Sustainability III
 WD46 Empirical Research in Service Operations
 WD47 Strategic Planning for the Closed Loop Supply Chain
 WD48 Revenue Management Pricing II
 WD49 Facility Location I
 WD50 Urban Spatial and Environmental Issues
 WD51 Strategic Behavior and Decision Making within Supply Chains
 WD52 Retail Management IV
 WD54 Service Science II
 WD55 Decision Analysis III
 WD56 Manufacturing II
 WD57 Electricity Market Design and Operation
 WD58 Renewable-based Optimization Models in Electricity Markets
 WD61 Operations/Economics Interface I
 WD62 Optimization for Renewable Energy Integration

WD63 Operations Management VI
 WD64 Information Elicitation and Aggregation
 WD65 Maritime Transportation
 WD66 Airline Planning: Crew and Maintenance
 WD67 Strategic Freight Demand Models
 WD68 Advances in Transportation Network Modeling
 WD69 Real-Time Traffic Monitoring and Control
 WD70 Vehicle Routing III
 WD71 Transportation Operations III
 WD72 Image and Functional Data Analysis: Methods and Applications
 WD73 Maintenance/Reliability Models
 WD74 Reliability III
 WD76 Simulation and Optimization
 WD77 Supply Chain Competition II
 WD78 Analytic Hierarchy Process

Wednesday, 4:30pm-6:00pm

WE01 Scheduling, Workload and Complexity
 WE02 Scheduling V
 WE03 Inventory Management - Inventory Policies
 WE04 Inventory Management - Stochastic Demand
 WE06 Portfolio Analysis II
 WE07 Risk Analysis II
 WE08 E-Business/Commerce III
 WE09 Research and Development
 WE10 Marketing in E-Business/Commerce
 WE11 Optimization Integer Programming IV
 WE13 Robust/Stochastic Optimization
 WE14 Risk-Aware Decision Making under Uncertainty
 WE15 Optimization Methodology II
 WE16 Optimization Large Scale I
 WE17 Networks and Graphs II
 WE18 Optimization Linear Programming
 WE19 Computational Optimization with Risk and Uncertainty
 WE21 Mathematical Modeling of HIV at the Cellular, Individual, and Population Level
 WE22 Stochastic Processes II
 WE23 New Directions in Applied Probability
 WE24 Artificial Intelligence II
 WE26 Project Management II
 WE27 Multicriteria Decision Making II
 WE29 Big Data: Inference and Prediction
 WE30 Information Systems IV
 WE31 Statistical Roles in Stochastic Decision-Making
 WE32 Data Mining in Manufacturing
 WE33 Scheduling in Residency Rotational Medical Programs
 WE35 Public Health
 WE36 Optimization in Cyber and Physical Systems
 WE37 Health Care Strategy and Policy III
 WE38 Optimization Combinatorial IV
 WE39 Supply Disruption, Price Competition, and Quality
 WE40 Operations Management/Marketing Interface IV
 WE43 Pricing and Inventory Control
 WE44 New Approaches in Dynamic Pricing and Revenue Management
 WE45 Reducing the Carbon Footprint
 WE46 Studies in Customer Queueing Behavior
 WE47 Consumer Returns Management in Retailing
 WE49 Facility Location II
 WE50 Empirical Studies in Supply Chain Risk Management
 WE51 Facilities Planning and Design
 WE52 Productivity and Competitiveness
 WE53 Environmental Operations
 WE54 Service Science III
 WE55 Design Engineering
 WE56 Manufacturing III
 WE57 Stochastic Methods Applied to Power System Operations

WE58	Bi- and Multi-Level Optimization in Energy Systems	WE68	Routing Problems with Uncertainty II
WE59	Technology Management	WE69	Intelligent Traffic Signal Control
WE60	Operations/Economics Interface III	WE70	Vehicle Routing IV
WE61	Operations/Economics Interface II	WE71	Transportation- Public
WE62	Resilience in Power Systems	WE72	Physical and Computer Experiments
WE63	Operations/Finance Interface	WE73	Reliability Test Design
WE64	Advances in Decision Analysis	WE74	Reliability IV
WE65	Rail Transportation	WE76	Simulation and Optimization Applications
WE66	Aviation Revenue Management	WE77	Decision Analysis for Supply Chains
WE67	Topics in Transport II	WE78	New Product Development

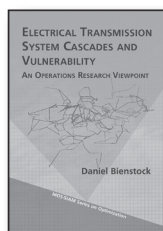
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Electrical Transmission System Cascades and Vulnerability: An Operations Research Viewpoint

Daniel Bienstock

MOS-SIAM Series on Optimization 22

Power grid robustness is a complex problem for two reasons: the underlying physics is mathematically complex, and modeling is complicated by lack of accurate data. This book sheds light on this complex problem by introducing the engineering details of power grid operations from the basic to the detailed and describing how to use optimization and stochastic modeling, with special focus on the modeling of cascading failures and robustness.

December 2015 • Approx. viii + 296 pages • Softcover • 978-1-611974-15-7 • MO22 • Price available at SIAM booth or online

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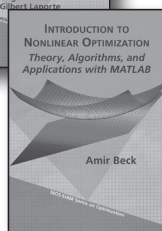
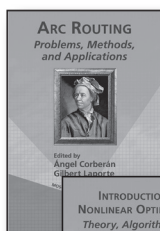
Arc Routing: Problems, Methods and Applications

Ángel Corberán and Gilbert Laporte, Editors

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This thorough and up-to-date discussion of arc routing by world-renowned researchers is organized by problem type and offers a rigorous treatment of complexity issues, models, algorithms, and applications. It opens with a historical perspective of the field and is followed by three sections that cover complexity and the Chinese Postman and the Rural Postman problems; the Capacitated Arc Routing Problem and routing problems with min-max and profit maximization objectives; and important applications, including meter reading, snow removal, and waste collection.

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Introduction to Nonlinear Optimization: Theory, Algorithms, and Applications with MATLAB

Amir Beck

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Readers will find more than 170 theoretical, algorithmic, and numerical exercises that deepen and enhance their understanding of nonlinear optimization. The author includes several subjects not typically found in optimization books—for example, optimality conditions in sparsity-constrained optimization, hidden convexity, and total least squares. The book also offers a large number of applications discussed theoretically and algorithmically.

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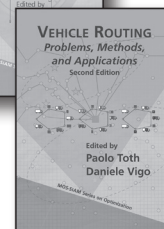
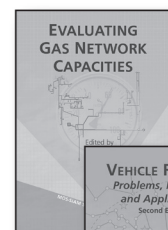
Evaluating Gas Network Capacities

Thorsten Koch, Benjamin Hiller, Marc E. Pfetsch, Lars Schewe, Editors

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This book provides an introduction to the field of gas transportation planning and discusses in detail the advantages and disadvantages of several mathematical models that address gas transport within the context of the technical and regulatory framework. It shows how to solve the models using sophisticated mathematical optimization algorithms and includes examples of large-scale applications of mathematical optimization to this real-world industrial problem.

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The text of this new edition is either completely new or significantly revised and provides extensive and complete state-of-the-art coverage of vehicle routing by those who have done most of the innovative research in the area. It emphasizes methodology related to specific classes of vehicle routing problems and, since vehicle routing is used as a benchmark for all new solution techniques, contains a complete overview of current solutions to combinatorial optimization problems.

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Gathering (Date & Time):

(Session 1)

2 November 2015, Monday
5:00-6:00pm

(Session 2)

3 November 2015, Tuesday
11:00am-12:00nn

Venue: Three Bay Hospitality Suite,
Marriott Philadelphia
Downtown



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