Manufacturing and Service Operations Management Conference 2022

**Book of Abstracts**

Version: June 25, 2022

**Important changes to the earlier communicated draft agenda**

Sunday, June 26

Sustainable Operations SIG

* Sessions SA03 Green Mobility: Government Regulations and Data Analytics was moved to 8:30-10:00 Session SE03 Energy Operations: Efficient Electricity Market and Integration of Energy Storage moved to 17:00-18:30.

Cancellations:

Monday, June 27

* Session MA12-FL1: Presentation “Efficient and Fair? — the Uniform Bottom-Up Output-Based Allocation of Emission Permits”
* Session MB8 - RM2: Presentation “Improving service capacity via coopetition”
* Session MC12 – FL3: Presentation “Inventory management of women top manager under business obstacles”
* 17:45-18:30: MSOM Fellow talk Charles Corbett

Tuesday, June 28

* Session TA3 – HC13: Presentation “An optimization model of organizational structure in blood supply chain”
* Session TA7 – IL5: Presentation “Combined pricing and Inventory control with multiple unreliable Suppliers”
* Session TB12 – FL6: Presentation “Blood platelet inventory management: incorporating data-driven demand forecasts”
* Session TC3 – HC15: Presentation “Pharmaceutical-CRO relationships: Are strategic partnerships the way forward?”
* Session TC12 – FL7: Presentation “Advertising by recruiting influencers”
* Session TD6 – PF7

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| **Date: Sunday, 26/June/2022** |
| SA 8:30-10:008:30am - 10:00am | **SA04 - SIG Service1: Fairness in online resource allocation**Location: Forum 6Session Chair: **Jing Dong**Session Chair: **Rouba Ibrahim** |
| Forum 6 |
| SA 8:30-10:008:30am - 10:00am | **SA03 - SIG Sustainable1: Green Mobility: Government Regulations and Data Analytics**Location: Forum 7Session Chair: **Can Zhang**Session Chair: **Yangfang Helen Zhou** |
| Forum 7 |
| SA 8:30-10:008:30am - 10:00am | **SA02 - SIG Healthcare1: Primary Care**Location: Forum 8Session Chair: **Jonas Jonasson**Session Chair: **Pengyi Shi** |
| Forum 8 |
| SA 8:30-10:008:30am - 10:00am | **SA01 - SIG SCM1: Inventory Innovations**Location: Forum 12Session Chair: **Rachel Chen**Session Chair: **Luyi Gui** |
| Forum 12 |
| SA 8:30-10:008:30am - 10:00am | **SA05- SIG iFORM1: Crowdfunding**Location: Forum 13Session Chair: **Gerry Tsoukalas**Session Chair: **Yuqian Xu** |
| Forum 13 |
| Coffee break10:00am - 10:30am | **S 10:00-10:30: Coffee break Sunday morning** |
|    |
| SB 10:30-12:0010:30am - 12:00pm | **SB04 - SIG Service2: Machine learning in action**Location: Forum 6Session Chair: **Jing Dong**Session Chair: **Rouba Ibrahim** |
| Forum 6 |
| SB 10:30-12:0010:30am - 12:00pm | **SB03 - SIG Sustainable2: Combating Food Waste**Location: Forum 7Session Chair: **Can Zhang**Session Chair: **Yangfang Helen Zhou** |
| Forum 7 |
| SB 10:30-12:0010:30am - 12:00pm | **SB02 - SIG Healthcare2: Volatility and workload of providers**Location: Forum 8Session Chair: **Jonas Jonasson**Session Chair: **Pengyi Shi** |
| Forum 8 |
| SB 10:30-12:0010:30am - 12:00pm | **SB01 - SIG SCM2: Data-Driven Models**Location: Forum 12Session Chair: **Rachel Chen**Session Chair: **Luyi Gui** |
| Forum 12 |
| SB 10:30-12:0010:30am - 12:00pm | **SB05 - SIG iFORM2: Implications of Blockchain technology for operations**Location: Forum 13Session Chair: **Gerry Tsoukalas**Session Chair: **Yuqian Xu** |
| Forum 13 |
| Lunch Break12:00pm - 1:00pm | **S 12:00-13:00: Sunday Lunch** |
|    |
| SC 13:00-14:301:00pm - 2:30pm | **SC04 - SIG Service3: Managing queues in service systems**Location: Forum 6Session Chair: **Jing Dong**Session Chair: **Rouba Ibrahim** |
| Forum 6 |
| SC 13:00-14:301:00pm - 2:30pm | **SC03 - SIG Sustainable3: Socially Responsible Operations**Location: Forum 7Session Chair: **Can Zhang**Session Chair: **Yangfang Helen Zhou** |
| Forum 7 |
| SC 13:00-14:301:00pm - 2:30pm | **SC02 - SIG Healthcare3: The operational aftermath of the pandemic**Location: Forum 8Session Chair: **Jonas Jonasson**Session Chair: **Pengyi Shi** |
| Forum 8 |
| SC 13:00-14:301:00pm - 2:30pm | **SC01 - SIG SCM3: Revenue Management**Location: Forum 12Session Chair: **Rachel Chen**Session Chair: **Luyi Gui** |
| Forum 12 |
| SC 13:00-14:301:00pm - 2:30pm | **SC05 - SIG iFORM3: Supply Chain Financing**Location: Forum 13Session Chair: **Gerry Tsoukalas**Session Chair: **Yuqian Xu** |
| Forum 13 |
| Coffee break2:30pm - 3:00pm | **S 14:30-15:00: Coffee break Sunday afternoon** |
|    |
| SD 15:00-16:303:00pm - 4:30pm | **SD04 - SIG Service4: Platform operations**Location: Forum 6Session Chair: **Jing Dong**Session Chair: **Rouba Ibrahim** |
| Forum 6 |
| SD 15:00-16:303:00pm - 4:30pm | **SD03 - SIG Sustainable4: Emerging Topics: Agricultural Operations and Ocean Waste Recycling**Location: Forum 7Session Chair: **Can Zhang**Session Chair: **Yangfang Helen Zhou** |
| Forum 7 |
| SD 15:00-16:303:00pm - 4:30pm | **SD02 - SIG Healthcare4: Patient flow in healthcare systems**Location: Forum 8Session Chair: **Jonas Jonasson**Session Chair: **Pengyi Shi** |
| Forum 8 |
| SD 15:00-16:303:00pm - 4:30pm | **SD01 - SIG SCM4: E-commerce Analytics**Location: Forum 12Session Chair: **Rachel Chen**Session Chair: **Luyi Gui** |
| Forum 12 |
| SD 15:00-16:303:00pm - 4:30pm | **SD05 - SIG iFORM4: Capacity/Inventory Management under Financial Risks**Location: Forum 13Session Chair: **Gerry Tsoukalas**Session Chair: **Yuqian Xu** |
| Forum 13 |
| SE 17:00-18:305:00pm - 6:30pm | **SE04 - SIG Service5: Evidence-based approach in operations management**Location: Forum 6Session Chair: **Jing Dong**Session Chair: **Rouba Ibrahim** |
| Forum 6 |
| SE 17:00-18:305:00pm - 6:30pm | **SE03 - SIG Sustainable5: Energy Operations: Efficient Electricity Market and Integration of Energy Storage**Location: Forum 7Session Chair: **Can Zhang**Session Chair: **Yangfang Helen Zhou** |
| Forum 7 |
| SE 17:00-18:305:00pm - 6:30pm | **SE02 - SIG Healthcare5: Medical and operational decision making**Location: Forum 8Session Chair: **Jonas Jonasson**Session Chair: **Pengyi Shi** |
| Forum 8 |
| SE 17:00-18:305:00pm - 6:30pm | **SE01 - SIG SCM5: Empirical Supply Chain Management**Location: Forum 12Session Chair: **Rachel Chen**Session Chair: **Luyi Gui** |
| Forum 12 |
| SIG Dinner7:30pm - 10:00pm | **S 19:30-22:00: SIG Dinner** |
|    |
| **Date: Monday, 27/June/2022** |
| MA 8:30-10:008:30am - 10:00am | **MA1 - SO1: Strategies for social sustainability**Location: Forum 1-3Session Chair: **Xabier Barriola** |
| Forum 1-3 |
| MA 8:30-10:008:30am - 10:00am | **MA2 - HC1: Emergency departments 1**Location: Forum 6Session Chair: **Asterios Tsiourvas** |
| Forum 6 |
| MA 8:30-10:008:30am - 10:00am | **MA3 - HC9: Healthcare applications 3**Location: Forum 7Session Chair: **Lina Song** |
| Forum 7 |
| MA 8:30-10:008:30am - 10:00am | **MA4 - BO1: Behavioral newsvendor**Location: Forum 8Session Chair: **Michael Becker-Peth** |
| Forum 8 |
| MA 8:30-10:008:30am - 10:00am | **MA5 - SCM1: Digital technology in SCM**Location: Forum 9Session Chair: **Janice Carrillo** |
| Forum 9 |
| MA 8:30-10:008:30am - 10:00am | **MA6 - PF1: Platform management**Location: Forum 10Session Chair: **Thomas De Munck** |
| Forum 10 |
| MA 8:30-10:008:30am - 10:00am | **MA7 - IL1: Logistics**Location: Forum 11Session Chair: **Sérgio Vasconcelos Castro** |
| Forum 11 |
| MA 8:30-10:008:30am - 10:00am | **MA8 - RM1: Dynamic pricing**Location: Forum 12Session Chair: **Laura Niome Sprenkels** |
| Forum 12 |
| MA 8:30-10:008:30am - 10:00am | **MA9 - EF1: Solar energy**Location: Forum 13Session Chair: **Tarkan Tan** |
| Forum 13 |
| MA 8:30-10:008:30am - 10:00am | **MA10 - RT1: Retail channels**Location: Forum 14Session Chair: **Tim Schlaich** |
| Forum 14 |
| MA 8:30-10:008:30am - 10:00am | **MA11 - ML1: Learning methods**Location: Forum 15Session Chair: **Ho-Yin Mak** |
| Forum 15 |
| MA 8:30-10:008:30am - 10:00am | **MA12 - FL1: Flash: Sustainable Operations**Location: Forum 16Session Chair: **Alexander Bloemer** |
| Forum 16 |
| Coffee break10:00am - 10:30am | **M 10:00-10:30: Coffee break Monday morning** |
|    |
| MB 10:30-12:0010:30am - 12:00pm | **MB1 - SO2: Auditing for sustainability**Location: Forum 1-3Session Chair: **Bengisu Urlu** |
| Forum 1-3 |
| MB 10:30-12:0010:30am - 12:00pm | **MB2- HC2: Emergency departments 2**Location: Forum 6Session Chair: **Vera Tilson** |
| Forum 6 |
| MB 10:30-12:0010:30am - 12:00pm | **MB3- HC10: Healthcare inventory management**Location: Forum 7Session Chair: **Nikos Trichakis** |
| Forum 7 |
| MB 10:30-12:0010:30am - 12:00pm | **MB4 - BO2: Behavior in queues**Location: Forum 8Session Chair: **Hummy Song** |
| Forum 8 |
| MB 10:30-12:0010:30am - 12:00pm | **MB5 - SCM2: Publication and faculty strategy in OM**Location: Forum 9Session Chair: **Richard Daniel Metters** |
| Forum 9 |
| MB 10:30-12:0010:30am - 12:00pm | **MB6 -PF2: Multi-homing in platforms**Location: Forum 10Session Chair: **Sandeep Chitla** |
| Forum 10 |
| MB 10:30-12:0010:30am - 12:00pm | **MB7 - IL2: Warehouse management**Location: Forum 11Session Chair: **Reeju Guha** |
| Forum 11 |
| MB 10:30-12:0010:30am - 12:00pm | **MB8 - RM2: Capacity aspects of revenue management**Location: Forum 12Session Chair: **Mika Sumida** |
| Forum 12 |
| MB 10:30-12:0010:30am - 12:00pm | **MB9 - EF2: Wind power energy**Location: Forum 13Session Chair: **Emre Nadar** |
| Forum 13 |
| MB 10:30-12:0010:30am - 12:00pm | **MB10 - RT2: Omnichannel design**Location: Forum 14Session Chair: **Yale Herer** |
| Forum 14 |
| MB 10:30-12:0010:30am - 12:00pm | **MB11 - ML2: Applications of Learning**Location: Forum 15Session Chair: **Morvarid Rahmani** |
| Forum 15 |
| MB 10:30-12:0010:30am - 12:00pm | **MB12 - FL2: Flash: Revenue Management and Machine Learning**Location: Forum 16Session Chair: **Eunji Lee** |
| Forum 16 |
| MSOM Business Meeting - Lunch12:15pm - 1:45pm | **M 12:15-13:45: MSOM Business Meeting & Monday Lunch** |
|   Forum 1-3 |
| MC 14:00-15:302:00pm - 3:30pm | **MC1: Panel: The future of OM conferences**Location: Forum 1-3Session Chair: **Atalay Atasu**The future of OM conferences |
| Forum 1-3 |
| MC 14:00-15:302:00pm - 3:30pm | **MC2 - HC3: Patient scheduling**Location: Forum 6Session Chair: **Christos Zacharias** |
| Forum 6 |
| MC 14:00-15:302:00pm - 3:30pm | **MC3 - HC11: Healthcare resources**Location: Forum 7Session Chair: **Chaoyu Zhang** |
| Forum 7 |
| MC 14:00-15:302:00pm - 3:30pm | **MC4 - BO3: Performance and feedback**Location: Forum 8Session Chair: **Tom Tan** |
| Forum 8 |
| MC 14:00-15:302:00pm - 3:30pm | **MC5 - SCM3: R&D in supply chains**Location: Forum 9Session Chair: **Yasemin Limon** |
| Forum 9 |
| MC 14:00-15:302:00pm - 3:30pm | **MC6- PF3: Ride hailing**Location: Forum 10Session Chair: **Saif Benjaafar** |
| Forum 10 |
| MC 14:00-15:302:00pm - 3:30pm | **MC7 - IL3: Manufacturing**Location: Forum 11Session Chair: **Florian E. Sachs** |
| Forum 11 |
| MC 14:00-15:302:00pm - 3:30pm | **MC8 - RM3: Auctions and mechanisms**Location: Forum 12Session Chair: **Alireza Fallah** |
| Forum 12 |
| MC 14:00-15:302:00pm - 3:30pm | **MC9 - SM1: Transportation Services**Location: Forum 13Session Chair: **Kashish Arora** |
| Forum 13 |
| MC 14:00-15:302:00pm - 3:30pm | **MC10 - RT3: Omnichannel strategy**Location: Forum 14Session Chair: **Wenxin Xu** |
| Forum 14 |
| MC 14:00-15:302:00pm - 3:30pm | **MC11 - ML3: Prediction and regret**Location: Forum 15Session Chair: **Omar Mouchtaki** |
| Forum 15 |
| MC 14:00-15:302:00pm - 3:30pm | **MC12 - FL3: Flash: Inventory and behavioral models**Location: Forum 16Session Chair: **Alexander Bloemer** |
| Forum 16 |
| Coffee break3:30pm - 4:00pm | **M 15:30:16:00: Coffee break Monday afternoon** |
|    |
| MD 16:00-17:304:00pm - 5:30pm | **MD1 - DEI: MSOM: Diversity, equity, inclusion**Location: Forum 1-3Session Chair: **Siddharth Singh**Session Chair: **Anupam Agrawal**Participants: Sherwat Elwan Ibrahim, Rohit Verma, Jun Li & Christiane Barz |
| Forum 1-3 |
| MD 16:00-17:304:00pm - 5:30pm | **MD2 - HC4: Appointment scheduling**Location: Forum 6Session Chair: **Siddharth Arora** |
| Forum 6 |
| MD 16:00-17:304:00pm - 5:30pm | **MD3- HC12: Approval and testing in healthcare**Location: Forum 7Session Chair: **Wendy Olsder** |
| Forum 7 |
| MD 16:00-17:304:00pm - 5:30pm | **MD4 - BO4: Human machine interaction**Location: Forum 8Session Chair: **Bryce Hunter McLaughlin** |
| Forum 8 |
| MD 16:00-17:304:00pm - 5:30pm | **MD5 - SCM4: Supply chain innovations**Location: Forum 9Session Chair: **Hao Jiang** |
| Forum 9 |
| MD 16:00-17:304:00pm - 5:30pm | **MD6 - PF4: Freight markets and platform pricing**Location: Forum 10Session Chair: **Donghao Zhu** |
| Forum 10 |
| MD 16:00-17:304:00pm - 5:30pm | **MD7 - IL4: Flexibility and sharing**Location: Forum 11Session Chair: **Karca D. Aral** |
| Forum 11 |
| MD 16:00-17:304:00pm - 5:30pm | **MD8 - RM4: Analytics for pricing**Location: Forum 12Session Chair: **Jean Pauphilet** |
| Forum 12 |
| MD 16:00-17:304:00pm - 5:30pm | **MD9 - SM2: Service operations applications 1**Location: Forum 13Session Chair: **Evgeny Kagan** |
| Forum 13 |
| MD 16:00-17:304:00pm - 5:30pm | **MD10 - RT4: Assortment planning 1**Location: Forum 14Session Chair: **Fernando Bernstein** |
| Forum 14 |
| MD 16:00-17:304:00pm - 5:30pm | **MD11 - ML4: Bandit algorithms**Location: Forum 15Session Chair: **Daniel Russo** |
| Forum 15 |
| MD 16:00-17:304:00pm - 5:30pm | **MD12 - FL4: Flash: Supply Chain Management**Location: Forum 16Session Chair: **Niklas Tuma** |
| Forum 16 |
| **Date: Tuesday, 28/June/2022** |
| TA 8:30-10:008:30am - 10:00am | **TA1 - SO3: Sustainability strategy**Location: Forum 1-3Session Chair: **Morris Cohen** |
| Forum 1-3 |
| TA 8:30-10:008:30am - 10:00am | **TA2 - HC5: Healthcare applications 1**Location: Forum 6Session Chair: **Ozden Engin Cakici** |
| Forum 6 |
| TA 8:30-10:008:30am - 10:00am | **TA3 - HC13: Optimization in healthcare**Location: Forum 7Session Chair: **Thomas Breugem** |
| Forum 7 |
| TA 8:30-10:008:30am - 10:00am | **TA4 - BO5: Events and queuing behavior**Location: Forum 8Session Chair: **Yueyang Zhong** |
| Forum 8 |
| TA 8:30-10:008:30am - 10:00am | **TA5 - SCM5: Supply Chain Risk**Location: Forum 9Session Chair: **Keno Theile** |
| Forum 9 |
| TA 8:30-10:008:30am - 10:00am | **TA6 - PF5: Platform applications**Location: Forum 10Session Chair: **Mahsa Hosseini** |
| Forum 10 |
| TA 8:30-10:008:30am - 10:00am | **TA7 - IL5: Inventory management**Location: Forum 11Session Chair: **Ioannis Spantidakis** |
| Forum 11 |
| TA 8:30-10:008:30am - 10:00am | **TA8 - EF3: Energy Storage**Location: Forum 12Session Chair: **Christopher Chen** |
| Forum 12 |
| TA 8:30-10:008:30am - 10:00am | **TA9 - SM3: Estimation and optimization for services**Location: Forum 13Session Chair: **Lucas Weber** |
| Forum 13 |
| TA 8:30-10:008:30am - 10:00am | **TA10 - RT5: Online retail**Location: Forum 14Session Chair: **Fábio Neves-Moreira** |
| Forum 14 |
| TA 8:30-10:008:30am - 10:00am | **TA11 - ML5: Learning algorithms**Location: Forum 15Session Chair: **Antoine Desir** |
| Forum 15 |
| TA 8:30-10:008:30am - 10:00am | **TA12 - FL5: Flash: Healthcare 1**Location: Forum 16Session Chair: **Donghao Zhu** |
| Forum 16 |
| Coffee break10:00am - 10:30am | **T 10:00-10:30: Coffee break Tuesday morning** |
|    |
| TB 10:30-12:0010:30am - 12:00pm | **TB1 - SO4: Applications in sustainable supply chains**Location: Forum 1-3Session Chair: **Elisabeth Paulson** |
| Forum 1-3 |
| TB 10:30-12:0010:30am - 12:00pm | **TB2- HC6: Machine learning for health care**Location: Forum 6Session Chair: **Kyra Gan** |
| Forum 6 |
| TB 10:30-12:0010:30am - 12:00pm | **TB3 - HC14: Operations control in healthcare**Location: Forum 7Session Chair: **Pengyi Shi** |
| Forum 7 |
| TB 10:30-12:0010:30am - 12:00pm | **TB4- BO6: Bullwhip effect and contracts**Location: Forum 8Session Chair: **Kai Wendt** |
| Forum 8 |
| TB 10:30-12:0010:30am - 12:00pm | **TB5 - SCM6: Supply Chain Resilience**Location: Forum 9Session Chair: **Dmitry Ivanov** |
| Forum 9 |
| TB 10:30-12:0010:30am - 12:00pm | **TB6 - Africa Initiative: MSOM Africa Initiative**Location: Forum 10Session Chair: **Burak Kazaz** |
| Forum 10 |
| TB 10:30-12:0010:30am - 12:00pm | **TB7 - SM7: Service staffing and capacity allocation**Location: Forum 11Session Chair: **Gar Goei Loke** |
| Forum 11 |
| TB 10:30-12:0010:30am - 12:00pm | **TB8 - RM5: Online algorithms in revenue management**Location: Forum 12Session Chair: **Will Ma** |
| Forum 12 |
| TB 10:30-12:0010:30am - 12:00pm | **TB9 - SM4: Real estate and hospitality services**Location: Forum 13Session Chair: **Abhishek Deshmane** |
| Forum 13 |
| TB 10:30-12:0010:30am - 12:00pm | **TB10 - RT6: Retail analytics**Location: Forum 14Session Chair: **Saravanan Kesavan** |
| Forum 14 |
| TB 10:30-12:0010:30am - 12:00pm | **TB11 - RT9: Product returns**Location: Forum 15Session Chair: **Mehmet Sekip Altug** |
| Forum 15 |
| TB 10:30-12:0010:30am - 12:00pm | **TB12 - FL6: Flash: Healthcare 2**Location: Forum 16Session Chair: **Niklas Tuma** |
| Forum 16 |
| Lunch12:00pm - 1:00pm | **T 12:00-14:00: Tuesday Lunch** |
|    |
| Plenary: MSOM Fellow Talk 1:00pm - 1:45pm | **T 13:00-13:45: MSOM Fellow Talk**Location: Forum 1-3Session Chair: **Burak Kazaz**Session Chair: **Owen Wu** |
| Forum 1-3 |
| TC 14:00-15:302:00pm - 3:30pm | **TC1 - SO5: Labor aspects in sustainable supply chains**Location: Forum 1-3Session Chair: **Zhoupeng Zhang** |
| Forum 1-3 |
| TC 14:00-15:302:00pm - 3:30pm | **TC2 - HC7: Bandit algorithms in health care**Location: Forum 6Session Chair: **Jackie Baek** |
| Forum 6 |
| TC 14:00-15:302:00pm - 3:30pm | **TC3 - HC15: Healthcare innovations**Location: Forum 7Session Chair: **Andreas K. Gernert** |
| Forum 7 |
| TC 14:00-15:302:00pm - 3:30pm | **TC4 - BO7: Customer behavior and populations**Location: Forum 8Session Chair: **Freddy Lim** |
| Forum 8 |
| TC 14:00-15:302:00pm - 3:30pm | **TC5 - EF4: Supply Chain Finance**Location: Forum 9Session Chair: **David Wuttke** |
| Forum 9 |
| TC 14:00-15:302:00pm - 3:30pm | **TC6 - PF6: Online platforms**Location: Forum 10Session Chair: **Yeqing Zhou** |
| Forum 10 |
| TC 14:00-15:302:00pm - 3:30pm | **TC7 - SM8: Queuing models in services 1**Location: Forum 11Session Chair: **Jingui Xie** |
| Forum 11 |
| TC 14:00-15:302:00pm - 3:30pm | **TC8 - RM6: Choice and promotions**Location: Forum 12Session Chair: **Yi Chen** |
| Forum 12 |
| TC 14:00-15:302:00pm - 3:30pm | **TC9 - SM5: Service operations applications 2**Location: Forum 13Session Chair: **Jun Li** |
| Forum 13 |
| TC 14:00-15:302:00pm - 3:30pm | **TC10 - RT7: Environmental and financial aspects in retail**Location: Forum 14Session Chair: **Afshin Mansouri** |
| Forum 14 |
| TC 14:00-15:302:00pm - 3:30pm | **TC11 - RT10: Food waste 1**Location: Forum 15Session Chair: **Tobias Winkler** |
| Forum 15 |
| TC 14:00-15:302:00pm - 3:30pm | **TC12 - FL7: Flash: Services 1**Location: Forum 16Session Chair: **Eunji Lee** |
| Forum 16 |
| Coffee break3:30pm - 4:00pm | **T 15:30-16:00: Coffee break Tuesday afternoon** |
|    |
| TD 16:00-17:304:00pm - 5:30pm | **TD1- SO6: Environmental strategies**Location: Forum 1-3Session Chair: **Ece Gulserliler** |
| Forum 1-3 |
| TD 16:00-17:304:00pm - 5:30pm | **TD2 - HC8: Healthcare applications 2**Location: Forum 6Session Chair: **Sandeep Rath** |
| Forum 6 |
| TD 16:00-17:304:00pm - 5:30pm | **TD3 - HC16: Healthcare analytics**Location: Forum 7Session Chair: **Jiatao Ding** |
| Forum 7 |
| TD 16:00-17:304:00pm - 5:30pm | **TD4 - BO8: Innovation and projects in behavioral operations**Location: Forum 8Session Chair: **Ramazan Kizilyildirim** |
| Forum 8 |
| TD 16:00-17:304:00pm - 5:30pm | **TD5 - EF5: Financial performance**Location: Forum 9Session Chair: **Guillaume Lapierre-Berger** |
| Forum 9 |
| TD 16:00-17:304:00pm - 5:30pm | **TD6 - PF7: Platform design**Location: Forum 10Session Chair: **Ilan Morgenstern** |
| Forum 10 |
| TD 16:00-17:304:00pm - 5:30pm | **TD7 - SM9: Queuing models in services 2**Location: Forum 11Session Chair: **Ricky Roet-Green** |
| Forum 11 |
| TD 16:00-17:304:00pm - 5:30pm | **TD8 - RM7: Pricing**Location: Forum 12Session Chair: **Chung Piaw Teo** |
| Forum 12 |
| TD 16:00-17:304:00pm - 5:30pm | **TD9 - SM6: Performance evaluation for services**Location: Forum 13Session Chair: **Cornelia Schön** |
| Forum 13 |
| TD 16:00-17:304:00pm - 5:30pm | **TD10 - RT8: Assortment planning 2**Location: Forum 14Session Chair: **Arash Asadpour** |
| Forum 14 |
| TD 16:00-17:304:00pm - 5:30pm | **TD11 - RT11: Food waste 2**Location: Forum 15Session Chair: **Nina Mayer** |
| Forum 15 |
| TD 16:00-17:304:00pm - 5:30pm | **TD12 - FL8: Flash: Services 2**Location: Forum 16Session Chair: **Donghao Zhu** |
| Forum 16 |

### SA04 - SIG Service1: Fairness in online resource allocation

Time: Sunday, 26/June/2022: SA 8:30-10:00  ·  Location: Forum 6
Session Chair: Jing Dong
Session Chair: Rouba Ibrahim

Fair assortment planning

Qinyi Chen1, Negin Golrezaei1, Fransisca Susan1, Edy Baskoro2

1Massachusetts Institute of Technology, United States of America; 2Institut Teknologi Bandung, Indonesia; qinyic@mit.edu

Discussant: Omar El Housni (Cornell University)

We introduce and study a fair assortment planning problem, where any two products with similar merits are offered similar visibility. We propose a framework to find near-optimal solutions to this problem, using the Ellipsoid method and a separation oracle to its dual. We then develop two approximate separation oracles, which result in a polynomial-time 1/2-approx. algorithm and an FPTAS for our problem. We conclude with a case study on a movie dataset, showing the efficacy of our algorithms.

Fair dynamic rationing

Vahideh Manshadi1, Rad Niazadeh2, Scott Rodilitz3

1Yale School of Management; 2University of Chicago, Booth School of Business; 3Stanford Graduate School of Business; scott.rodilitz@gmail.com

Discussant: Gad Allon (University of Pennsylvania)

Social planners often aim to equitably and efficiently ration a social good among agents whose (possibly correlated) demands realize sequentially. We design a simple adaptive policy that simultaneously achieves the best-possible guarantees on the expected minimum fill rate and the minimum expected fill rate, where each agent's fill rate is determined by an irrevocable, one-time allocation. We complement our results with a numerical study motivated by the rationing of COVID-19 medical supplies.

### SA03 - SIG Sustainable1: Green Mobility: Government Regulations and Data Analytics

Time: Sunday, 26/June/2022: SA 8:30-10:00  ·  Location: Forum 7
Session Chair: Can Zhang
Session Chair: Yangfang Helen Zhou

Curbing emissions: environmental regulations and product offerings across markets

Zheng Han1, Bin Hu2, Milind Dawande2

1University of Science and Technology of China; 2University of Texas at Dallas; bin.hu@utdallas.edu

Discussant: Owen Wu (Indiana University)

The Trump administration’s 2018 announcement to freeze the EPA standard threatened to widen its gap from the CARB standard and cause a split market where automakers offer differentiated car models in CARB and non-CARB states. Inspired by this crisis, we adopt a game-theoretic model where two regulators set efficiency standards in their respective markets. We show that horizontal negotiations and vertical negotiations can both unify a split market and reduce emissions.

Planning bike lanes with data: ridership, congestion, and path selection

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Discussant: Ho-Yin Mak (University of Oxford)

Bike lane expansion promotes cycling and reduces car traffic, but narrows vehicle lanes and amplifies congestion. We study the bike lane planning problem considering the conflicting effects. In an extensive case study in Chicago, we present a consistent estimator for travel-time function and optimize new bike lane locations while enforcing traffic equilibrium. We estimate 25 miles of new bike lanes increase cycling ridership by 76%, with at most an 8% increase in driving time between each OD pair.

### SA02 - SIG Healthcare1: Primary Care

Time: Sunday, 26/June/2022: SA 8:30-10:00  ·  Location: Forum 8
Session Chair: Jonas Jonasson
Session Chair: Pengyi Shi

Continuity of care increases clinical productivity in primary care

Harshita Kajaria Montag1, Michael Freeman2, Stefan Scholtes3

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Discussant: Hummy Song (The Wharton School, University of Pennsylvania)

Relational Continuity (RC) in primary care confers many reported benefits, yet it has been in sharp decline. Using multiple econometric techniques on a large consultation-level dataset comprising of 5M patients registered with 300 primary care practices across the UK over the course of 10 years, we find that RC has a significant productivity benefit, with operational and strategic implications for primary care practices and third-party payers.

The power of data: Assessing primary care performance using routinely collected Emergency Department data

Nicos Savva1, Sandra Sülz2, Mark Kinirons3, Richard Leach3

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Discussant: Fernanda Bravo (UCLA)

The rising demand for Emergency Department (ED) care is partially driven by the failure to provide timely and high-quality primary care, resulting in patients being forced to use EDs. It is therefore important to identify primary care practices (PCPs) whose patients place a lower burden on ED departments so that best practices can be identified and disseminated, and practices whose patients place a higher burden in order to provide support. This work develops and validates one such methodology.

### SA01 - SIG SCM1: Inventory Innovations

Time: Sunday, 26/June/2022: SA 8:30-10:00  ·  Location: Forum 12
Session Chair: Rachel Chen
Session Chair: Luyi Gui

Learning from the aggregated optimum: decision rules for managing ameliorating food inventory

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The management of ameliorating food inventories with age-differentiated products entails a trade-off between immediate revenues and further maturation. We derive interpretable decision rules for purchasing, fulfilment, and issuance decisions under purchase price and decay uncertainty. We learn the rules from the optimal policy for an aggregated problem. A linear program facilitates scaling back. For a port wine industry case, our derived management strategies yield a substantial profit increase.

Fixing inventory inaccuracies at scale

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We observe that detecting inventory inaccuracies can be viewed as a problem of identifying anomalies in a (low-rank) Poisson matrix. We propose a conceptually simple approach whose cost approaches that of an optimal algorithm at a min-max optimal rate. Using data from a consumer goods retailer, we show that our approach provides up to a 10× cost reduction over incumbent approaches to anomaly detection.

Predictive 3D printing with IoT

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We consider the problem of a 3D printer supplying a critical part installed in multiple machines embedded with sensors and interconnected via IoT. We show that it is optimal to print-to-stock predictively in advance of demand, triggered by a system-lifetime-status dependent threshold. We further quantify the impact of IoT on system cost and inventory by separately assessing the impact of advance demand information from embedded sensors and that of IoT's real-time information fusion.

### SA05- SIG iFORM1: Crowdfunding

Time: Sunday, 26/June/2022: SA 8:30-10:00  ·  Location: Forum 13
Session Chair: Gerry Tsoukalas
Session Chair: Yuqian Xu

Product development in crowdfunding: Theoretical and empirical analysis

Sidika Tunc Candogan1, Philipp B. Cornelius2, Bilal Gokpinar1, Ersin Korpeoglu1, Christopher S. Tang3

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Entrepreneurs often use crowdfunding to solicit feedback from customers to improve their products, and may therefore prefer to launch crowdfunding campaigns for a basic version of their products. Yet, customers may not be persuaded by a campaign if a product appears too basic. Analyzing a game-theoretical model and testing its predictions empirically, we study how a product’s level of enhancement at campaign launch influences product improvements during campaign and campaign success.

All-or-Nothing vs Keep-it-All: comparing campaign designs in rewards-based crowdfunding platforms

Ekaterina Astashkina2, Simone Marinesi1

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We compare the two most popular campaign designs employed by rewards-based crowdfunding platforms: All-or-Nothing (AoN), in which the entrepreneur collects the money pledged by backers only if the project can raise the funding goal set for the campaign, and Keep-it-All (KiA), in which the entrepreneur collects the money pledged by backers even when the funds raised are less than the funding goal. We provide guidelines for which design performs best as a function of campaign characteristics.

### SB04 - SIG Service2: Machine learning in action

Time: Sunday, 26/June/2022: SB 10:30-12:00  ·  Location: Forum 6
Session Chair: Jing Dong
Session Chair: Rouba Ibrahim

Cold start to improve market thickness on online advertising platforms: data-driven algorithms and field experiments

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Discussant: Santiago Gallino (The Wharton School)

To solve the cold start problem on advertising platforms, we build a data-driven optimization model that captures the essential trade-off between short-term revenue and long-term market thickness on the platform, and propose a bandit algorithm to solve the problem. We also demonstrate the effectiveness of our algorithm via a novel two-sided randomized field experiment, and show our algorithm increases the cold start success rate by 62% and boosts the platform’s overall market thickness by 3.1%.

Synthetically Controlled Bandits

Vivek Farias3, Ciamac Moallemi2, Tianyi Peng4, Andrew Zheng1

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Discussant: Hamsa Bastani (Wharton School, University of Pennsylvania)

We present a dynamic experimental design for settings where the experimental units are coarse (e.g. to mitigate interference). `Region-split' experiments on online platforms are one such setting. Our design, dubbed Synthetically Controlled Thompson Sampling (SCTS), minimizes the cost (i.e. regret) associated with experimentation at no meaningful loss to inferential ability. We provide theoretical guarantees and experiments highlighting the merits of SCTS relative to fixed and switchback designs.

### SB03 - SIG Sustainable2: Combating Food Waste

Time: Sunday, 26/June/2022: SB 10:30-12:00  ·  Location: Forum 7
Session Chair: Can Zhang
Session Chair: Yangfang Helen Zhou

Estimating Stockout Costs and Optimal Stockout Rates to improve the Management of Ugly Produce Inventory

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Discussant: Victor Martínez de Albéniz (IESE Business School)

Efficiently managing inventories requires an accurate estimation of stockout costs. This estimation is complicated by challenges in determining how to compensate consumers monetarily so that they will maintain the same level of utility had stockouts not occurred. This paper presents an analysis of these compensation costs, as applied to the design of optimal stockout rates by an online retailer selling to consumers aesthetically substandard fruits and vegetables rejected by mainstream grocers.

On the Management of Premade Foods

Jae-Hyuck Park1, Dan A. Iancu2, Erica Plambeck2

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Discussant: Dorothee Honhon (University of Texas at Dallas)

We examine a grocery retailer's management of premade food. The retailer's objective is to maximize the direct profit plus (weighted) customer welfare generated the food product. The retailer chooses: the shelf life, FIFO vs. LIFO issuance, and whether or not to time-stamp items. Our first main result is that LIFO issuance is universally optimal. Second, the retailer time-stamps items if the disposal cost for unsold items is low or the retailer puts sufficient weight on customer welfare.

### SB02 - SIG Healthcare2: Volatility and workload of providers

Time: Sunday, 26/June/2022: SB 10:30-12:00  ·  Location: Forum 8
Session Chair: Jonas Jonasson
Session Chair: Pengyi Shi

"I Quit": Schedule volatility as a driver of voluntary employee turnover

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Discussant: Harshita Kajaria Montag (University of Cambridge)

We examine how employer-driven volatility in workers' schedules impacts their decision to voluntarily leave their job. Using time-stamped work log data of home health nurses, we construct and study an operational measure of schedule volatility. Using an instrumental variables approach, we find that higher levels of schedule volatility substantially increase workers' likelihood of quitting. Using policy simulations, we illustrate how schedule volatility, and employee turnover, could be mitigated.

Does What Happens in the ED Stay in the ED? The Effects of Emergency Department Physician Workload on Post-ED Care Use

Mohamad Soltani1, Robert J. Batt2, Hessam Bavafa2, Brian W. Patterson3

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Discussant: Zhichao Zheng (Singapore Management University)

Using a data set assembled from detailed ED visit-level data and exhaustive billing data in an integrated health system, we show that there is an increasing concave relationship between ED physician workload and post-ED care use. Further, we identify ED physician test ordering behavior as a mechanism of these effects. Together, these findings suggest that when ED physician workload increases, resource utilization increases in the ED and several other channels of care in the healthcare system.

### SB01 - SIG SCM2: Data-Driven Models

Time: Sunday, 26/June/2022: SB 10:30-12:00  ·  Location: Forum 12
Session Chair: Rachel Chen
Session Chair: Luyi Gui

A data-driven model of a firm's operations with application to cash flow forecasting

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A firm’s cash flow from operations is a function of the contemporaneous and lagged values of its operational variables---sales, operating cost, inventory, payables, etc. Estimating this function is important for forecasting and managing cash flows. However, cash flow forecasting is a challenging problem. In this paper, we propose a generalizable and data-driven model of a firm's operations to disentangle this endogeneity and estimate causal impacts among variables.

How big should your data really be? Data-driven newsvendor and the transient of learning

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We study the data-driven newsvendor problem in which the decision-maker must trade-off underage and overage costs and only observes historical demand. Our metric of interest is the worst-case relative expected regret, compared to an oracle knowing the demand distribution. We provide an exact analysis of Sample Average Approximation across all data sizes. We also derive a minimax optimal algorithm and its performance. Our work reveals that tens of samples are sufficient to perform efficiently.

### SB05 - SIG iFORM2: Implications of Blockchain technology for operations

Time: Sunday, 26/June/2022: SB 10:30-12:00  ·  Location: Forum 13
Session Chair: Gerry Tsoukalas
Session Chair: Yuqian Xu

Supply chain transparency and blockchain design

Yao Cui1, Vishal Gaur1, Jingchen Liu2

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We consider two ways that blockchain can enhance supply chain transparency: (1) making the manufacturer’s sourcing cost transparent to the buyers (vertical cost transparency), and (2) making the ordering status of buyers transparent to each other (horizontal order transparency). We develop prescriptions to supply chain practitioners with regard to when blockchain should be adopted, who should be the initiator, and how to design the blockchain’s access control layer for the logistics data.

Accounts receivable tokenization in multitier supply networks

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Accounts receivable can be turned into digital assets that program ownership and the flow of cash into transferable tokens that can either be sold on at a discount via factoring or be passed on to the upstream of the supply chain as a payment instrument. This paper investigates how accounts receivable tokenization impacts the multitier supply chain's decisions and profits under different configurations and contractual forms.

Measuring utility and speculation in blockchain tokens

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Problem Definition: A large segment of cryptoassets consists of tokens that serve as a payment or governance mechanism for a digital platform, usually a peer-to-peer marketplace of various services. An ongoing debate about the viability of the token market is centered on whether tokens are used purely for speculation, or have actual utility on their underlying platforms. The objective of this study is to create and validate a set of granular measures of token utility and speculation.

### SC04 - SIG Service3: Managing queues in service systems

Time: Sunday, 26/June/2022: SC 13:00-14:30  ·  Location: Forum 6
Session Chair: Jing Dong
Session Chair: Rouba Ibrahim

The psychology of virtual queue: when waiting feels less like waiting

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Discussant: Qiuping Yu (Georgia Institute of Technology)

We use a text mining approach to extract waiting complaints from over 0.72 million online customer reviews of restaurants and conduct difference-in-differences regressions to estimate the impact of Virtual Queue (VQ). We find that VQ reduces customers' pre-process waiting complaints and does not lead to in-process waiting complaints increase. VQ also enhances customers' overall satisfaction. Service providers who face high substitutability or offer low-value service are benefited most from VQ.

Fair scheduling of heterogeneous customer populations

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Discussant: Laurens Debo (Tuck School of Business)

When managing service systems, it is common to use priority rules based on some operational criteria. We consider the societal implications of such individual-focused priority policies, when individuals are members of broader population groups. We find that optimal service policies can lead to significant inequity across population groups. We propose policies that generate equitable outcomes across populations with little, or at times, even no additional system cost.

### SC03 - SIG Sustainable3: Socially Responsible Operations

Time: Sunday, 26/June/2022: SC 13:00-14:30  ·  Location: Forum 7
Session Chair: Can Zhang
Session Chair: Yangfang Helen Zhou

Unmasking human trafficking risk in commercial sex supply chains with machine learning

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Discussant: Chung Piaw Teo (NUS)

The covert nature of sex trafficking provides a barrier to generating large-scale, data-driven insights to inform law enforcement, policy and social work. We leverage massive deep web data (collected from leading commercial sex websites) with a novel machine learning framework to study how and where sex worker recruitment occurs. We provide a geographical network view of commercial sex supply chains, highlighting deceptive recruitment-to-sales pathways that signal high trafficking risk.

The effect of social impact language on employee recruitment

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Discussant: Charles Corbett (UCLA Anderson School of Management)

Firms use social impact claims to attract workers, but the credibility of these claims is understudied. We suggest that when social impact is presented as corporate purpose, firm capacity is a key source of credibility. Using an online job board, we use topic modeling to confirm that (i) firms present social impact as purpose, (ii) purpose claims attract job seekers, and (iii) the latter effect is moderated by firm size. We experimentally confirm that perceptions of capacity drive our results.

### SC02 - SIG Healthcare3: The operational aftermath of the pandemic

Time: Sunday, 26/June/2022: SC 13:00-14:30  ·  Location: Forum 8
Session Chair: Jonas Jonasson
Session Chair: Pengyi Shi

Dynamic capacity management for deferred surgeries

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Discussant: Jean Pauphilet (London Business School)

The COVID-19 pandemic has necessitated widespread deferrals of elective surgeries, which non only increase the cost from deterioration of patients' conditions but also decrease the revenue. We develop a robust optimization framework for the dynamic surgical capacity management problem. Our Implementation for more than 15,000 hernia patients in the United States demonstrates sizable improvements over alternative methods by up to 10% with multiple practical insights on optimal expansion strategy.

Quantifying the benefits of targeting for pandemic response

Sergio Camelo1, Florin Ciocan2, Dan Iancu1,2, Xavier Warnes1, Spyros Zoumpoulis2

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Discussant: Elodie Adida (University of California at Riverside)

We propose and implement a rigorous framework and algorithms to quantify the merits of targeted confinement interventions for pandemic response, and demonstrate them in a case study of COVID-19 in Île-de-France. We find that optimized interventions that differentiate based on both population groups and activities are interpretable, and achieve significantly better health and economic outcomes, while also reducing confinement time for each group, compared to less targeted interventions.

### SC01 - SIG SCM3: Revenue Management

Time: Sunday, 26/June/2022: SC 13:00-14:30  ·  Location: Forum 12
Session Chair: Rachel Chen
Session Chair: Luyi Gui

Network revenue management with nonparametric demand learning: \sqrt{T}-regret and polynomial dimension dependency

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This paper studies the classic price-based network revenue management (NRM) problem with demand learning. The retailer dynamically decides prices of n products over a finite selling season (of length T) subject to m resource constraints, with the purpose of maximizing the cumulative revenue. In this paper, we focus on nonparametric demand model with some mild technical assumptions which are satisfied by most of the commonly used demand functions.

Optimal algorithm for solving composition of convex function with random functions and its applications in network revenue management

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Various operations management problems can be formulated as stochastic optimization under random truncation. Leveraging a convex reformulation, we propose a mirror gradient method that achieves global convergence for the nonconvex objective with optimal complexity. The proposed method only operates in the original space using estimators of the nonconvex objective and consistently outperforms several state-of-the-art control policies in passenger and air-cargo network revenue management.

Joint assortment optimization and personalization

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We consider a joint customization and assortment optimization problem. A firm faces customers of different types, each making a choice according to a different MNL model. The firm picks an assortment of products to carry subject to a constraint. Then, a customer of a certain type arrives into the system and the firm customizes the assortment that it carries by, possibly, dropping products from the assortment. We study the value of customization, the complexity of the problem and design novel algorithms.

### SC05 - SIG iFORM3: Supply Chain Financing

Time: Sunday, 26/June/2022: SC 13:00-14:30  ·  Location: Forum 13
Session Chair: Gerry Tsoukalas
Session Chair: Yuqian Xu

Financing a sustainable supply chain

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We study the role of financing in establishing supply chain (SC) sustainability. We consider an SC where a buyer sources from a financially constrained supplier, who borrows from either a bank or the buyer. We show that both bank financing and buyer financing cannot simultaneously manage SC sustainability and profitability. We thus propose an alternative, in which the supplier borrows from a bank but the buyer offers a reward if the supplier passes the audit, and demonstrates its effectiveness.

Retailer-initiated inventory-based financing

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We study the contract design and the effectiveness of the retailer initiated inventory-based financing (IBF) scheme. Using a game-theoretical model, we derive the small retailer’s optimal inventory ordering and pledging decisions during the stockpiling phase and characterize the optimal interest rate for the large retailer. We also empirically study the small retailer’s borrowing pattern and estimate the impact of the interest rate on the small retailers’ planning horizon and the loan amount.

### SD04 - SIG Service4: Platform operations

Time: Sunday, 26/June/2022: SD 15:00-16:30  ·  Location: Forum 6
Session Chair: Jing Dong
Session Chair: Rouba Ibrahim

Structuring online communities

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Discussant: Yiangos Papanastasiou (UC Berkeley)

Users in online communities can ask questions and other users can answer these questions. Generally, question answerers get rewards while the askers gain knowledge if their questions get answered. We model the community as a stochastic game and find how users decide to participate in such communities. We theoretically validate the empirically observed network structure in such communities. Further, we find that the number of users in the community is non-monotonic in the participation cost.

On-demand transportation: Drivers wages versus platform profit

Omar Besbes1, Vineet Goyal1, Garud Iyengar1, Raghav Singal2

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Discussant: Philipp Afeche (University of Toronto)

Motivated by the debate around drivers' welfare in on-demand transportation, we propose a framework to evaluate current practices and possible alternatives. The platform allocates time slots to drivers, who are strategic agents maximizing their utility, which depends on their temporal preference (when to drive), slots they are allocated, and time they spend on-road. We use our framework to evaluate existing policies and propose improvements with respect to platform profit and drivers' wages.

### SD03 - SIG Sustainable4: Emerging Topics: Agricultural Operations and Ocean Waste Recycling

Time: Sunday, 26/June/2022: SD 15:00-16:30  ·  Location: Forum 7
Session Chair: Can Zhang
Session Chair: Yangfang Helen Zhou

Innovative business models in ocean-bound plastic recycling

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Discussant: Robert Swinney (Duke University)

30 million tons of plastic reach the ocean each year, most from developing countries. We study novel business models to address this problem. Firms profitably recycle plastic to reduce ocean pollution while positively impacting local communities. They sell (a) plastic offsets and (b) segregated plastic. We analyze a supply chain model of (a), (b) or both. Adopting both attains larger environmental and social impacts and profitability. We use empirical data to unveil additional insights.

Improving cash-constrained smallholder farmers' revenue: The role of government loans

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Discussant: Jayashankar Swaminathan (University of North Carolina at Chapel Hill)

A critical challenge faced by smallholder farmers is that the need for immediate cash often forces them to sell their crops at sub-optimal times. This paper develops a game-theoretic model to examine how cash constraints influence farmers' selling decisions across the harvest and lean seasons, as well as to analyze the efficacy of government loan programs in improving farmers' revenue. Finally, we use field data of Bengal gram farmers in India to empirically validate and quantify our insights.

### SD02 - SIG Healthcare4: Patient flow in healthcare systems

Time: Sunday, 26/June/2022: SD 15:00-16:30  ·  Location: Forum 8
Session Chair: Jonas Jonasson
Session Chair: Pengyi Shi

Design of patient visit itineraries in tandem systems

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Discussant: Jingui Xie (Technical University of Munich)

In many healthcare settings, patients receive a series of services during a single visit, e.g., infusion care and orthopedic visit. A key commonality is the tandem structure where each stage involves a non-trivial random service time. We develop the first analytic model to provide each patient an individualized visit itinerary in a tandem health service system. A case study populated by data from a large infusion center shows that our approach makes a remarkable 27% cost reduction over practice.

What causes delays in admission to rehabilitation care? A structural estimation approach

Jing Dong1, Berk Gorgulu2, Vahid Sarhangian2

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Discussant: Christopher Chen (Indiana University)

Delays in admission to rehabilitation care can be both capacity-driven and/or due to processing delays. Standard data however only includes a single measure of delay, and the bed allocation decisions in practice do not follow a systematic policy. We propose a hidden Markov model to estimate the processing times and the status-quo bed allocation policy. We validate our structural model and conduct counterfactual experiments to evaluate various operational interventions aimed at reducing delays.

### SD01 - SIG SCM4: E-commerce Analytics

Time: Sunday, 26/June/2022: SD 15:00-16:30  ·  Location: Forum 12
Session Chair: Rachel Chen
Session Chair: Luyi Gui

Online advertisement allocation under customer choices and algorithmic fairness

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In this paper, we explore dynamic ad allocation with limited slots upon each customer arrival for e-commerce platforms when customers follow a choice model to click the ads. Motivated by the recent advocacy for the algorithmic fairness, we adjust the value from advertising by a general fairness metric evaluated with the click-throughs of different ads and customer types. We propose a two-stage stochastic program and design a debt-weighted offer-set algorithm to solve the online problem.

Designing Sparse Graphs for Stochastic Matching with an Application to Middle-Mile Transportation Management

Yifan Feng1, Rene Caldentey2, Linwei Xin2, Yuan Zhong2, Bing Wang3, Haoyuan Hu3

1National University of Singapore; 2University of Chicago; 3Zhejiang Cainiao Supply Chain Management Co., Ltd; yifan.feng@nus.edu.sg

Motivated by the middle-mile delivery operations of an e-retailer, we consider the problem of designing a sparse graph that supports a large matching after random node deletion. We study three families of sparse graph designs (namely, Clusters, Rings, and Erdos Renyi graphs) and show that their performances are close to the complete graph. We test our theory using real data and conclude that adding a little flexibility to the routing network can significantly reduce transportation costs.

Simple and order-optimal correlated rounding schemes for multi-item e-commerce order fulfillment

Will Ma

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We provide the first improvements to the celebrated correlated rounding procedure of Jasin and Sinha (2015), which has become a fundamental problem in multi-item e-commerce order fulfillment.

We derive rounding schemes with guarantees of $1+\ln(n)$ and $d$, where $d$ is the maximum number of fulfillment centers containing an item.

The first of these improves their guarantee of ~n/4 by an entire order of magnitude in terms of the dependence on $n$.

We also show our guarantees to be tight.

### SD05 - SIG iFORM4: Capacity/Inventory Management under Financial Risks

Time: Sunday, 26/June/2022: SD 15:00-16:30  ·  Location: Forum 13
Session Chair: Gerry Tsoukalas
Session Chair: Yuqian Xu

Capacity expansion in service platforms: financing vs. employment

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Service platforms connecting consumers to independent service providers are now ubiquitous in industries such as ride-hailing, food delivery, and accommodation. We study how a platform may expand capacity through either financing new providers' assets (e.g., cars), or investing in assets directly and employing the providers. We use a game-theoretic model to show when the platform prefers to expand by either scheme compared to conventional bank financing, and how this affects provider profits.

Reshoring under tariff uncertainty and competition

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Recent development in the U.S. tariff policies has forced companies to rethink their global operational strategies, particularly whether to add a domestic production location that is immune to tariffs. This paper formulates a three-stage model to analyze the global firm's reshoring capacity, output quantity, and production decisions. We examine how reshoring capacity investment is affected by domestic competition and by tariff uncertainty at both the raw-material and finished-goods level.

### SE04 - SIG Service5: Evidence-based approach in operations management

Time: Sunday, 26/June/2022: SE 17:00-18:30  ·  Location: Forum 6
Session Chair: Jing Dong
Session Chair: Rouba Ibrahim

Identifying the bottleneck unit: Impact of congestion spillover in hospital inpatient unit network

Song-Hee Kim1, Fanyin Zheng2, Joan Brown3

1SNU Business School, Korea, Republic of (South Korea); 2Columbia Business School, USA; 3Keck Medicine of USC, USA; songheekim@snu.ac.kr

Discussant: Vishal Gaur (Johnson School, Cornell University)

We use 5-year data from a hospital with 16 inpatient units to empirically examine whether and how much congestion propagates through the network of inpatient units. We find that the magnitude of the congestion spillover is substantial in our study hospital. We then use counterfactual analyses to empirically identify the bottleneck unit---the unit that has the biggest impact on system performance when an intervention is applied to increase its capacity.

Capping mobile data access creates value for bottom-of-the-pyramid consumers – experimental evidence from a Mumbai settlement

Alp Sungu, Kamalini Ramdas

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Discussant: Senthil Veeraraghavan (Wharton)

Via an app we developed, we identify a barrier to digital information access by the poor – data shortages. In a Mumbai slum, we randomly assigned respondents to a data plan with daily replenishment cycles – or a standard plan. Our data reveal that absent caps, respondents binge on YouTube and social media, resulting in subsequent data shortages. The capped plan increases late-plan access of WhatsApp invites to health camps, increases attendance at these camps, and reduces social media checking.

### SE03 - SIG Sustainable5: Energy Operations: Efficient Electricity Market and Integration of Energy Storage

Time: Sunday, 26/June/2022: SE 17:00-18:30  ·  Location: Forum 7
Session Chair: Can Zhang
Session Chair: Yangfang Helen Zhou

Renewable, flexible, and storage capacities: Friends or Foes?

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Discussant: John R. Birge (University of Chicago)

We study the investment relations among the renewable, flexible, and storage capacities. We optimize the joint operations of these three types of resources. We then optimize the investment mix of these resources and examine the investment relations among them. We find that whether storage complements or substitutes other resources depends on how storage reduces operating cost and whether the potential cost reduction is constrained by charging or discharging.

Aggregating distributed energy resources: efficiency and market power

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Discussant: Saed Alizamir (Yale University)

The rapid expansion of distributed energy resources (DERs) is one of the most significant changes to electricity systems. We study in this paper two models to aggregate DERs. In the first model, a profit-seeking aggregator procures electricity from DERs, and sells them in the wholesale market. In the second model, a uniform two-part pricing policy is applied to DER owners, while the aggregator becomes fully regulated but is guaranteed positive profit. Both models are shown to be fully efficient.

### SE02 - SIG Healthcare5: Medical and operational decision making

Time: Sunday, 26/June/2022: SE 17:00-18:30  ·  Location: Forum 8
Session Chair: Jonas Jonasson
Session Chair: Pengyi Shi

Individualized dynamic patient monitoring under alarm fatigue

Hossein Piri1, Steven Shechter1, Tim Huh1, Darren Hudson2

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Discussant: Andrew Daw (University of Southern California, Marshall School of Business)

Hospitals are rife with alarms, many of which are false. This leads to alarm fatigue, in which clinicians become desensitized and may inadvertently ignore real threats. We develop a partially observable Markov decision process model for recommending dynamic, patient-specific alarms. We find that compared to current approaches of setting patients’ alarms, our dynamic patient-centred model significantly reduces the risk of patient harm.

Split liver transplantation: An analytical decision support model

Yanhan Tang1, Alan Scheller-Wolf1, Sridhar Tayur1, Emily Perito2, John Roberts2

1Carnegie Mellon University, United States of America; 2The University of California, San Francisco, United States of America; yanhanta@andrew.cmu.edu

Discussant: Vahid Sarhangian (University of Toronto)

Split liver transplantation (SLT) can save two lives using one liver. To facilitate increased SLT usage, we formulate a multi-queue fluid model, incorporating size matching specifics, dynamic health conditions, transplant type, and fairness. We find the optimal organ allocation policy, and evaluate its performance versus other common allocations.

### SE01 - SIG SCM5: Empirical Supply Chain Management

Time: Sunday, 26/June/2022: SE 17:00-18:30  ·  Location: Forum 12
Session Chair: Rachel Chen
Session Chair: Luyi Gui

Using Internet-of-Things Point-of-Consumption Data for smart Replenishment

Sandria Weißhuhn1, Yale T. Herer2, Kai Hoberg1

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Newly emerging smart replenishment systems at the point-of-consumption track product usage via smart, connected devices and use this data to automate order processes. Based on a large industry dataset from the professional coffee industry, we develop models for demand forecasting, inventory control, and replenishment under inventory inaccuracies.

Project networks and reallocation externalities

Vibhuti Dhingra1, Harish Krishnan2, Juan Serpa3

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Project networks involve several participants; clients, contractors, and subcontractors; each working on multiple projects concurrently. By tracking a network of 2.6 million public projects over a five-year span, we show that when a project suffers a localized disruption, other projects in the network get delayed because participants reallocate resources to the disrupted project. This creates a domino-effect externality that ripples through the network, causing delays across unrelated projects.

### MA1 - SO1: Strategies for social sustainability

Time: Monday, 27/June/2022: MA 8:30-10:00  ·  Location: Forum 1-3
Session Chair: Xabier Barriola

Better Safe Than Sorry: How CEO neuroticism leads to faster product recalls

Daniel F Gass1, Andreas Fügener1, Lorenz Graf-Vlachy2

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In the healthcare industry, quickly recalling defecting products can be instrumental in avoiding potentially harm to patients. Building on upper echelons theory and personality theory, we argue that neurotic CEOs are more vigilant when they face uncertainty, as they do when making recall decisions, leading to faster recalls. We build on a novel, machine-learning based approach to measure the personalities of 110 CEOs of U.S. healthcare firms and find broad support for our theory in analyses.

Browsers Don’t Lie? Gender Differences in the Effects of the Indian COVID-19 Lockdown on Digital Activity and Time Use

Amalia Miller1, Kamalini Ramdas2, Alp Sungu2

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We measure the digital impact of the Indian COVID-19 lockdown using a survey coupled with browser history data (n=1,094). Gender differences are present for online leisure, production, YouTube, social media and job search – and not for online learning. Working women sacrificed online leisure while maintaining online production. The gender gap is larger among parents. Fathers self-reported significantly larger childcare time increases, yet browser data and partner reports do not support this.

Inequity in disaster operations management

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We analyze prices paid in low-income and high-income areas after three hurricanes. Using a triple difference regression, we isolate the percentage change in prices paid by low-income versus high-income areas in affected versus unaffected areas. Compared to high-income areas, low-income areas experience a larger drop in promotions, higher unit percent price increases, a larger decrease in offer sets of low-priced items, and a larger increase in substitution from low-priced to high-priced items.

### MA2 - HC1: Emergency departments 1

Time: Monday, 27/June/2022: MA 8:30-10:00  ·  Location: Forum 6
Session Chair: Asterios Tsiourvas

Reducing abandonment and improving attitudes in emergency departments: Integrating delay announcements into operational transparency to signal service quality

Monika Westphal1, Galit B. Yom-Tov2, Avi Parush2, Anat Rafaeli2

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Emergency Department (ED) clients lack knowledge about the various elements their personal ED journey comprises. In a field study (N=18,903) we provide "Personalized Information about Operations and Time (PIOT)" – (frequently updated) information about the procedures and anticipated wait times for each patient. We show PIOT improves people’s attitudes, and PIO (operational-only information) reduces patients' abandonment. Providing PIOT offers a novel approach to improving healthcare service.

On the Effects of Boarding Patients on Treatment Time in Emergency Departments

Zahra Jalali1, Beste Kucukyazici Verter2, Mehmet Gumus1

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In this paper, we study how the boarding patients can affect the treatment time in emergency departments (EDs). First, we conduct an empirical analysis using a dataset from eight EDs and show that the relationship has an inverted U-shape. Next, we recognize two mechanisms behind it: (i)the additional workload on ED physicians, (ii) the hospitalist visits triggered by boarding congestion. Finally, we propose two interventions that can jointly mitigate this impact up to 68% in a tertiary hospital.

A Granular approach to optimal and fair patient placement in hospital emergency departments

Maureen Canellas1, Dessislava Pachamanova2, Georgia Perakis3, Omar Skali Lami4, Asterios Tsiourvas4

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We introduce a MILP formulation for patient prioritization in the ED that incorporates a breakdown of predicted patient LOS. We propose an SAA based reformulation that can be solved efficiently and provide guarantees on its convergence, stability and sample complexity. A study of 40000 patient visits from a US hospital shows that our solution increases ED throughput by >50% and decreases average waiting time by >75%. Our method displays desirable properties of fairness in patient prioritization.

### MA3 - HC9: Healthcare applications 3

Time: Monday, 27/June/2022: MA 8:30-10:00  ·  Location: Forum 7
Session Chair: Lina Song

Service anatomy: balancing acute and post-acute Care

Noa Zychlinski1, Itai Gurvich2

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Motivated by trends in the healthcare industry, we study the integration of Acute Care (AC) and Post-Acute Care (PAC). Patients' outcomes depend on both the AC length of stay and the PAC efforts. A central controller that manages both AC and PAC may choose to discharge a patient earlier and ``compensate'' for this by greater PAC efforts. We characterize the optimal effort integration and its dependencies on patient's operational severity, and the extent to which AC and PAC are complements/substitutes.

Combining pre-Approval clinical trials and post-approval spontaneous adverse event reporting for improved safety signaling

Fernanda Bravo1, Lawrence Chen2, John Silberholz3

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We propose a method to enhance post-approval safety surveillance of pharmaceuticals. Clinical trials typically do not provide sufficient evidence for flagging rare safety issues. Our approach combines pre-approval clinical trial results with post-approval surveillance data for common and rare adverse effects to decide whether to flag the rare reaction, weighing type I and type II error costs. We analytically show when our approach is most valuable and numerically demonstrate its effectiveness.

The Allocation of Funds in Healthcare: which Hospital to Support?

Lina Song1, Soroush Saghafian2

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We examine policies to allocate funds among U.S., hospitals, in the context of two payment programs— Medicare DSH and the CAH—where one targets urban and the other rural hospitals. We analytically suggest optimal investment policies, such as investing in (substantially) rural and (slightly) lower-quality hospitals. We then calibrate our model to a dataset of over 300,000 patients and show that (a) investing more in DSHs or (b) reducing the total number of CAHs improves social welfare.

### MA4 - BO1: Behavioral newsvendor

Time: Monday, 27/June/2022: MA 8:30-10:00  ·  Location: Forum 8
Session Chair: Michael Becker-Peth

Strategic behavior in a serial newsvendor setting

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We study the interaction between a seller and a buyer, both of whom face uncertainty related to downstream demand, over a two-period horizon. Making multi-unit purchase decisions before demand from their respective lower tier realizes, both agents seek to minimize their demand mismatch risk as perceived according to their degree of foresight. Focusing on the effect of buyer foresight, we find that with multi-unit purchases sellers benefit from some degree of buyer foresight but not too much.

Return of the behavioral Newsvendor: An experimental analysis of consumer return policy decisions

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Behavioral aspects of consumer return policy design and their interaction with other decisions in retailing have not been investigated to date. Leveraging a generalized newsvendor model, we conduct a randomized experiment to assess how subjects jointly make key decision (order quantity, price, and refund amount) and the effect of salvage value on them. We identify time-dependent behavioral regularities that we explain through a process theory, thus providing a new direction for future research.

To clean or to compensate - How to manage data inaccuracy in inventory decisions

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Actual inventory can be lower than recorded system inventory due to shrinkage or loss. To handle inventory inaccuracy, managers can decide to clean inventory data before placing order quantities. Alternatively, they can deliberately decide to not clean, but to compensate for the inaccuracy in the order decision. The optimal decision depends on the cost of cleaning and the efficiency loss due to the compensation. We present a set of hypotheses on this trade-off and test these in lab experiments.

### MA5 - SCM1: Digital technology in SCM

Time: Monday, 27/June/2022: MA 8:30-10:00  ·  Location: Forum 9
Session Chair: Janice Carrillo

Traceability technology adoption in supply chain networks

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Modern traceability technologies promise simplified recalls, increased visibility, and verification of sustainable practices. However, the benefits obtained from traceability are conditional on technology adoption throughout a supply chain. Hence, traceability initiatives need to subsidize some early adopters within a network of supply chains to achieve broad diffusion. We address the problem of identifying this "seed set" and describe how the supply chain network structure affects the choice.

Simulation of blockchain-enabled market for supplier capacity trading among competing retailers

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We design a behavioral simulation using a blockchain-enabled market for trading suppliers’ capacities among competing retailers. Retailers have different valuations for goods and order before knowing their demand. After demand realization, retailers can trade among themselves. While average initial orders do not differ significantly compared to the control group, significant improvements in inventory allocation and profits are achieved, and trading strategies arise that mitigate demand risk.

Selling and Leasing for Digital Goods with Piracy in Supply Chains

Hongseok Jang1, Janice Carrillo2, Kyung Sung Jung2, Young Kwark2

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This study examines the impact of (a) leasing or selling decisions and (b) alternate supply chain forms (CSC or DSC) on digital piracy and supply chain profits. We develop an analytical model where supply chain members lease or sell digital goods in the presence of pirated goods in a two-period setting. We find that leasing digital goods to buyers has higher supply chain profit than selling in a CSC, and selling provides higher supply chain profit than leasing in a DSC.

### MA6 - PF1: Platform management

Time: Monday, 27/June/2022: MA 8:30-10:00  ·  Location: Forum 10
Session Chair: Thomas De Munck

Assortment display, price competition and fairness in online marketplaces

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Motivated by the setting of Airbnb, we consider a game theoretical setup in which each seller on the platform provides a single-unit product and competes on price. We investigate sellers' optimal pricing decisions and the platform's optimal assortment display policy. Additionally, we incorporate constraints to guarantee a certain degree of seller and customer fairness. Using data from Airbnb, we present a case study to illustrate how our model framework can be applied in practice.

Improving dispute resolution in two-sided platforms: the case of review blackmail

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We study the relative merits of different dispute resolution mechanisms in two-sided platforms, in the context of disputes involving malicious reviews and blackmail. We develop a game-theoretic model of the strategic interactions between a seller and a (potentially malicious) consumer. Our results suggest that decentralization, when implemented correctly, may represent a more efficient approach to dispute resolution.

Priority management for on-demand Service Platforms with waiting time differentiation

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We consider an on-demand service platform (e.g., Uber, Lyft, DiDi) that serves two customer classes with distinct willingness to wait and to pay. We formulate this problem as a Markov decision process in which the platform controls customer admission and service provider allocation. Using our model's structural properties, we show that the optimal policy is characterized by two admission thresholds. In a numerical study, we then compare the optimal policy with several simpler policies.

### MA7 - IL1: Logistics

Time: Monday, 27/June/2022: MA 8:30-10:00  ·  Location: Forum 11
Session Chair: Sérgio Vasconcelos Castro

Management of empty containers by consignees in the hinterland

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This study analyses street-turn strategies for empty container repositioning in the hinterland using a double-ended queue model for matching operations. Containers arrive over time at the consignee and the demand for containers arises from the shipper. We prove that the matching time impacts matching proportion, while it marginally influences the consignee's inventory policy and cost per container. Also, the consignee's withholding level is mainly determined by the shipper's production rate.

Vehicle routing optimization with relay: an arc-based column generation approach

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In relay-based logistics, orders are routed through pit-stops with a different driver assigned to each segment. This paper formulates an integer optimization model to coordinate driver, truck and driver movements. We develop an arc-based column generation algorithm which expands time-space networks iteratively until convergence. Results show that relay operations, combined with our algorithm, can lead to faster deliveries, better driver lifestyles, and a lower environmental footprint.

Optimizing order fulfillment via genetic programming generated policies

Sérgio Vasconcelos Castro1,2, Gonçalo Figueira1,2, Bernardo Almada-Lobo1,2

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In online retail, fulfillment optimization is the problem of dynamically determining, for every new order, the fulfillment node that will fulfill every item within the order. To solve the problem, we propose a novel policy function approximation approach based on genetic programming to generate interpretable fulfillment policies. Results show that policies more simple than mathematical programming based ones are able to significantly improve over a myopic assignment.

### MA8 - RM1: Dynamic pricing

Time: Monday, 27/June/2022: MA 8:30-10:00  ·  Location: Forum 12
Session Chair: Laura Niome Sprenkels

Optimal dynamic pricing when customers develop a habit or satiation

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We study a dynamic pricing problem over multiple periods when consumers develop a habit or satiation from their past consumption. We derive an inter-temporal demand function to capture these two effects. We establish that the profit maximization problem under our demand function is jointly concave and then characterize the trends in the optimal prices over the multi-period horizon. Finally, we provide several extensions including bounds on prices and optimal profit and non-stationary state dependence.

Pricing fast and slow: limitations of dynamic pricing mechanisms in ride-hailing

Daniel Freund1, Garrett J. van Ryzin2

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Ride-hailing firms set prices dynamically to match supply and demand. But rapid price changes incentivize riders to wait for low prices. When prices drop, patient customers request en masse, causing a drop in supply and a price increase. We show how dynamic pricing inherently creates such oscillations in supply and prices, that these oscillations in supply levels are inherently inefficient, and that a service model that allows riders to wait in a formal queue overcomes this inefficiency.

Multi-product pricing: A customer choice model and a dynamic pricing approximation

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We study the pricing problem of an assortment of multiple, substitutable products. We propose two new methods that can support retailers with maximizing their revenues. The first method is a customer choice model based on the Markov Chain Choice model in combination with reservation prices. The second method relies on a linear approximation for the finite inventory, finite time horizon multi-product dynamic pricing problem.

### MA9 - EF1: Solar energy

Time: Monday, 27/June/2022: MA 8:30-10:00  ·  Location: Forum 13
Session Chair: Tarkan Tan

Towards industrial decarbonization via robust solar capacity expansion

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We present our collaboration with OCP, the world’s largest producers of phosphate and phosphate-based products, in support of a green initiative designed to reduce the company’s greenhouse gas emissions. The proposed robust optimization-based methodology guides the company’s investment in solar panels and batteries, which accounts to over one billion US dollars, as well as their day-to-day operations, and is expected to significantly reduce both the company’s emissions and energy bill.

Electric vehicles and solar panels co-adoption via diffusion models

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Electrification is as a critical enabler of the decarbonization. It is imperative to study the growth in electric vehicles adoption to plan for this impending transformation. Existing EV adoption studies typically ignore the influence of other green technologies. In this paper, we bridge these critical gaps. We employ a dynamic discrete choice model to study these technologies' diffusion. Our work projects adoption and evaluates counterfactual scenarios.

Retreat, defend, or attack? Optimal investment decisions in green technology under competition

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Firms that already invest in more sustainable technologies as a proactive measure against changing market dynamics, are likely to gain a significant competitive advantage. We analyze a large focal firm's optimal green investment strategy, accounting for the uncertainty in the competitors' actions and the future green market size. Optimal policy is composed of `Retreat’, `Defend’, and `Attack’ strategies, one of which is optimal based on the problem parameters. We provide managerial insights.

### MA10 - RT1: Retail channels

Time: Monday, 27/June/2022: MA 8:30-10:00  ·  Location: Forum 14
Session Chair: Tim Schlaich

Part-Time Workers vs Gig-Contractors: Impact of Worker Availability on Performance of Contingent Workers in Online Retail

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Companies operating under gig-contractor models are offering part-time job requiring longer work availability. This ensures quicker delivery & better service quality. Using data from an online retailer we find that workers with similar level of experience perform differently. This is explained through the role of worker availability. At similar levels of experience, workers in high-work group perform better than those in the low-work group after controlling for task and worker characteristics.

Effect of a sustainable firm’s entry on customer channel choices and existing retailers' market shares

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1NC State University, United States of America; 2University of South Carolina, United States of America; olga.perdikaki@moore.sc.edu

New sustainability-marketed firms have emerged in the grocery and consumer packaged goods categories responding to consumers’ rising preferences for sustainable products. Motivated by this trend in the retail industry, we study how the entry of a new firm that sells an assortment of sustainable consumer goods affects the consumers’ channel choices and the existing retailers’ market shares in two different types of product offerings -- packaged and fresh goods.

When is the next order? Forecasting the timing of retail orders using Point-of-Sales data and channel inventory estimations

Tim Schlaich, Kai Hoberg

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Slow-moving items constitute a large share of the retail assortment and often result in intermittent orders by the retailer. We estimate retail channel inventories based on prior orders and Point-of-Sales data to predict the timing of future orders. We demonstrate both theoretically and empirically that this an inventory modeling approach outperforms the Croston's method and thus provides a viable alternative to conventional time-series models.

### MA11 - ML1: Learning methods

Time: Monday, 27/June/2022: MA 8:30-10:00  ·  Location: Forum 15
Session Chair: Ho-Yin Mak

MOTEM: Method for optimizing over tree ensemble models

Georgia Perakis, Leann Thayaparan

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When tree-based models, such as Random Forest or XGBoost, are used in optimization, their formulations are often intractable and unscalable. We propose a scalable approximation of the optimization formulation that can optimize over ensemble tree models in linear time while still capturing over 90% of optimality on a variety of datasets. MOTEM (Method for Optimizing over Tree Ensemble Models) is an algorithm for optimizing an objective function that is determined by an ensemble tree model.

Is your machine better than you? You may never know.

Francis de Véricourt, Huseyin Gurkan

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AI systems are increasingly demonstrating their capacity to make better predictions

than humans. Yet, recent empirical studies suggest that experts may doubt the quality of these systems. We explore the extent to which a decision maker (DM) can properly learn whether a machine produces better recommendations, and analyze a dynamic Bayesian model, where a machine performs repeated decision tasks under a DM’s supervision. We fully characterize the conditions at which learning fails and succeeds.

Prescriptive PCA: dimensionality reduction for two-stage stochastic optimization

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We study data-driven operations management problems with high-dimensional data. The standard approach involves two separate modeling phases: learning a low dimensional statistical model (dimensionality reduction) from data and then optimizing a decision problem with parameters input from said statistical model. We propose a prescriptive dimensionality reduction approach that better aligns the two phases and delivers superior results over standard methods (e.g., principal component analysis).

### MA12 - FL1: Flash: Sustainable Operations

Time: Monday, 27/June/2022: MA 8:30-10:00  ·  Location: Forum 16
Session Chair: Alexander Bloemer

Managing reusable packaging via a deposit system

Mahyar Taheri1,2, Yann Bouchery2, Sandra Transchel2, Jan C. Fransoo3

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Increasingly, Consumer Packaged Goods (CPG) companies make use of reusable packaging and manage them via a deposit system. We study a CPG company that offers a product in reusable and disposable packaging, and manages reusable packaging via a deposit system. We formulate a decision model in which the CPG company sets product price and deposit fee under price and deposit sensitive demand while considering packaging durability. We provide analytical conditions for optimality and procedure to solve

Online demand response programs and optimal price determination

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Power systems require new approaches to system operations to respond to the increased volatility of solar or wind energy. In this paper, we suggest a novel online demand response program with variable prices. Our program is able to incorporate new information on changing wholesale market conditions while notifying load operators early enough to enable response. We furthermore propose Deep Reinforcement Learning as a tool to identify effective prices.

Privately-owned battery storage - Re-shaping the way we do electricity

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In this research project, we aim to understand when private households with existing or planned

rooftop solar installations should invest in electricity storage and how these investment decisions

affect their electricity usage patterns as well as the market structure overall. We use a novel household panel datasets to structurally estimate households consumption utility functions and valuations for self-produced solar energy.

What are the drivers of (low) farm productivity? A study of smallholder coconut farming in the Philippines

Canberk Ucel

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I study farmer poverty and productivity with unique data from 2,000 Philippine coconut farms and field work. I find strong evidence that micro-level farming practices account for large productivity differences and that best fertilization practices vary with environment. Supporting organizations should develop customized farming advice and assist farmers with fine details of implementation, an approach not currently preferred, but increasingly available through emerging information technologies.

The impact of cost auditing on supply chain social responsibility

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Firms increasingly recognize the importance of their upstream suppliers’ social responsibility. However, they may fail to heed the unintended negative consequences of their own common practices on the suppliers’ social responsibility decision. Our study shows that cost auditing may undermine the supplier's social responsibility choice, which sheds light on the reluctance of many suppliers to commit to social responsibility programs.

Input material reduction incentives vs. scrap recycling for closed loop supply chains

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We consider contracting between a supplier of specialty material forgings and a buyer that manufactures airplane components by extensively machining them down. Due to high material removal costs, the buyer prefers forgings to be as similar in geometry and size to the component as possible. We assess the implications of two innovative approaches for improving supply chain performance: (i) Input material reduction incentives via contracting, and (ii) scrap material recycling.

### MB1 - SO2: Auditing for sustainability

Time: Monday, 27/June/2022: MB 10:30-12:00  ·  Location: Forum 1-3
Session Chair: Bengisu Urlu

Examining the Impact of Leniency Bias on Supplier Audits

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We study the impact of monitor leniency on supplier CSR risk. Using audit data from a global apparel brand, we find that leniency helps to reduce CSR risk. Testing interaction effects with our moderators, we find that greater leniency helps to reduce CSR risk when a facility’s compliance ability is low; when a facility has been audited a small number of times; and when a facility is located in a developing country. Our work provides insight into the relational factors that can influence supplier audits.

Multi-tier sustainability incentives: audits and supplier development in a two-stage principal agent problem

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Manufacturers are increasingly being held responsible for sustainability violations across their whole supply chain. We examine a three-tier supply chain where a manufacturer and its direct supplier incentivize sub-supplier sustainability through auditing and supplier development. We show that the mechanisms are substitutive for the supplier but can be complementary for the manufacturer. Moreover, the manufacturer delegates the effort in case of very low or very high external pressure.

Stop auditing and start to care: paradigm shift in assessing and improving supplier sustainability

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We propose a conceptual framework for supplier sustainability improvement that we refer to as CARE, based on self-assessments and consisting of Collect, Assess, React, and Enhance phases. CARE is highly scalable, making use of machine learning techniques to understand the link between the general supplier characteristics and their verified sustainability profile, predict the future sustainability levels of even unassessed suppliers, and determine the best plan for improvement.

### MB2- HC2: Emergency departments 2

Time: Monday, 27/June/2022: MB 10:30-12:00  ·  Location: Forum 6
Session Chair: Vera Tilson

Share or hide emergency department queue-lengths to reduce congestion?

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We present a queueing games framework to investigate how sharing of real-time queue-length information at emergency department (ED), where urgent patients receive priority over nonurgent patients, influences nonurgent patients' decision to enter or balk the ED queue, and how it affects the overall social welfare of patients who visit the ED. We show that under certain conditions, it may be better to partially reveal ED queue-length information rather than making ED queues completely transparent.

Providing wait time information to ED patients: effects on satisfaction and reneging

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In a field experiment in an Emergency Department, we found that providing delay information improves patients' waiting satisfaction by 81%, and decreases their likelihood of reneging by 14%. The announced delay acts as a reference point against which the patients compare the actual delay. Following Prospect Theory, we found that patients are loss-averse that the likelihood of LWBS is much lower when they wait a shorter time than announced than when they wait a longer time than announced.

Models of the impact of triage nurse standing orders on emergency department length of stay

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Standing orders allow triage nurses in EDs to order tests for certain medical conditions before the patient sees a physician, which could reduce the patient’s LOS. Medical literature documents the use of standing orders decreasing average ED LOS for the patient subject to standing orders. We model operational impact of standing orders and introduce a threshold based congestion-sensitive policy which performs well wrt overall average ED LOS across a wide range of scenarios.

### MB3- HC10: Healthcare inventory management

Time: Monday, 27/June/2022: MB 10:30-12:00  ·  Location: Forum 7
Session Chair: Nikos Trichakis

Inventory-responsive donor management policy: A tandem queueing network model

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In the blood donor management problem, the blood bank incentivizes donors to donate, given blood inventory levels. We propose an optimization model to design donor incentivization schemes that account for the blood inventory dynamics and the donor's donation process. By adopting the Pipeline Queue paradigm, we have a tractable convex reformulation. Numerical results show the advantages of the optimal policy compared with benchmark policies in reducing both shortages and wastage.

Inventory management and shipment policies for clinical trials

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Clinical trials are a critical step for the development of new drugs, both in

cost and in terms of elapsed time to bring the potential drug to the market. Since clinical trials are increasingly going global, optimizing the supply chain can bring huge benefits. We use a MDP to model the inventory problem between the central depot and the regional depots that will then supply the investigation sites. The main decision is when to resupply and how much inventory to send to each regional depot.

Reshaping organ allocation policy through multi-objective optimization

Theodore Papalexopoulos1, Dimitris Bertsimas1, Nikolaos Trichakis1, James Alcorn2, Rebecca Goff2, Darren Stewart2

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The Organ Procurement & Transplantation Network (OPTN) is migrating all US organ allocation policies to a novel continuous-distribution model. We introduce a novel analytical framework to illuminate policy tradeoffs and enable exploration of the efficient frontier of policies. Jointly with the OPTN, we applied our framework to the design of a new allocation policy for lungs. Starting in 2023, all deceased-donor lungs in the US will be allocated according to this policy.

### MB4 - BO2: Behavior in queues

Time: Monday, 27/June/2022: MB 10:30-12:00  ·  Location: Forum 8
Session Chair: Hummy Song

Evaluating experienced and prospective queues: a behavioral investigation

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How the cost of completing a queue varies with (i) the experience of wait and (ii) the characteristics of the queue are not well understood. In this study, we use the incentive-compatible BDM mechanism to experimentally address these questions. We find that when service speed is slow, experienced wait increases (decreases) the completion cost of impatient (patient) subjects. Also, the length and speed of a queue affect completion costs, but not proportional to their effects on total waiting time

Social queues (cues)

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Through a series of experiments, we show that when others are waiting in line, customers accelerate their own service time, sacrificing their own consumption utility. This behavior is driven by concern for others. We show that the negative effect of others queueing on one’s own service time is moderated by the participants' self-wait and visibility between customers in service and those waiting in line.

Queue configurations and servers’ customer orientation: An experimental investigation

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Contrary to traditional queueing theory, recent field studies in health care and call centers indicate that pooling queues may not lead to operational efficiencies relative to dedicated queues. We use a series of experiments to examine the conditions under which this may be the case and to test servers' customer orientation as a behavioral mechanism that may explain why. We also examine whether higher levels of customer orientation and performance persist across changes in queue configuration.

### MB5 - SCM2: Publication and faculty strategy in OM

Time: Monday, 27/June/2022: MB 10:30-12:00  ·  Location: Forum 9
Session Chair: Richard Daniel Metters

Fast or slow? Competing on publication frequency

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For many information goods, longer publication cycles are more economical, but often result in less timely information. While the digitalization of publication processes makes shorter cycles more economically viable, in practice, not all competing firms choose to publish more frequently. In this paper, we use a game-theoretic model to determine how information providers choose publication cycles and prices under competition and inform publishers of adaptive strategies for digitalization.

Solo, first, or last author? Equilibrium project ownership and execution

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In knowledge-intensive businesses, projects are often initiated by individuals, who may then look for collaborators to push their idea forward. What operating dynamics arise in equilibrium when the decision-making process on project ownership and project execution is decentralized? Using a stylized principal-agent model, we find that principal investigators have a tendency to keep ideas for themselves too much, but when they share the project ownership, they tend to over delegate.

Determinants of operations management faculty salary

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Demographic and professional activity data on 227 Operations Management faculty in 22 U.S. public schools is compared to their base salaries (all 227 faculty) and total compensation (a subset of 15 schools and 150 faculty). A primary factor correlated with pay levels are “A” journal publications. Local school effects (cost of living), willingness to move institutions, taking on administrative duties, and achieving Fellow status in professional societies are all correlated with higher salaries.

### MB6 -PF2: Multi-homing in platforms

Time: Monday, 27/June/2022: MB 10:30-12:00  ·  Location: Forum 10
Session Chair: Sandeep Chitla

Multi-homing across platforms: friend or foe?

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Multi-homing gives platforms access to a larger pool of supply; however, it also changes the nature of competition between platforms in a market. It is not clear whether this works to the advantage of platforms or not. In light of this, we ask a fundamental question: When is it better for two-sided platforms to pool their workers? We answer this question through a game-theoretic study. We identify the key trade-offs associated with pooling decision and highlight the key role of scale.

Managing multihoming workers in the gig economy

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Gig workers prevalently "multihome'' by dynamically allocating their services in real-time between multiple platforms. As a growing number of platforms access the same pool of workers to complete their gigs, the question of how workers choose between competing platforms has grown in salience. In this work, we study gig workers' multihoming decisions by using machine learning methods to estimate a structural model from ride-hailing proprietary data combined with publicly reported trips data.

Customers’ Multi-homing in ride-hailing: Empirical evidence

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Using a large panel dataset with repeated choices of riders for both Uber and Lyft, we estimate a structural “consider-then-choose” model to better understand the trade-offs faced by riders. We find that riders' choices are not fully explained by operational factors such as price and waiting time, indicating that riders view the platforms as differentiated services and not as commodities. We also find that the multi-homing behavior of riders is only observed for a small fraction of the rides.

### MB7 - IL2: Warehouse management

Time: Monday, 27/June/2022: MB 10:30-12:00  ·  Location: Forum 11
Session Chair: Reeju Guha

Capacity flexibility via on-demand warehousing

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We study capacity flexibility via an innovative business practice: On-Demand Warehousing. In this emerging application, a platform connects independent warehouse providers, who are willing to sell excess capacity, with a firm that requires on-demand capacity. On-demand warehousing does not require long-term commitments, but rather provides flexible warehouse capacity, on-demand. Our results highlight how on-demand warehousing allows a firm to absorb demand fluctuations better.

Decision model for selecting robotized order picking solutions

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Enabled through recent advances in technology, coupled with the advent of new system providers and decreased price points, automated and robotic order picking solutions evolved as a surging market. As implementation projects and the variety of solutions are rising, managers face the decision which ones to select for their specific business case. We contribute by proposing a mathematical optimization approach that assigns each stock keeping unit the most suitable solution under space constraints.

When the Customer is in my Warehouse: Analysis of Customer Interference on Picking Operations

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Online pickers encounter customer interference while picking orders, affecting productivity due to store traffic and queues, and service quality due to picking errors. Within the day, there are less-busy periods when stores resemble a warehouse. We match similar orders picked during peak vs non-peak periods to establish the value of picking during non-busy hours. Our research has implications for online grocers willing to be productive without incurring additional cost of maintaining dark stores

### MB8 - RM2: Capacity aspects of revenue management

Time: Monday, 27/June/2022: MB 10:30-12:00  ·  Location: Forum 12
Session Chair: Mika Sumida

Dynamic resource constrained reward collection problems: unified model and analysis

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Dynamic resource allocation problems arise under a variety of settings and have been studied across disciplines such as Operations Research and Computer Science. This work introduces a unifying model for a very large class of dynamic optimization problems. We show that this class encompasses a variety of disparate and classical dynamic optimization problems and we characterize the performance of the fluid certainty equivalent control heuristic for this class of problems.

Revenue management with heterogeneous resources: Unit resource capacities, advance bookings, and itineraries over time intervals

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We consider revenue management problems with heterogeneous resources, each with unit capacity. An arriving customer makes a booking request for a particular interval of days. The goal is to find a policy that determines an assortment to offer each customer to maximize total expected revenue. We show that we can efficiently perform rollout on any static policy. We develop two static policies derived from value function approximations, and give performance guarantees for both policies.

### MB9 - EF2: Wind power energy

Time: Monday, 27/June/2022: MB 10:30-12:00  ·  Location: Forum 13
Session Chair: Emre Nadar

Optimal hour-ahead commitment and storage decisions of wind power generators

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We study the energy commitment, generation, and storage problem for a wind farm co-located with a battery. Modeling this problem as a Markov decision process under wind and price uncertainties, we prove the optimality of a state-dependent threshold policy. Our numerical study with data-calibrated instances has revealed the high efficiency and scalability of our solution method constructed with structural knowledge.

Integration of pumped hydro energy storage and wind energy generation: a structural analysis

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We study the energy generation and storage problem for a pumped hydro energy storage facility integrated with a wind farm. The operator decides in real-time how much water to pump/release, how much wind energy to generate, and how much energy to buy/sell. Modeling the problem as a Markov decision process, we prove the optimality of a state-dependent threshold policy for the upper reservoir water level. Leveraging this result, we develop an efficient solution method for data-calibrated instances.

### MB10 - RT2: Omnichannel design

Time: Monday, 27/June/2022: MB 10:30-12:00  ·  Location: Forum 14
Session Chair: Yale Herer

Store network design for omnichannel retailing

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We explore the effect of physical store presence on purchase decisions in omnichannel retailing. We use geolocated customer-level data from a major shoe retailer and study the differential role of physical proximity (number of stores, distance to closest store), as well as service quality (assortment breadth and service level). We find that, while proximity generally increases sales, the service quality provided by the physical store network increases offline sales but decreases online sales.

Channel changes charm: An empirical study about omnichannel demand sensitivity to fulfillment lead time

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We examine transaction-level data of an Italian furniture retailer to study channel-specific effects of fulfillment lead time on demand. We find that the showroom channel makes consumers less sensitive to fulfillment lead time than both online and catalog channels. Niche products and experience goods further accentuate the difference of lead time sensitivity between showroom and non-physical channels. Our study highlights the previously-ignored lead time aspect of the physical store’s value.

Last-mile fulfillment in an omnichannel grocery retailing environment: A dynamic approach

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An omnichannel grocery retailer can fulfill incoming orders either from the dark store or from a brick-and-mortar store. Customers are offered only those products available in the DS and the B&M store. We develop a new business model that offers customers all products available in the DS or the B&M store. We develop a new decision-making mechanism to determine the fulfilment location for each order. We computationally compare our dynamic policies with the omnisciently optimal solution.

### MB11 - ML2: Applications of Learning

Time: Monday, 27/June/2022: MB 10:30-12:00  ·  Location: Forum 15
Session Chair: Morvarid Rahmani

Uncertain search with transfer learning

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We study a problem of sequential learning and choosing from a group of similar alternatives. The unknown payoff of accepting an alternative depends on a set of common features that enable transfer learning across the group. There is also an idiosyncratic value that needs to be learned by sampling over time. The problem is whether to accept the current alternative, continue sampling, or switch to the next one. We model it as a Bayesian dynamic program and analyze structural properties.

Dynamic matching under type uncertainty

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We consider the prototypical problem of sequentially assigning jobs to workers at a large centralized matching platform under an infinite worker supply governed by a fixed distribution; this encapsulates the defining characteristic of large market settings such as online labour marketplaces. The goal is to maximize cumulative payoffs from matches. We resolve several foundational questions pertaining to the complexity of this problem setting and provide novel rate-optimal algorithms and analyses.

Optimal presentation of alternatives

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In many contexts such as technology and management consulting, clients seek the expertise of providers to find solutions for their business problems. We develop a dynamic game-theoretic model where the provider chooses how to present alternative solutions, and the client chooses which solution to try.

### MB12 - FL2: Flash: Revenue Management and Machine Learning

Time: Monday, 27/June/2022: MB 10:30-12:00  ·  Location: Forum 16
Session Chair: Eunji Lee

Waste reduction of perishable products through markdowns at expiry dates

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We study if discounts for products at their expiry dates can reduce waste and increase profit. In a Markovian inventory model we obtain combinatorial expressions for the transition rates, but with no informative stationary distribution. In a regime where customer arrivals and order-up-to-level grow large, we obtain via Donsker's theorem expressions for waste and profit. In an MNL setting we prove that optimizing regular prices and discounts always reduces waste compared to not giving discounts.

BM retailer's exclusive brand introduction decision and consumer showrooming: A distribution channel perspective

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Consumers often exhibit showrooming behaviour in which they visit a brick-and-mortar (BM) store to gather product information but complete the product purchase in the online channel. Many BM retailers carry exclusive store brand products. We examine how consumer showrooming interacts with a BM retailer's exclusive store brand strategy. Contrary to common notion, our findings reveal that the BM retailer can benefit from consumer showrooming when it carries an exclusive store brand.

Product portfolio choices in competitive enivronment

Sleiman Jradi, Alejandro Lamas, Mozart Menezes

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We investigate whether horizontal competition drives the increase of the number of product portfolio varieties of self-interested firms that compete for demand through their product portfolio sets. We characterize the equilibrium, in both, the complete information game and the incomplete information game and prove that neither firms have the incentive to go beyond its monopolistic choice. Moreover, we show that proliferation may fail as an entry barrier when the game is played a la Stackelberg.

On the Impact of Product Portfolio Adjustments on the Bullwhip Effect

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Many manufacturers frequently introduce new products and retire low-performing SKUs. These portfolio adjustments cause a demand shock for existing products. We study the impact of these demand shocks on the bullwhip effect for existing products. We prove that retiring products always increase the bullwhip effect for existing SKUs while introducing new products does not necessarily lead to this increase. We also study the behavior of the bullwhip effect as function of time remaining to the shock.

Predictably unpredictable: How judgmental and machine learning forecasts complement each other

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We propose a three-step demand forecasting framework that combines the expert's knowledge of the market with the machine learning algorithm's ability to leverage historical information to forecast seasonal demand for rapid innovation products. Using data from Canyon Bicycles, we find a 29% reduction in forecast error (measured by WMAPE) over a purely judgmental forecast.

Improving large-scale procurement practices using natural language processing and machine learning

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We present our work with a publicly listed food manufacturer in the UK and a private equity firm that invests in the heavy equipment industry to improve their procurement practice. We used natural language processing and machine learning to organize their vast unstructured procurement data and to classify the suppliers and products into hierarchical categories. With our accompanying decision support tool, we identify the procurement inefficiencies and provides request-for-quote (RFQ) targets.

Learning consumer preferences from bundle sales data

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We study the problem of learning customer-reservation prices from sales data, including bundles. (1) We provide an analytical framework to study this problem and develop a Monte Carlo expectation-maximization algorithm. (2) We extend the base model to study the censored sales data. (3) We use the mixture of Gaussian distribution to classify the customer preferences. (4) We establish that our algorithm quadratically converges to a good fixed point, a constant distance of the global optimum.

### MC2 - HC3: Patient scheduling

Time: Monday, 27/June/2022: MC 14:00-15:30  ·  Location: Forum 6
Session Chair: Christos Zacharias

Multi-class advance patient scheduling

Mohamad Kazem Shirani Faradonbeh1, Mohamad Sadegh Shirani Faradonbeh2, Hossein Abouee-Mehrizi3

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Strategies for scheduling patients to minimize resource and waiting costs is a key problem in healthcare operation. The provider should decide patients to schedule as well as future appointment times to assign. We consider the multi-class advance scheduling problem with random arrivals. We propose and analyze the optimal policy that determines patients and appointments for the current state, effectively prioritizes the patients, and efficiently balances the workload across the booking window.

Predictive prescriptions for surgery scheduling

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We propose a data-driven method for surgery scheduling that combines AI algorithms with stochastic optimization techniques. While existing approaches only consider the surgery type to differentiate between surgeries, our method allows us to consider different surgery-, patient- and physician-related aspects. We find that our method outperforms an existing method which only takes procedure types into account, resulting in higher operating room utilization and lower waiting times.

Dynamic inter-day and intra-day scheduling

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The simultaneous consideration of dynamic inter-day and intra-day scheduling decisions is an established theoretical and practical problem that has remained open due to its highly stochastic nature, complex structure, and the curse of dimensionality. We develop the first analytical optimization model and theoretical results addressing this joint problem within a computationally tractable optimization framework with theoretical performance guarantees.

### MC3 - HC11: Healthcare resources

Time: Monday, 27/June/2022: MC 14:00-15:30  ·  Location: Forum 7
Session Chair: Chaoyu Zhang

Managing Medical Equipment Capacity with Early Spread of Infection in a Region

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We develop a model for a regional decision-maker to analyze the requirement of medical equipment capacity in the early stages of a spread of infections. We use a stochastic differential equation to capture the growth of infections in a community spread and shutdown model. We develop results to determine shutdown time, to show how to compensate for limited medical equipment capacity, and to show how capacity-sharing across regions can deliver a peak-timing benefit beyond traditional risk pooling.

Managing hospital resources amid a pandemic for improving regional health outcomes

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During the early weeks of the COVID-19 pandemic, hospitals managed surge capacities by transferring patients among different hospitals within the same health network, repurposing operating rooms as ICU beds, and cancelling elective surgeries. Using publicly available data we develop an analytical framework to study how these policies can be implemented, individually or in combination, in order to optimize the pandemic response in a region, while delivering care to the uninfected patients.

Capacitated SIR Model with an Application to COVID-19

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The classical SIR model and its variants have succeeded in predicting infectious diseases' spread. To better capture the COVID-19 outbreak, we extend the SIR model to impose a testing capacity. We study how to choose the best type of testing method, how to allocate limited testing capacity over time and across symptomatic and asymptomatic people. We use the COVID-19 data and a sliding window method to calibrate our model and point out its public policy implications.

### MC4 - BO3: Performance and feedback

Time: Monday, 27/June/2022: MC 14:00-15:30  ·  Location: Forum 8
Session Chair: Tom Tan

Algorithm reliance under pressure: the effect of customer load on service workers

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The algorithm-augmented business model promises service companies the benefits of both algorithms and humans. But companies will only realize this promise if their workers rely on algorithms, and there is conflicting evidence about workers’ willingness to do this. We design a laboratory experiment to resolve this conflict, and find that workers are generally unwilling to rely on algorithms but that they become more willing to do so in response to high customer loads and learning interventions.

The demotivating effects of relative performance feedback: The impact on middle-ranked workers’ performance

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We conduct a series of online experiments to isolate the pure effects of three types of Relative Performance Feedback, RPF, on middle-ranked workers' performance. We find that providing any type of feedback reduces performance compared to no feedback. Aligned with theory, delivering feedback increases the focal employee's shame and social comparison involvement (SCI), which measures the focal individual’s level of engagement in social comparison while performing the task.

It's in your hands: Elevating performance with goals and information provision in a warehousing field experiment

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Many human-machine interactions focus on the optimization of the system output yet tend to overlook human behavior. Using an intervention-based field experiment in a semi-automated warehouse, we study the impact of a behavioral intervention that provides humans with more information about the picking process and enables them to choose out of a set of pre-defined goals. We find that human performance is enhanced by 6%. Our insights enrich the discussion on human-machine interactions.

### MC5 - SCM3: R&D in supply chains

Time: Monday, 27/June/2022: MC 14:00-15:30  ·  Location: Forum 9
Session Chair: Yasemin Limon

The impact of operational transparency on R&D novelty

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Being operationally transparent is often misaligned with firms’ incentives. In such situations, regulators or industry watchdogs may impose operational transparency requirements on firms. In this study, we examine the impact of operational transparency on R&D novelty. Exploiting an exogenous shock in the US pharma industry, we show that increased transparency leads to less novel R&D bets. Our research not only contributes to operations management theory but also informs policy.

More investment less profit? An R&D investment conundrum of a financially constrained firm in a supply chain

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A financial constraint for R&D is an essential issue for a firm's operations yet often ignored in research. We analyze a supply chain consisting of a supplier and a manufacturer, where the latter has an R&D opportunity with limited resources. We show that the latter's profit can decrease even if it can afford more investment, referred to as the R&D conundrum. We investigate operational and information strategies, including upfront R&D investment and keeping its financial budget private.

Sequential versus concurrent product development: Approval uncertainty, time-sensitive consumption utility, and asymmetric competition

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Concurrent development strategies can enable a firm to gain the first-mover advantage by developing a new product faster. However, they usually entail upfront investments that the firm cannot recoup if the product failed to meet certain quality requirements. Using a two-stage duopoly model, we examine under what conditions a firm will adopt concurrent development strategy in equilibrium in view of uncertain product approval, time-sensitive consumer utility, and asymmetric competition.

### MC6- PF3: Ride hailing

Time: Monday, 27/June/2022: MC 14:00-15:30  ·  Location: Forum 10
Session Chair: Saif Benjaafar

Measuring strategic behavior by gig economy workers: multihoming and repositioning

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Gig economy workers make strategic decisions about where and when to work. We empirically measure two types of strategic behavior: multihoming, an online change between platforms, and repositioning, a physical change between locations. Using a structural model, we show that workers are highly heterogenous in their preferences for both multihoming and repositioning. We provide counterfactual estimates on the effects of proposed firm and regulatory policies aimed at multihoming and repositioning.

Matching technology and competition in ride-hailing marketplaces

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Taxis’ and Uber’s matching technologies differ: taxis random-walk in search of curbside pick-ups while Uber centrally dispatches drivers. We study how taxis can defend against Uber encroachment. We find that imitating Uber’s centralized dispatch can improve taxi market share but only when Uber drivers are relatively reluctant to drive. Otherwise, imitating Uber can entice more Uber drivers to drive, leading to an unintended reduction in taxi market share.

Human in the loop automation: ride-hailing with remote(tele-) drivers

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Tele-driving refers to a novel concept in which drivers can remotely operate vehicles. Because remote drivers can be operated as a shared resource, tele-driving has the potential to reduce the severity of the spatial mismatch between vehicle supply and customer demand that is often experienced in on-demand mobility services. In this paper, we compare a traditional ride-hailing system with one with tele-drivers, and quantify the potential gains that could be realized by tele-driving.

### MC7 - IL3: Manufacturing

Time: Monday, 27/June/2022: MC 14:00-15:30  ·  Location: Forum 11
Session Chair: Florian E. Sachs

Stochastic Capacity Investment and Flexible vs. Dedicated Technology Choice in the Presence of Subscription Programs

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We study flexible versus dedicated technology choice and capacity investment of a two-product firm under demand uncertainty in the presence of subscription programs. With subscription programs, a proportion of customers allocated to a particular product are allowed to switch to the other product. We analyze how the switching proportion and demand correlation between two subscription demands affect capacity investment and profitability with each technology, and shape optimal technology choice.

Synchronization in a two-supplier assembly system: Combining a fixed lead-time module with capacitated make-to-order production

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High-tech products consist of many modules. We study an assembly system with one module sourced from a supplier with a fixed lead-time and one module produced in-house in a make-to-order (MTO) production system. Since unavailability of modules is costly, it is important to coordinate between the ordering policy for one module and the production of the other. We show optimality of an order policy for the lead-time module with base-stock levels depending on the state of the MTO production system.

Design of unreliable flow lines with limited buffer capacities and spare part provisioning

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The buffer allocation problem is a fundamental optimization problem if flow line planners need to cope with stochastic influences. Additionally, practitioners include spare part planning for manufacturing systems to increase the machine's availability directly. Hence, we tackle this crucial question and are the first to present a joint optimization of buffer capacities and spare part stocks for flow lines of arbitrary length. Among others, we generate new insights on spare part allocations.

### MC8 - RM3: Auctions and mechanisms

Time: Monday, 27/June/2022: MC 14:00-15:30  ·  Location: Forum 12
Session Chair: Alireza Fallah

On the robustness of second-price auctions in prior-independent mechanism design

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The seller wants to sell an item to n buyers such that the buyers' valuation distribution is from a given class (i.i.d., mixtures of i.i.d., affiliated and exchangeable, exchangeable, and all distributions) and the seller minimizes worst-case regret. The first three classes admit the same minimax regret, decreasing in n, while the last two have the same minimax regret equal to that of the case n = 1. Across all settings, the optimal mechanisms are all second-price auctions with random reserve.

Selling online display advertisements via guaranteed contracts and real-time bidding

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We study a new selling mechanism in online display advertising markets that combines both guarantee contracts (GC) and real-time bidding (RTB) and allow advertisers to strategically choose between these two channels. Despite the complexity due to the advertisers’ strategic behaviour and the auctions, we are able to obtain the closed-form solution and show that combining GC and RTB can generate more revenue for the publisher, compared to the case when only RTB or GC is used.

Optimal and differentially private data acquisition: central and local mechanisms

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We consider a platform's problem of collecting data from privacy sensitive users to estimate an underlying parameter of interest. We formulate this question as a Bayesian-optimal mechanism design problem, in which an individual can share her (verifiable) data in exchange for a monetary reward or services, but at the same time has a (private) heterogeneous privacy cost which we quantify using differential privacy.

### MC9 - SM1: Transportation Services

Time: Monday, 27/June/2022: MC 14:00-15:30  ·  Location: Forum 13
Session Chair: Kashish Arora

Structural Estimation of Driver Attrition in a Last-Mile Delivery Platform

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In this paper, we consider the question of how to better manage turnover among independent drivers who transport parcels for last-mile delivery platforms. We collaborate with a last-mile delivery platform to build a structural model that enables us to estimate the effects of key predictors of drivers' decisions to continue or leave the platform. For this estimation, we apply a dynamic discrete-choice framework in a two-step procedure that accounts for unobserved heterogeneity among drivers.

The driver-aide problem: coordinated logistics for last-mile delivery

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We introduce the `Driver-Aide (DA) Problem', a new mode of service operations in last-mile delivery. The use of a DA can shorten route durations, allowing larger delivery volumes without the need for additional vehicles. However, it is challenging to determine the best way to use a DA (as there are two different ways to use a DA) and evaluate the tradeoffs involved. We develop an optimization-based solution framework and conduct an economic analysis using data provided by an industrial partner.

Private vs. pooled transportation: customer preference, environmental effect and congestion management

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In this work, we build a structural model to study customers’ preferences on prices and service features when choosing between private taxis and a scheduled shuttle service.

### MC10 - RT3: Omnichannel strategy

Time: Monday, 27/June/2022: MC 14:00-15:30  ·  Location: Forum 14
Session Chair: Wenxin Xu

The value of experience-centric stores in omnichannel retail

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The omnichannel retail evolution has changed the role(s) of the store. Applying a quasi-experimental design to data on store openings by an omnichannel consumer electronics retailer, we explore these new store roles and the value they provide to the retailer. We find that, in contrast to small stores, large experience-centric stores substantially benefit online-first retailers through both customer acquisition and activation mechanisms. Category-level analyses reveal the underlying mechanisms.

Omnichannel pricing strategies under product value uncertainty

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This paper studies a monopolistic omnichannel retailer's pricing strategies when customers are strategic in making a channel choice and a purchasing decision in the presence of product value uncertainty. We find that charging a uniform price across the sales channels and disclosing it via the online store is optimal. We study the structural properties of the optimal price and the corresponding profit. Finally, we assess the value of omnichannel retailing relative to single-channel counterparts.

To keep price consistency or not: multi-channel retailing with consumers’ fairness concern

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We examine how consumers’ fairness concerns affect a multichannel retailer’s pricing strategy. We find that the retailer should maintain consistent price across channels only when the fraction of unfair-adversed consumers is in an intermediate range, and otherwise should charge different channel prices. Moreover, as the fraction of unfair-adversed consumers increases, the retailer may be better off by strategically enlarging the price gap.

### MC11 - ML3: Prediction and regret

Time: Monday, 27/June/2022: MC 14:00-15:30  ·  Location: Forum 15
Session Chair: Omar Mouchtaki

Regret bounds for risk-sensitive reinforcement learning

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Reinforcement learning is a promising strategy for data-driven sequential decision-making. In many real-world applications, it is desirable to optimize objectives that account for risk in the achieved outcomes. We prove the first regret bounds for reinforcement learning algorithms targeting a broad class of risk-sensitive objectives, including the popular conditional value at risk (CVaR) objective. Our analysis relies on novel characterizations of the risk-sensitive objective and the optimal policy.

Prediction with missing data

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Missing information is inevitable in real-world data sets. While imputation is well-suited for statistical inference, its relevance for out-of-sample prediction remains unsettled. We analyze widely used data imputation methods and highlight their key deficiencies in making accurate predictions. Alternatively, we propose adaptive linear regression, a new class of models that can be directly trained and evaluated on partially observed data. We validate our findings on real-world data sets.

Data-driven newsvendor: operating in a heterogeneous environment

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We study a newsvendor problem in which the decision-maker only observes historical demands. In contrast to the extant literature, we relax the i.i.d. assumption for past demands and assume instead that they are drawn from distributions within a distance r away from the future demand distribution. We establish an exact characterization of the worst-case regret of Sample Average Approximation. When r is small, we present a near-optimal algorithm which robustifies SAA by using less samples.

### MC12 - FL3: Flash: Inventory and behavioral models

Time: Monday, 27/June/2022: MC 14:00-15:30  ·  Location: Forum 16
Session Chair: Alexander Bloemer

Managing inventory: Does national culture matter?

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We predict that societal culture will have a significant impact on inventory management by (1) causing behavioral biases on individual decision makers and (2) affecting the organizational culture. In this paper, we look at the national inventory levels with a dataset that spans the globe. We find that all national characteristics have a statistically significant impact on managing inventory, some in counter-intuitive ways. We also discuss the impact of development status of nations.

How supply chain complexity drives inventory record inaccuracy: empirical evidence from cross-border e-commerce

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Retailers in e-commerce are facing muti-sources of supply chain complexity, making accurate inventory records increasingly important while greatly challenged. This study systematically explores how supply chain complexity affects IRI using a hierarchical segmentation of the complexity sources in e-commerce. Our research contributes a hierarchical framework for supply chain complexity and complements existing literature regarding IRI by systematically analyzing its causes.

An asymptotic perspective on risk pooling: Limitations and relationship to transshipments

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We asymptotically characterize and compare risk pooling approaches. We show that physical pooling dominates information pooling in settings with no additional per-location costs. In the presence of such costs, however, information pooling becomes a viable alternative to physical pooling. Through asymptotic analysis, we also address the grouping problem. The convergence of the expected total costs and the base stock levels are demonstrated through a simple numerical illustration.

Prescriptive analytics for mitigating the flood risk in coastal cities facing climate-change-induced sea level rise

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We develop an optimization framework for infrastructure development to mitigate the risk of flooding caused by sea level rise and storm surge in a coastal area. Expected flood costs are included using a range of possible sea level rise scenarios, and investment costs are modeled for overall infrastructure development assuming budgetary limitations. Using the City of Boston as a case for this study, our methodology resulted in more than 90% cost reduction compared to a “do nothing” strategy.

Simple policies for joint pricing and inventory management

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We analyze the performance of simple (static) pricing policies for the joint pricing and inventory control problem. Compared to dynamic pricing policies, static pricing policies are more tractable, easier to implement and strategy-proof. We consider a continuous review system with Poisson arrivals of unit demand. We construct simple pricing policies that only increase inventory costs by a constant factor while actually increasing revenue, in comparison with the optimal dynamic pricing policy.

Behavioral implications of bilateral relationships on supply chain contracting

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This paper investigates the impact of bilateral relationships on contracting incentives in a supply chain from a behavioral perspective. Our experimental data suggests systematic deviations from the theoretical benchmark and reveal behavioral regularities on contracting behavior. We develop a new behavioral theory where a firm's unfavorable bargaining position inflicts distress to a firm. We show that our behavioral theory explains and predicts supply contract bargaining incentives well.

Choice overload with search cost and anticipated regret: Theoretical framework and field evidence

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We study the impact of assortment size on consumer choice decisions in an online recommender system context. Via a field experiment on Alibaba's online retail platforms, we causally show that the both consumers' search and purchase likelihoods first increase and then decrease as the number of options increases. We develop a two-stage consumer choice model and demonstrate that our empirical results are consistent with the predictions of a model that incorporates consumers' anticipated regret.

### MD2 - HC4: Appointment scheduling

Time: Monday, 27/June/2022: MD 16:00-17:30  ·  Location: Forum 6
Session Chair: Siddharth Arora

Customer-driven appointment scheduling

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Appointment scheduling under uncertainty encounters a fundamental trade-off between capacity utilization and waiting times. In contrast to traditional approaches, we maximize capacity utilization while limiting waiting times. We derive a robust mixed-integer linear model, prove NP-hardness for the general problem, and optimality of well-known scheduling rules for special cases. Using real patient data, we show that our approach is a win-win solution to this fundamental trade-off.

Strategic idling in appointment systems with sequential servers

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Using distributionally robust optimization (DRO) that accounts for service times’ correlation, we study a two-sequential-server appointment scheduling problem. We observe that the optimal schedule can lead to imbalanced waiting times in the two servers, concentrating on the downstream server. To rebalance the waiting times without rescheduling patients, we adopt an idea in the queueing literature to strategically idle (SI) the upstream server. A DRO model is used to find the optimal SI policy.

Modelling the Risk of Hospital Admission in an Emergency Department and Understanding the Patient Flow during the Pandemic

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We present a personalized and probabilistic framework to model the risk of hospital admissions for patients (with and without COVID-19) that attended an Emergency Department (ED) during the pandemic. As predictors, we use patient demographics, measures of ED crowdedness, and the triage information, and investigate if population-level data (such as human mobility, number of COVID-19 cases, vaccination status etc.) could help improve the prediction accuracy of admission risk at the patient level.

### MD3- HC12: Approval and testing in healthcare

Time: Monday, 27/June/2022: MD 16:00-17:30  ·  Location: Forum 7
Session Chair: Wendy Olsder

Robust combination testing: Methods and application to Covid-19 detection

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For COVID-19 detection, point-of-care tests are cheap and quick but fail policymakers’ accuracy requirements. We propose a robust optimization methodology for optimally combining results from cheap tests for increased diagnostic accuracy. Combining three rapid tests increases area under the curve by 6% compared with the best performing individual test for antigen detection. We demonstrate that robust optimization is a powerful tool to avoid overfitting and improve out-of-sample performance.

Adaptive approval of drugs for rare diseases

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Adaptive approval is a novel regulatory program that enables earlier patient access to new drugs for rare diseases. The program has been in place for almost a decade, however, industry participation has been surprisingly low. We present a Stackelberg game-theoretic model to understand why industry participation has been low. Our results inform healthcare policymakers on ways to redesign adaptive approval programs to likely increase industry participation and improve patients' welfare.

### MD4 - BO4: Human machine interaction

Time: Monday, 27/June/2022: MD 16:00-17:30  ·  Location: Forum 8
Session Chair: Bryce Hunter McLaughlin

On the Fairness of Machine-Assisted Human Decisions

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In this project, we study the fairness implications of using machine learning to assist a human decision-maker. Relative to a baseline where machine decisions are implemented directly, we show in a formal model that the inclusion of a biased human decision-maker can revert common relationships between accuracy and fairness. Specifically, we document that excluding information about protected groups from the prediction may fail to reduce, and may even increase, ultimate disparities.

Automation and Sustaining the Human-Algorithm Learning Loop

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In many practical settings, a human reviews recommendations from a decision support algorithm and either approves or adjusts the recommendation. Automation may reduce a ML system's longer-term ability to predict effective adjustments and leads to predictive performance degradation over time. We (empirically) demonstrate this effect and show how to include the loss of learning into the automation decision.

Algorithmic assistance with recommendation-dependent preferences.

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We provide a stylized model in which a principal chooses a classifier, D, with known properties for a Bayesian decision-maker who observes the outcome of D before determining their own label in a binary classification problem. The decision-maker has a utility which deviates from the principal ’s whenever they take an action which contradicts the classifier. We characterize the optimal posterior decision and show how the optimal classifier for assistance depends on the decision-maker's prior.

### MD5 - SCM4: Supply chain innovations

Time: Monday, 27/June/2022: MD 16:00-17:30  ·  Location: Forum 9
Session Chair: Hao Jiang

Incumbent inertia: When and how to respond to an innovative startup?

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When entrepreneurs introduce innovations, incumbents must respond, yet may fail to do so in due course. I characterize the incumbent's optimal policy, specifying the conditions under which an incumbent ignores the threat or decides to acquire or imitate the startup. Incumbent inertia may arise if the incumbent waits until the market is ripe or if it is ambivalent about the appropriate response. This second rationale has not previously been identified as a cause for incumbent inertia.

How to compose innovation portfolios: commitment or flexibility?

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When composing their innovation portfolios, firms can rely on their internal R&D units and invest in projects that are promoted internally; or they can acquire projects that originated outside their boundaries. We ask: How should a firm allocate its scarce resources across the different sources? We investigate this decision by designing a stylized game-theoretic model, and we identify the firm’s optimal resource allocation policy.

How market conditions affect firms’ participation in cooperative venture

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Although the participation of firms in cooperative ventures that benefit all firms, such as industry alliances and generic advertising campaigns, has been well-studied in the literature, prior studies have not explored how the firms decide their participation levels when the underlying market conditions change. In this paper, we investigate the impact of boom and bust conditions of the market on two firms' strategic decisions, when they face the prospect of cooperating with their competitor.

### MD6 - PF4: Freight markets and platform pricing

Time: Monday, 27/June/2022: MD 16:00-17:30  ·  Location: Forum 10
Session Chair: Donghao Zhu

Centralized versus decentralized pricing controls for dynamic matching platforms

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We examine the effect of centralization on platforms' pricing decisions in two-sided matching markets. We develop a stylized model that describes the platforms' dynamic matching and pricing process over a continuum of market participants, which is directly motivated by the design of ridehailing platforms. We provide a comprehensive analytical characterisation of the market equilibrium. Next, we develop a simulation-based framework to compare the social welfare under three operating models.

Posted price versus auction mechanisms in freight transportation marketplaces

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We consider a truckload transportation marketplace in which a platform serves an intermediary to match shippers, who pay for transportation services, with carriers, who get compensation for transporting the loads. The objective of the platform is to design pricing and allocation mechanisms to maximize its long-run average profit. In this paper, we analyze the performance of posted price, auction, and hybrid mechanisms (which combine posted price and auction mechanisms).

Platform information design: a queueing-theoretic approach to online freight matching

Donghao Zhu, Stefan Minner, Martin Bichler

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The decision to display information of the freight market's current state impacts revenue due to user abandonment. The implications of such a decision are not well understood in platforms for freight exchanges. We study which information design maximizes expected revenue. Queueing models with balking and reneging are applied, and the steady-state behavior of the underlying Markov chains is analyzed. We find that in large markets, showing state information is preferred.

### MD7 - IL4: Flexibility and sharing

Time: Monday, 27/June/2022: MD 16:00-17:30  ·  Location: Forum 11
Session Chair: Karca D. Aral

Inventory control for periodic intermittent demand

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Intermittent demand is difficult to forecast, as many periods have no demand. The time between demands is often not memoryless but –contrary to implicit model assumptions—displays periodicity. Consequently, the time since the last demand is a predictor for future demand. We propose a demand model that accommodates such periodicity and show that the optimal inventory policy is a state-dependent base-stock policy, where the order-up-to-levels depend on the time since the last demand.

Managerial flexibility and inventory management

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We study how managers’ potential personal costs due to shareholder scrutiny affect inventory policies exploiting a quasi-natural experiment. Using a staggered DiD approach, we find that firms incorporated in constituency states increased inventory by 5.2% relative to control firms, indicating a heightened focus on customer service levels. To our best knowledge, our paper is the first to study managerial incentives pertaining to inventory management in a quasi-natural experimental setting.

Sharing Newsboys

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We consider a network of socially connected newsvendors who can share their oversupply with their neighbors. We define two classes of social networks: friendship and acquaintances networks. We show that when the social network grows, all newsvendors increase their stocking levels in the acquaintance's network. In contrast, all newsvendors will decrease (resp. increase) their stocking levels for high fractile (resp. low fractile) products in the friendship network.

### MD8 - RM4: Analytics for pricing

Time: Monday, 27/June/2022: MD 16:00-17:30  ·  Location: Forum 12
Session Chair: Jean Pauphilet

Loss functions for discrete contextual pricing with observational data

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We study a discrete pricing setting where each customer is offered a contextual price. Often only historical sales records rather than customer valuations are available, where the data is influenced by the previous pricing policy. This introduces difficulties in estimating revenue. We approach this problem using ideas from learning with corrupted labels to formulate loss functions that directly optimize revenue, rather than going through an intermediate demand estimation stage.

Estimating demand with unobserved no-purchases on revenue-managed data

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Problem definition: This paper investigates the joint estimation of the consumer arrival rate and choice model parameters when ``no-purchasers” (customers who considered the product but did not purchase) are not observable. Estimating demand even with the simplest discrete-choice model such as the MNL becomes challenging as we do not know the fraction that have chosen the outside option (i.e., not purchased).

Robust and heterogenous odds ratio: estimating price sensitivity for unbought items

Jean Pauphilet

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Mining for heterogeneous response to treatment is a crucial step in data-driven operations. We propose a partitioning algorithm to estimate heterogeneous odds ratio, a popular measure when response to treatment is binary. We integrate an adversarial imputation step to account for partially observed treatments (e.g., if full information is only available for purchased items). We validate our methodology on synthetic data and case studies from political science, medicine, and revenue management.

### MD9 - SM2: Service operations applications 1

Time: Monday, 27/June/2022: MD 16:00-17:30  ·  Location: Forum 13
Session Chair: Evgeny Kagan

Should gig platforms decentralize dispute resolution?

Wee Kiat Lee, Yao Cui

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Disputes can be a common occurrence in online labor platforms due to users' gaming behavior and disagreement over contracting terms. While traditional platforms resolve disputes using a centralized approach, there are emerging platforms that relegate dispute resolution to independent platform users through a voting mechanism. We study when and why this decentralized approach can be better for the platform and the social welfare and how the platform should adjust the dispute fee when adopting it.

Optimizing free-to-play multiplayer games with premium subscription

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We consider the optimal operating policies of a free-to-play game. Accounting for social comparisons between free and premium players, we model the game attracting or losing players. We characterize optimal dynamic pricing and advertising policies and show that the developer should prioritize initial growth through aggressive advertising while postponing the introduction of premium subscription. Surprisingly, the optimal subscription price may start high and gradually decrease.

The gatekeeper's dilemma: when should I transfer this customer

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In many service encounters front-line workers have the discretion to attempt to resolve a customer request or to transfer the customer to an expert service provider. We experimentally examine this decision. Our experiments show that transfers are too low under some incentive systems. However, transfer behavior responds correctly to congestion information. Taken together, these results advance our understanding of cognitive capabilities and rationality limits on human server behavior.

### MD10 - RT4: Assortment planning 1

Time: Monday, 27/June/2022: MD 16:00-17:30  ·  Location: Forum 14
Session Chair: Fernando Bernstein

Retail category management with store brand sourcing

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We analyze a retailer’s interactions with a national brand manufacturer (NBM) using a setting in which the retailer makes category management and store brand (SB) sourcing decisions and the NBM strategically determines whether it should produce the retailer’s SB. Our analysis sheds light on different SB strategies observed in practice.

Algorithmic assortment curation: An empirical study of Buybox in online marketplaces

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The majority of online sales worldwide take place in online marketplaces that connect many sellers and buyers. Online marketplaces adopt algorithmic tools to curate how the different options in an assortment are presented to customers. This paper focuses on one such tool, the Buybox, that algorithmically chooses one option to be presented prominently to customers. Our analyses show that the Buybox produces benefits for customers, sellers, and the marketplace.

A customer choice model of impulse buying in social commerce

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Social commerce integrates user interactions and user-generated content with commercial activities in the context of social media platforms. Examples include the "shop" feature on Instagram. A social media user's on-site purchase decision involves a transformation of the mindset from "social" to "shopping" stimulated by the impulse to purchase. We propose a novel choice model to capture users' shopping behavior on social media sites and examine two strategies to sell through social media.

### MD11 - ML4: Bandit algorithms

Time: Monday, 27/June/2022: MD 16:00-17:30  ·  Location: Forum 15
Session Chair: Daniel Russo

Learning across Bandits in High Dimension via Robust Statistics

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Decision-makers often face the "many bandits" problem, where one must jointly learn across related but different contextual bandit instances. We study the setting where the unknown parameter in each instance can be decomposed into a global parameter plus a local sparse term. We propose a novel two-stage estimator exploiting this structure efficiently using robust statistics and LASSO. We prove that it improves regret bounds in the context dimension, which is exponential for data-poor instances.

Increasing charity donations: a bandit learning approach

Divya Singhvi1, Somya Singhvi2

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We consider the problem of maximizing charity donations with personalized recommendations and unknown donor preferences. On charity platforms, a donation is observed only when the recommended campaign is selected by the donor, and an eventual donation is made, leading to selection bias issues. We propose the Sample Selection Bandit (SSB) algorithm that uses Heckman's two step estimator with the optimism to resolve the sample selection bias issue.

Adaptivity and confounding in multi-armed bandit experiments

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We explore a new model of bandit experiments where a potentially nonstationary sequence of contexts influences arms' performance. Our main insight is that an algorithm we call deconfounted Thompson sampling strikes a delicate balance between adaptivity and robustness. Its adaptivity leads to optimal efficiency properties in easy stationary instances, but it displays surprising resilience in hard nonstationary ones which cause other adaptive algorithms to fail.

### MD12 - FL4: Flash: Supply Chain Management

Time: Monday, 27/June/2022: MD 16:00-17:30  ·  Location: Forum 16
Session Chair: Niklas Tuma

Product recalls and insider trading

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The timeline of product recalls provides corporate insiders with an opportunity to sell stocks before the market reacts to a recall. In this paper, we examine whether such insider trading occurs during the product recall process. Our results show that insider trading is present and that directors but not officers seem to engage in it in the days following defect awareness. Thus, we identify the product recall process as a novel source of information that insiders exploit for personal gains.

Supply chain contracting for network goods

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How should manufacturers sell network goods through retailers? We study this new supply chain contracting problem, where the retailer can privately observe and control the evolving market conditions. The optimal contract resembles the second-best in the short run, but converges to the first-best in the long run. We guide practice why manufacturers should over supply, mitigate network effects, favor incumbent retailers, and improve retailer information capability, despite information asymmetry.

Smart home insurance: collaboration and pricing

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Insurers have started incentivising customers for buying smart home security products along with home insurance to achieve a reduction in hazard likelihood. In this paper, we study the discounting decision of the insurer and pricing and quality decisions of the smart product manufacturer for offering "smart home insurance" to customers under no-contract, a Wholesale price contract and a Cost-sharing contract, considering (1) equal market power and (2) having a dominant SPM separately.

Computational analysis of stochastic and robust optimization models for capacitated lot sizing under uncertain customer demand

Manuel Schlenkrich, Sophie Parragh

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This work presents a computational study of two-stage stochastic programming and budget-uncertainty robust optimization for capacitated lot-sizing under uncertain demand. To solve the stochastic models, a Benders decomposition approach is tailored to the problem. The tradeoff between computational time and performance on out-of-sample scenarios is investigated. Managerial insights are provided by analyzing the structure of the obtained production plans and the impact of flexibility in planning.

Tactical production planning and strategic buffer placement under demand and supply uncertainty in the high-tech manufacturing industry

Tijn Fleuren, Yasemin Merzifonluoglu, Maarten Hendriks, Renata Sotirov

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This paper proposes an integrated methodology to optimize tactical production planning and strategic buffer placement in complex capacity constrained high-tech manufacturing supply chains. We introduce a novel multi-stage stochastic programming model that simultaneously tackles demand and lead time uncertainty. For extended planning horizons, we establish a data-driven rolling horizon-based decision framework to derive efficient buffer replenishment policies for varying service levels.

Frictions in international operations: a financial approach

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We study frictions in foreign exchange market. We consider two companies with opposite needs of currencies. They can negotiate an exchange between themselves. Forward contract is where negotiation happens prior to randomness resolution, while ad-hoc contract after. The forward contract has a larger potential in increasing quantity decisions due to prior commitment. Ad-hoc contract leads to either unique or continuum of equilibrium(a). Payoff dominance uniquely selects an equilibrium.

### TA1 - SO3: Sustainability strategy

Time: Tuesday, 28/June/2022: TA 8:30-10:00  ·  Location: Forum 1-3
Session Chair: Morris Cohen

Are fast supply chains sustainable?

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A critical decision made by many firms is whether to adopt a responsive supply chain (prioritizing speed) or an efficient supply chain (prioritizing cost). We consider the environmental implications of this choice, and find that firms will have the greatest incentive to invest in responsiveness when it is most detrimental to the environment. We discuss the implications of this for policymakers seeking to encourage firms to use supply chains that generate the least environmental impact.

How marginal value of time influences optimality when remanufacturing to multiple generations

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We investigate a Remanufacturing Original Equipment Manufacturer (ROEM) who can choose

to remanufacture recovered cores either to their original configuration or to current technology. The decay of consumers’ valuations of the products as time passes influences the optimality managerial decisions. Hence, we examine the traditional method of studying this effect and develop a more realistic model that offers new insights into the optimal remanufacturing choices.

From bespoke supply chain resilience to sustainability

Morris Cohen1, Shiliang Cui2, Sebastian Doetsch3, Ricardo Ernst2, Arnd Huchzermeier3, Panos Kouvelis4, Hau Lee5, Hirofumi Matsuo6, Andy A. Tsay7

1The Wharton School, University of Pennsylvania; 2McDonough School of Business, Georgetown University; 3WHU - Otto Beisheim School of Management; 4Olin Business School, Washington University in St. Louis; 5Graduate School of Business, Stanford University; 6Tokyo International University; 7Leavey School of Business, Santa Clara University; cohen@wharton.upenn.edu

This paper extends our research on “bespoke” resilience strategies, by formulating a supply chain model that enhances reported models by adding sustainability. The proposed model examines tradeoffs, constraints, and risks for the extended problem and considers implications for supply chain strategy development. One key question was whether the two concepts are mutually reinforcing or conflicting. Our analysis shows how the answer depends on the features of the supply chain environment.

### TA2 - HC5: Healthcare applications 1

Time: Tuesday, 28/June/2022: TA 8:30-10:00  ·  Location: Forum 6
Session Chair: Ozden Engin Cakici

Learning personalized treatment strategies with predictive and prognostic covariates

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We consider the problem of designing a sequential clinical trial with a fixed budget in order to find the best treatment as a function of predictive and prognostic patient covariates. We propose computationally tractable heuristics based on the expected value of information that perform well and are asymptotically optimal in the limit of large sample size. We show the benefits of incorporating predictive and prognostic covariates in allocation policies for learning the best treatment strategy.

Learning in Recovery from Disruption: Empirical Evidence from the U.S. Drug Shortages

Hyun Seok {Huck} Lee1, Jung Hee Lee2, In Joon Noh3

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We exmaine potential learning at the manufacturing facility level. Considering drug shortages as a manufacturing disruption, we investigate the two sources of learning: (1) experience of recovery from disruptions in the past and (2) experience of recovery from on-going disruptions. In addition to these learning effects, we also examine whether the two learning sources are substitutes or complements, and how the diversity of disruption resolution experience moderate these learning effects.

Telehealth in acute care: pay parity and patient access

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Many US states have adopted telehealth pay-parity policies requiring payers to reimburse healthcare providers equally for telehealth and office visits. But telehealth may require a duplicate visit for a physical exam. We analyze a three-stage game to study the impact of telehealth reimbursement on provider's operational decisions, where patients choose strategically between telehealth and office channels. We find that pay parity can decrease patient access and discuss its policy implications.

### TA3 - HC13: Optimization in healthcare

Time: Tuesday, 28/June/2022: TA 8:30-10:00  ·  Location: Forum 7
Session Chair: Thomas Breugem

Coordinating the treatment of multiple chronic conditions

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We present a Markov decision model for simultaneously managing the treatment of multiple chronic conditions. We first provide a general framework, then demonstrate under which conditions model complexity can be dramatically reduced--including to that of an index optimal policy. We present a case study on patients with age related macular degeneration, and demonstrate that following our framework could reduce symptoms by 38% and direct medical costs by 23%.

Operational models for mobile diagnostic laboratories in non-emergency deployment

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Mobile labs are a promising approach to improving access to health. Although there is a variety of use cases for mobile labs, their usage has been primarily in emergency deployment. This means mobile labs are at risk of being idle if not used in non-emergency settings. We analyse operational models for non-emergency mobile lab deployment. Our results show substantial impact can be generated and help inform decision-making regarding pathogen prioritization and operational models.

### TA4 - BO5: Events and queuing behavior

Time: Tuesday, 28/June/2022: TA 8:30-10:00  ·  Location: Forum 8
Session Chair: Yueyang Zhong

Once bitten second shy? The Effect of Supplier Exposure and Rare Events on the Timing of Orders

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Using 50K observations of purchase tasks, we examine the mechanism behind purchasers’ decisions on the timing of the orders. Our analysis focuses on the impact of exposure to suppliers and rare events throughout the history of experiences of the purchasers. We find that exposure to specific suppliers increases the safety time for the current order; rare events in the prior orders are increasing the safety time. We also observe that purchasers rely on self-experienced orders rather than peers.

Is separately modeling subpopulations beneficial for sequential decision-making?

Ilbin Lee

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In recent applications of Markov decision processes, it is common to estimate model parameters from data. When data are collected from a population, one faces a modeling question of whether to estimate different models for subpopulations. This work provides theoretical results and empirical methods for making the decision of whether to model subpopulations separately or not. We also present how to use our results to select the best stratification and empirical results using various instances.

Behavior-aware queueing: The finite-buffer setting with many strategic servers

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Service system design is often informed by queueing theory, which traditionally assumes that servers work at constant speeds. However, servers in service systems are people, and design decisions influence their work speeds. We study how server work speed is affected by managerial decisions concerning (i) how many servers to staff and (ii) whether and when to turn away customers, in the finite-buffer many server queues in which the work speeds emerge as the solution to a noncooperative game.

### TA5 - SCM5: Supply Chain Risk

Time: Tuesday, 28/June/2022: TA 8:30-10:00  ·  Location: Forum 9
Session Chair: Keno Theile

Text-based measure of supply chain risk exposure

Andrew Wu

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Supply chain risks, despite being a well-developed theoretical concept, are difficult to empirically quantify. I develop a firm-level measure of supply chain risk exposure using textual analysis on a novel source of unstructured data: managers' discussions during earnings conference calls. Economically validated, the measure provides a credible quantification of firm-level exposure to supply chain risks, and can be reliably utilized as outcome or explanatory variables in empirical research.

Improving supply chain performance under weather risk

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Weather has a significant impact on the demand of various products. To improve the performance of the supply chain of weather sensitive products the main objective of the proposed research is to design new classes of contract that can outperform the widely used contracts, such as wholesale price, buyback, and revenue sharing contracts. . A firm’s objective under risk is measured by using the Conditional Value at Risk. Results show that the designed contracts outperform the traditional contracts.

Are Disclosures of Pandemics as a Source of Risk Informative? Evidence from Changes in Equity Risk Before and After the COVID-19 Pandemic.

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Gathering information on risks in a supply chain is still a significant challenge for firms. However, firms are requested to disclose their material risks in 10-K reports, leading to a substantial amount of information on their risk status. It remains an unanswered question if the information is informative. Using the natural experiment presented by the COVID-19 pandemic and an event study methodology, our analysis provides evidence that risk disclosures are informative.

### TA6 - PF5: Platform applications

Time: Tuesday, 28/June/2022: TA 8:30-10:00  ·  Location: Forum 10
Session Chair: Mahsa Hosseini

Joint order partitioning and routing for courier fleets on crowdsourced delivery platforms

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Crowdsourced delivery platforms have made use of two types of couriers: ad-hoc couriers, who are more flexible, and committed couriers, who are more reliable. In this paper we show that by designing a system that intelligently utilizes order partitioning between the two delivery channels (e.g., makes routing and partitioning decisions jointly), the delivery platform can exploit the benefits of each courier base to improve customer service and reduce the total cost when compared to order pooling.

Online algorithms for matching platforms with multi-channel traffic

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On two-sided matching platforms such as VolunteerMatch (VM), a sizable fraction of website traffic arrives via an external link, bypassing the platform's recommendation algorithm. We study how platforms can account for this, given the goal of maximizing successful matches. We model the problem as a variant of online matching and introduce an algorithm providing near-optimal guarantees in certain parameter regimes. We also show our algorithm’s strong performance in a case study based on VM data.

Dynamic relocations in car-sharing networks

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We propose a dynamic car relocation policy for a car-sharing network with centralized control and uncertain, unbalanced demand. The policy is derived from a reformulation of the fluid model approximation of the dynamic problem. We project the full-dimensional fluid approximation onto the lower-dimensional space of relocations only. Our policy exploits these gradients to make dynamic car relocation decisions. We close the optimality gap on average by 30% in static and time-varying settings.

### TA7 - IL5: Inventory management

Time: Tuesday, 28/June/2022: TA 8:30-10:00  ·  Location: Forum 11
Session Chair: Ioannis Spantidakis

Capacity and demand information sharing in a supply chain with bilateral information asymmetry

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In bilateral asymmetric information sharing, a retailer has private demand and a supplier private capacity information. We propose non-financial information-sharing mechanisms without power structure and examine analytically how one’s sharing affects the other’s sharing for cooperative, sequential sharing, and under risk aversion. We find that the retailer shares if demand is higher than a threshold. The supplier shares if capacity cost is within a range of upper and lower cost thresholds.

A decomposition approach for constrained inventory replenishment

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We consider inventory allocation of multiple products, across a network of warehouses. We propose a multi-period, multi-product newsvendor formulation over a network of capacitated warehouses with depth constraints, minimizing the e-tailer’s shipment cost. The efficient algorithm we propose balances the tradeoff between overage and underage costs across periods. We establish its rate of convergence and in collaboration with a fashion e-tailer, we perform a study showing a cost reduction of 9%.

### TA8 - EF3: Energy Storage

Time: Tuesday, 28/June/2022: TA 8:30-10:00  ·  Location: Forum 12
Session Chair: Christopher Chen

Cost-saving synergy: Demystifying energy stacking with battery energy storage systems

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Despite the potential of a battery energy storage system (BESS) to electrical grids, most standalone use of BESS is not economical due to its high upfront cost and batteries' limited lifespan. Energy stacking, a strategy providing multiple services simultaneously, has been of great interest to improve profitability. However, some key questions remain unanswered. We show that there exists cost-saving synergy, which enables stacking to double the profit of the best standalone service.

When should the off-grid sun shine at night? Optimum renewable generation and energy storage investments.

Christian Kaps, Simone Marinesi, Serguei Netessine

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Solar power has risen as a sustainable & inexpensive option, but its generation is variable during the day and non-existent at night. Thanks to recent technological advances, a combination of solar+storage holds the promise of cheaper, greener, and more reliable off-grid power. Our work sheds light on this question by developing a model of strategic capacity investment in renewable generation and storage to match demand with supply in off-grid use-cases, while relying on fossil fuel as backup.

Does renewable energy renew the endeavor in energy efficiency?

Amrou Awaysheh1, Christopher Chen2, Owen Wu2

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We examine whether and how renewable energy adoption affects energy efficiency (EE) improvement. Using site-level data from an industrial conglomerate, we find that using renewables to meet 10% more of a site's energy demand led to an additional 2.0% improvement in EE. This effect is heterogeneous in sourcing strategy where outside purchases led to gains, but on-site generation had no effect. Analysis of the mechanism suggests greater managerial focus on EE due to the costs of outside purchases.

### TA9 - SM3: Estimation and optimization for services

Time: Tuesday, 28/June/2022: TA 8:30-10:00  ·  Location: Forum 13
Session Chair: Lucas Weber

Optimal experimental design for staggered rollouts

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We study the problem of designing experiments that are conducted on a set of units, such as users in an online marketplace, for multiple time periods. We first study the optimal design of experiments, to most precisely estimate the instantaneous and lagged effects, post-experiment, when treatment decisions are made before the experiment starts. Next, we study the design of sequential experiments, where adaptive decisions are allowed, and the experiments can potentially be stopped early.

Robust queue inference: consistent estimators from partially observed data

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While observational data from queueing system is of great interest for statistical inference of arrival and service processes, the queueing dynamics and the absence of distributional information render queue estimation remarkably challenging. To this end, we propose a robust optimization based framework for inferring service times from waiting time observations. We provide conditions under which our framework produces statistically consistent estimators and present its managerial insights.

Modular capacitated sales force deployment problem

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Sales force deployment is a profit-maximizing planning problem. Total profit is a non-linear function of selling time. We linearize the objective function and extend an existing approach by allowing sales territories to be handled by more than one salesperson. Our model formulation features an infinite amount of binary variables. Therefore, we perform column generation in each node of a branch and bound tree to obtain a tight gap for the objective value of the optimal integer solution.

### TA10 - RT5: Online retail

Time: Tuesday, 28/June/2022: TA 8:30-10:00  ·  Location: Forum 14
Session Chair: Fábio Neves-Moreira

Pricing and delivery lead time policies for online retailers

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We consider an online retailer and characterize policies, which specify the options (selling price and delivery lead time) to be offered to customers. In the static M-option policy M options are set at the beginning of the planning horizon and the decisions on when to offer them are made dynamically. In dynamic single-option policy the retailer offers a single dynamic option. We propose algorithms to optimize the policies and evaluate their benefits.

The impact of committing to customer orders in online retail

Goncalo Figueira, Willem van Jaarsveld, Pedro Amorim, Jan Fransoo

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Online customers like to receive baskets of grocery orders at a confirmed time. Online retailers increasingly offer customers a choice of leadtime, while actively backordering missing items from the baskets. This fundamentally changes strategic inventory management. We develop new allocation policies that commit to an order upon arrival rather than at the moment the order is due. We give analytical results for the performance of these policies and evaluate them with e-tailer data.

Playing hide and seek: tackling in-store picking operations while improving customer experience

Fábio Neves-Moreira, Pedro Amorim

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Recently, several omnichannel retailers face the growth of online sales through in-store picking. We tackle a new relevant problem where a picker picks online orders while minimizing customer encounters. The problem is modelled as a Markov decision process and solved using a Q-learning approach. Results on a real retail store suggest that retailers should scale in-store picking without jeopardizing offline customers' experience. However, choosing simplistic picking policies is not sufficient.

### TA11 - ML5: Learning algorithms

Time: Tuesday, 28/June/2022: TA 8:30-10:00  ·  Location: Forum 15
Session Chair: Antoine Desir

Online learning via offline greedy algorithms: applications in market design and optimization

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We study the problem of transforming offline algorithms to their online counterparts, focusing on offline combinatorial problems that are amenable to a constant factor approximation using a greedy algorithm that is robust to local errors. We provide a general offline-to-online framework using Blackwell approachability, producing T^1/2 regret under the full information setting and T^2/3 regret in the bandit setting. We apply our framework to operations problems and produce improved regret bounds.

Deep policy iteration with integer programming for inventory management

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In this work, we discuss Programmable Actor Reinforcement Learning (PARL), a policy iteration method that uses techniques from integer programming and sample average approximation. We numerically benchmark the algorithm in complex supply chain settings where optimal solution is intractable and show its performs comparable to, and sometimes better than, state-of-the-art RL and commonly used inventory management benchmarks.

Representing random utility choice models with neural networks

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Motivated by the successes of deep learning, we propose a class of neural network-based discrete choice models, called RUMnets, which is inspired by the random utility maximization (RUM) framework. This model formulates the agents' random utility function using the sample average approximation (SAA) method. We show that RUMnets sharply approximates the class of RUM discrete choice models. We provide analytical and empirical evidence of the predictive power of RUMnets.

### TA12 - FL5: Flash: Healthcare 1

Time: Tuesday, 28/June/2022: TA 8:30-10:00  ·  Location: Forum 16
Session Chair: Donghao Zhu

Optimize and automate surgical block overbooking - sustained implementation

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The Operating Rooms (ORs) are some of the most expensive and resource intensive areas of healthcare delivery. We developed and implemented a unique method to overbook surgeon blocks, i.e. assigning more OR block time than we have OR capacity to improve OR access. Using Mixed Integer Quadratic Programming, we spread the risk of overbooking equitably and enable block overbooking through an automated process for the front-line to manage and sustain easily.

On the use of partitioning in the inpatient surgical department: robust surgery scheduling

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To efficiently schedule operating rooms (ORs) in complex inpatient surgical departments, we consider separating the more predictable elective surgeries from the less predictable elective and non-elective surgeries. We solve this problem by heuristics and simulation. Using the data from a university hospital, we find that the partitioning can considerably reduce the cancellation rate and can fairly reduce the elective access times without much damaging the non-elective access times.

Joint admission and discharge control with readmissions

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Admission and discharge decisions play important roles in hospital intensive care unit (ICU) bed capacity management. In this model, we formulate the readmission of patients as an endogenous process that relies on previous discharge decisions. We develop a model to jointly consider early discharge decisions and admission control, including emergency diversion and elective scheduling. By applying the riskiness index, we can reformulate the problem and solve it efficiently.

Nudging patients towards cost-effective providers: analysis of an insurer’s effort-based and cash reward-based mechanisms

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This work examines how health insurance companies (HICs) can exert effort and offer cash rewards to nudge patients towards cost-effective providers. We build a stylized model to analyze the HIC’s optimal effort and reward, individually and jointly, under different cost-share structures. We find that neither a reward-only nor an effort-only approach uniformly outperforms the other, and HIC strictly benefits most from the joint approach when the price difference is modest.

Optimal hearing loss screening for pediatric patients with cystic fibrosis disease

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Patients with cystic fibrosis disease experience frequent pulmonary exacerbation and require antibacterial treatments. Intravenous aminoglycosides are the primary choice but they cause hearing loss. To detect possible hearing loss, there are several hearing assessment methods available. The overarching aim of this research is to design cost-effective strategies to monitor pediatric patients with CF disease to detect potential hearing loss and improve their quality of life using a hearing aid.

A two-timescale approach for incarceration diversion with community corrections programs

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We study incarceration diversion decisions with community corrections as an alternative to jailing to alleviate the prominent issue of jail overcrowding. We formulate an MDP model to optimize incarceration diversions for individuals of different risks. To tackle the curse-of-dimensionality caused by non-memoryless, we develop a novel two-timescale approximation embedded in an actor-critic policy gradient algorithm. We provide structured insights for diversion decisions and service capacities.

Data-pooling reinforcement learning for personalized healthcare intervention

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Personalized intervention management in healthcare has received a rapidly growing interest. A key challenge for personalization is data scarcity. In this research, we develop data-pooling technique in the reinforcement learning (RL) context to address the small sample issue. We develop a novel data-pooling estimator and establish theoretical performance guarantee. We demonstrate its empirical success on a real hospital dataset with an application to reduce 30-day hospital readmission rate.

### TB1 - SO4: Applications in sustainable supply chains

Time: Tuesday, 28/June/2022: TB 10:30-12:00  ·  Location: Forum 1-3
Session Chair: Elisabeth Paulson

Combating lead pollution in Bangladesh through policy intervention in battery supply chain

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Informal recycling of used lead acid batteries causes tremendous environmental damage, especially to children’s physical and mental developments in Bangladesh. The problem is further exacerbated as lead extracted from the process is used to produce low-quality batteries that require frequent replacements. We study public policy interventions that give incentives to extend battery lives and promote formal recycling under strong environment production, to reduce the circulation of informally-recycled lead.

Reducing lead poisoning by increasing the life of electric three wheeler batteries in Bangladesh – Randomized control trial to design and test a business model innovation

Amrita Kundu1, Erica Plambeck2, Qiong Wang3

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We are designing a novel business model to extend the life of lead acid batteries used in electric three wheelers in Bangladesh. Through a randomized control trial, we are testing the impact of the business model on battery life and performance, recycling rate and lead emissions, energy consumption and CO2 emissions, and income and profit of battery users. The business model can be generalized to other durable goods and geographies where products fail fast because of market inefficiencies.

Outcome-driven dynamic refugee assignment with allocation balancing

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The initial landing location of a refugee has implications on their long-term success. We propose two new dynamic algorithms to match refugees to localities within a host country. The performance of the proposed methods is illustrated on real US refugee resettlement data. The first algorithm maximizes the average employment level, and is currently deployed in a pilot in Switzerland. The second algorithm balances employment with the desire for an even allocation to the localities over time.

### TB2- HC6: Machine learning for health care

Time: Tuesday, 28/June/2022: TB 10:30-12:00  ·  Location: Forum 6
Session Chair: Kyra Gan

Ensemble machine learning for personalized antihypertensive treatment

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Current clinical guidelines for hypertension provide physicians with general suggestions for first-line pharmacologic treatment, but do not consider patient-specific characteristics. We utilize electronic health record data to develop personalized predictions and prescription models for hypertensive patients. We demonstrate a 15.87% improvement over the standard of care and propose a novel interactive dashboard to facilitate the deployment of the derived models in the clinical practice.

Small area estimation of case growths for timely COVID-19 outbreak detection: a machine learning approach

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Rapid and accurate detection of local outbreaks is critical to tackle resurgent waves of COVID-19. A fundamental challenge in case growth rate estimation, a key epidemiological parameter, is balancing the accuracy vs. speed tradeoff for small sample sizes of counties. We present “Transfer Learning for Generalized Random Forests” (TLGRF), a novel framework which uses relevant features affecting the disease spread across time and counties to obtain more robust and timelier county-level estimates.

Toward a liquid biopsy: greedy approximation algorithms for active sequential hypothesis testing

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We address a set of problems that occur in the development of liquid biopsies via the lens of active sequential hypothesis testing (ASHT). Motivated by applications in which the number of hypotheses or actions is massive, we propose efficient algorithms and provide the first approximation guarantees for ASHT, under two types of adaptivity. We numerically evaluate the performance of our algorithms using both synthetic and real-world DNA mutation data.

### TB3 - HC14: Operations control in healthcare

Time: Tuesday, 28/June/2022: TB 10:30-12:00  ·  Location: Forum 7
Session Chair: Pengyi Shi

Skills-based routing under demand surges: the value of future arrival rates

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Motivated by recent development in predictive analytics, we study how to utilize future demand information to design optimal routing strategies when facing demand surges. We consider a multi-class multi-pool parallel server system with partial flexibility, where overflowing a customer to a non-primary server-pool can be associated with efficiency loss and other costs. Our results explicitly characterize how to incorporate future demand into routing decisions and quantify the benefit of doing so.

Steady-state performance approximations of many-server queueing networks

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Motivated by the need for decision support tools for workload prediction and capacity planning in hospitals under the COVID-19 pandemic, we consider a queueing network consisting of two many-server stations, which models the flow of patients between medical/surgical and intensive care unit wards. We approximate the steady-state customer count using the stationary distribution of the associated diffusion model, which can be computed efficiently and be used as a real-time decision support tool.

Patient census calibration for hospital networks operating in a random environment

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Motivated by the challenges in census prediction in data-driven settings for hospital resource management, this paper introduces and studies the patient census calibration problem for hospital networks operating in a random environment. We use the expectation-maximization method to efficiently solve the calibration problem. We present simulation results that demonstrate the efficiency and accuracy of the method, and theoretical analyses that provide large-sample statistical guarantees/

### TB4- BO6: Bullwhip effect and contracts

Time: Tuesday, 28/June/2022: TB 10:30-12:00  ·  Location: Forum 8
Session Chair: Kai Wendt

Wait and see, or pay now? On how people decide to pay a cost to avoid a loss

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An action associated with a small cost is commonly taken by humans for preventing a potential big loss in a wide range of domains. For example, technicians decide whether to do preventive maintenance now or to wait for the next updated machine status information. We model such decisions as a dynamic cost-loss game. We analytically show that using a probability threshold is an optimal policy. We next conduct a controlled laboratory observing how human decision makers behave in this environment.

Who should bear the risk? A theoretical and behavioral investigation of after-sales service contracts.

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Resource-based contracts fail to motivate suppliers to provide reliable services as they are paid for after-sales services. Performance-based contracts shifts much of the downtime risk to the supplier by making him responsible for machine uptime, but then customers might reduce care efforts. We propose the full-care contract to achieve both high reliability and care, and show that the FCC not only the best contract analytically but also can motivate risk averse suppliers to bear the chain risk.

Behavioral simulation of blockchain-enabled order history sharing and the Bullwhip Effect

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Using a behavioral game of supply rationing, we investigate the consequences of sharing information about competing retailers’ historical orders on the Bullwhip Effect. We find that decision makers act more strategically and closer to Nash equilibrium predictions if information about competitors’ historical orders is shared; however, sharing the entire order history does not accelerate the convergence to theoretical Nash equilibrium as much as sharing orders from the last period only.

### TB5 - SCM6: Supply Chain Resilience

Time: Tuesday, 28/June/2022: TB 10:30-12:00  ·  Location: Forum 9
Session Chair: Dmitry Ivanov

Creating supply chain resilience with operational and financial measures: complements or substitutes?

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We examine the interplay between operational effort to increase supply chain resilience and financial arrangements such as buyer intermediated financing, buyer direct financing, and advance payments. We characterize conditions when those arrangements complement operational effort and when they are substitutes. We study when those arrangements lead to coordination or at least efficiency gains for buyers and their upstream supply chain.

Expanding the freight contract portfolio: Index-based freight contract design under uncertainty

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Fixed-price freight contracts between firms and transportation providers are non-binding and often fail due to supply and demand uncertainties. We propose indexed pricing to reduce frequent unanticipated costs and supplier performance degradation. We show how to design these contracts for a Pareto improvement over traditional contracts, conduct an experiment with an agricultural firm to validate the models, and quantify the causal effect of indexed contracts on costs and performance.

Probability, adaptability, and time: Some research-practice paradoxes in supply chain resilience and viability modeling

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Modeling of resilience and viability became crucial in case of supply chain disruptions. We discuss research-practice paradoxes and show that the categories of probability, adaptability, and time are major determinants of resilience and viability modeling. We stress the importance of reliable suppliers, disruption probabilities, disruption time and ripple effect estimation, value-creation perspective of resilience, and viability of intertwined supply networks.

### TB6 - Africa Initiative: MSOM Africa Initiative

Time: Tuesday, 28/June/2022: TB 10:30-12:00  ·  Location: Forum 10
Session Chair: Burak Kazaz

Solar energy technology adoption; a vignette study for the up-scale residential sector in Egypt

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Investments in PV solar systems in the residential sector in Egypt are not thriving as expected despite the rapid decrease of the capital cost, electricity tariff reforming, and recent regulations for grid connection. This research targeted the residential sector in Egypt as it consumes 47% from the nation's electricity (IRENA, 2018), and explored the decision-making factors that affect the adoption of solar energy technology by the upscale residential sector.

Decent work compliance in Moroccan logistics industry in the aftermath of COVID-19 pandemic

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There is a scarcity of research on how the COVID-19 pandemic affected working conditions and decent work aspects (social protection, security, equality). In this study we investigate whether decent work principles are being taken into account in the Moroccan logistics industry. Based on a literature review, we would assess the previous contributions of research linking decent work, logistics, operations management and supply chain management which will be used for empiricaal investigation.

Operational challenges for EMS platforms in developing countries

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Many developing countries lack the health-emergency infrastructure of the developed world. In this context, our industry partner Flare (operating in Nairobi, Kenya) coordinates existing ambulance providers by operating a platform. We study the operational challenges for such platforms as they often lack the knowledge about all ambulances' future availability and their location at a tactical level, and typically do not fully control these ambulances.

### TB7 - SM7: Service staffing and capacity allocation

Time: Tuesday, 28/June/2022: TB 10:30-12:00  ·  Location: Forum 11
Session Chair: Gar Goei Loke

How to staff when customers arrive in batches

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From cloud computing to Covid quarantines, requests for service can arrive in batches. How should this impact the service's staffing? Here, we find that there is no economy of scale as batches grow large, a stark contrast with classical square root rules. By consequence, the queue length is not asymptotically normal; in fact, the fluid and diffusion-type limits coincide. When arrivals are both quick and in batches, an economy of scale can exist, but we show that it is weaker than expected.

Service staffing for shared resources

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Motivated by hotel housekeeping, we study shift construction decisions for room attendants amid uncertainty about customer arrival and departure times. We provide analytical results using the framework of M-convexity. A numerical case study for one hotel suggests that reallocating a small number of workers to later shifts can effectively eliminate guest waiting after the posted check-in time. We also identify alternate optimal solutions that can be useful for recruiting and retaining workers.

Joint capacity allocation and job assignment under uncertainty

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We consider the multi-period problem of jointly allocating resources to J supply nodes and assigning jobs of I different demand origins to the nodes. The goal is to maximize rewards for matching or minimize costs of waiting and assignment. We introduce a distributive decision rule, which represents the proportion of jobs served by each of the supply nodes. We test against benchmark models developed specifically for allocation or assignment decisions only and record 1-15% reductions in costs.

### TB8 - RM5: Online algorithms in revenue management

Time: Tuesday, 28/June/2022: TB 10:30-12:00  ·  Location: Forum 12
Session Chair: Will Ma

Online resource allocation for reusable resources

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We study a general model of reusable resource allocation problems. Customers of different types arrive according to a stationary stochastic process. The firm's goal is to maximize multiple kinds of rewards generated by customers. We develop an online policy for deciding on actions to take without knowing the distribution of customer types and show that when the usage duration is small compared with the length of the planning horizon, our policy achieves a near optimal performance.

The multi-secretary problem with many types

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We study the multisecretary problem with a capacity to hire up to B out of T candidates with their values drawn i.i.d from a distribution F on [0,1]. We investigate the achievable regret performance where our benchmark is the offline optimal policy. We establish the insufficiency of the common certainty equivalent heuristic for distributions with many types and gaps. We devise a new algorithmic principle called "Conservatism wrt Gaps" and use this to derive near-optimal regret scaling.

Tight guarantees for multi-unit prophet inequalities and online stochastic knapsack

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Prophet inequalities are a useful tool for designing online allocation procedures and comparing their performance to the optimal offline allocation. In this paper we derive the best-known guarantee for $k$-unit prophet inequalities for all $k>1$. We also provide a tight resolution to the related Magician's problem. Finally, we improve the guarantee from 0.2 to 0.319 for online knapsack, and from 0.321 to 0.3557 for unit-density online knapsack.

### TB9 - SM4: Real estate and hospitality services

Time: Tuesday, 28/June/2022: TB 10:30-12:00  ·  Location: Forum 13
Session Chair: Abhishek Deshmane

Product line and capacity decisions for the real estate industry under willingness-to-pay uncertainty

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A residential construction firm's product mix and land investment decisions are highly complex due to the need for long-term planning. We study these decisions using a 3-stage capacity-constrained stochastic optimization model with a heterogeneous consumer base under willingness-to-pay distribution uncertainty. Among others, we find that the land investment increases with uncertainty. We also discuss the impact of competition and housing affordability regulations and find non-intuitive results.

Price negotiations in real estate markets: Type-dependent offer curves, reservation prices and bargaining powers

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We empirically analyze price bargaining for houses between the company and individual buyers. In each bargain, the seller and buyer take turns to make concessions until one of them terminates the bargain by accepting the other’s offer or by exiting it. We relate concessions to compromises via reservation prices and then measure bargaining powers through compromises. We identify house and buyer types and obtain type-dependent estimates of reservation prices and bargaining powers.

Modelling sequential choices with an application to museums

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Visitor experience in museums is complex, where the utility procured by an artwork depends on multiple artistic, layout-related, and environmental factors. In this paper, we build a framework that analyses sequential choices made by the incumbent when the options are made available in a physical space. By applying it to the context of museums, we are able to study the effect of the curatorial decisions on visitor engagement and build counterfactuals for identifying better layout configurations.

### TB10 - RT6: Retail analytics

Time: Tuesday, 28/June/2022: TB 10:30-12:00  ·  Location: Forum 14
Session Chair: Saravanan Kesavan

The Past, Present, and Future of Retail Analytics: Insights from a Survey of Academic Research and Interviews with Practitioners

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Combining the insights from our survey of academic research and interviews with practitioners, we provide directions for future academic research that take advantage of the availability of big data. Future research on retail analytics can contribute to existing work by: (i) studying new decisions, (ii) using more advanced analytics, (iii) leveraging new data sources, or (iv) applying more sophisticated methods.

A Comparison of the Fast-Fashion and Traditional Approaches to Apparel Retail: Profits and Environmental Impact

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Apparel retailers have generally followed one of two supply chain approaches: the traditional approach (lacks quick response capabilities and produces more durable products) or the fast-fashion approach (has quick response capabilities and produces less durable products). Using an infinite horizon game theoretic model, we compare the profitability and environmental impact of the two approaches. We characterize win-win scenarios (higher profit and lower environmental impact) for both approaches.

Augmenting Algorithms with Inputs from Retail Merchants improves Profitability: Evidence from a Field Experiment

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We conduct a field experiment to examine whether algorithms should be automated or be used to augment human decision-makers. Unlike the common practice of allowing managers to override the output of algorithms, we allow retail merchants to override the inputs in order to capture the private information they possess. Our results show that the input augmentation model increases profitability by nearly 4% compared to the automation model where merchants were not involved.

### TB11 - RT9: Product returns

Time: Tuesday, 28/June/2022: TB 10:30-12:00  ·  Location: Forum 15
Session Chair: Mehmet Sekip Altug

Design of Contingent Free Shipping policy: The role of return environment

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A contingent free shipping (CFS) policy offers free shipment of an order only if it satisfies a pre-specified threshold amount. Our study empirically documents a novel determinant of optimal CFS terms: ease-of-return experience. To reflect its impact on the CFS policy’s embedded trade-offs, a manager shall apply the following counterintuitive adjustment; set lenient (resp. stringent) CFS terms when the customer return process is convenient (resp. inconvenient).

To Bundle or Not to Bundle: The Impact of Conditional Discounts on Sales and Returns

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We present our empirical findings on how bundle promotions affect consumer purchase and return behavior compared to markdowns, using a large apparel brand’s in-store purchase and return panel data. In this work, we show that bundle promotions increase the incidence and decrease the return probability of each product compared to products sold with markdowns, controlling for price, discount depth, and item characteristics.

The impact of online product reviews on retailer's pricing and return policy decisions

Mehmet Sekip Altug

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Customers use on-line product reviews more frequently. We explore the impact of product reviews on customer’s valuation uncertainty for an experience product and how that in turn affects a monopolist retailer’s pricing and refund decisions. In a duopolistic competition, the overall sentiment of the reviews are influenced by both retailers. We show that the retailers make their returns more lenient in the presence of product reviews in both settings.

### TB12 - FL6: Flash: Healthcare 2

Time: Tuesday, 28/June/2022: TB 10:30-12:00  ·  Location: Forum 16
Session Chair: Niklas Tuma

On the frontline: Engaging health workers to mitigate the last-mile stock-out of health commodities in developing countries

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We rigorously investigate whether and to what extent variations in the (i) the physical context where training is administered (i.e., onsite vs. offsite training); (ii) the familiarity of the trainer who administers the training (i.e., familiar vs. unfamiliar trainer); and (iii) the timing of the week when training is administered (i.e., early-week vs. mid-week vs. late-week training) impact the learning outcomes of health workers and subsequently the likelihood of health commodity stock-outs.

Service chains' operational strategies: standardization or customization? Evidence from the nursing home industry

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We investigate how the Degree of Standardization across service chain-belonging units impacts performance outcomes. We find that nursing homes that customize service delivery and standardize customer mix tend to experience improved financial performance; those that standardize customer mix tend to experience improved clinical outcomes, and those that customize service delivery tend to experience enhanced resident welfare.

Modeling strategic walk-in patients in appointment systems: equilibrium behavior and capacity allocation

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We develop a queueing model to represent a clinic with two types of strategic patients who choose between making an appointment, incurring type-dependent indirect wait cost, and walking in, bearing an inconvenience cost and a risk of being rejected. We focus on the clinics' decisions to allocate slots to walk-ins and appointments to maximize their revenues. The system is analyzed under observable and unobservable settings. The model assumptions and results are examined via a simulation platform.

Service speed under multi-dimensional workload in Emergency Departments

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This study improves our understanding of how workload affects service speed by analyzing patient flow through the ED at a high resolution. We exploit a novel dataset and a nonparametric ML method to track multiple dimensions of workload in realtime. We find the service rate resembles the hazard of a log-normal distribution, nurse load has a greater impact on service speed than physician load, which in turn has a greater impact than system load, and a clearer picture of the system workload.

Safely bridging offline and online reinforcement learning

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A key challenge to deploying reinforcement learning in practice is safe exploration. We propose a reinforcement learning algorithm that provably satisfies a safety constraint where it uniformly improves performance at each iteration while achieving sublinear regret. We experimentally validate our results on a sepsis treatment task and an HIV treatment task, demonstrating that our algorithm can learn while ensuring good performance compared to the baseline policy for every patient.

### TC1 - SO5: Labor aspects in sustainable supply chains

Time: Tuesday, 28/June/2022: TC 14:00-15:30  ·  Location: Forum 1-3
Session Chair: Zhoupeng Zhang

Evidence of the unintended labor scheduling implications of the minimum wage

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Our study is the first to empirically study the impact of the minimum wage on firms’ scheduling practices. Using a highly granular dataset from a chain of fashion retail stores, we estimate that a $1 increase in the minimum wage, while having a negligible impact on the total labor hours used by the stores, leads to a 27.7% increase in the number of workers scheduled per week, but a 19.4% reduction in weekly hours per worker, and less consistent schedules, which substantially hurt worker welfare.

A game theoretic model of forced labor reduction in supply chains

Kate Ashley, Shawn Bhimani

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Under current legislation, multinational companies are at risk of having imports into the U.S. blocked due to alleged use of forced labor in their supply chains. Using a game theoretic model, we study the equilibrium interactions between firms, who may exert costly 'responsibility effort,' and enforcement organizations that allocate scarce resources to investigate multiple firms. We characterize policies that incentivize greater supply chain responsibility based on firm and industry parameters.

Implications of Worker Classification in On-Demand Economy

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How shall gig workers be classified? Compared to the benchmark of contractors, we show that uniform classifications (employees, contractors+) suffer issues of worker’s being undercut and overjoining and will not always make vulnerable workers better off. To classify workers according to their needs, or operationally prioritizing vulnerable workers can Pareto improve over uniform classifications. Our work highlights the importance of worker-specific regulations in the on-demand economy.

### TC2 - HC7: Bandit algorithms in health care

Time: Tuesday, 28/June/2022: TC 14:00-15:30  ·  Location: Forum 6
Session Chair: Jackie Baek

Multi-armed bandit with endogenous learning and queueing: An application to split liver transplantation

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We enhance the multi-armed bandit model by considering endogenously non-stationary rewards – specifically rewards that are parametric functions of policy histories (learning). We further incorporate queueing costs, fairness, and arm correlation. We propose the L-UCB, FL-UCB, and QFL-UCB algorithms to solve our model, prove its logarithmic regret, and apply it to split-liver transplantation.

Bandits with Time-to-Event Outcomes

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We adapt online learning techniques to scenarios with time-to-event data, where there is a delay between choosing an arm and observing feedback that is endogenous to the quality of the arm. We posit a multi-armed bandit algorithm with a cox-proportional hazards estimator, prove guarantees on the regret under this algorithm, and analyze its performance on a dataset of metastatic breast cancer clinical trials, comparing it to that of other adaptive allocation schemes.

Targeted interventions for TB treatment adherence via reinforcement learning

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Lack of treatment adherence significant barrier to reducing the global disease burden of tuberculosis (TB). We study the design of targeted interventions for a treatment adherence support platform running in Kenya, whose goal is to help patients on TB treatment. We show empirically that there is large heterogeneity in treatment effects of interventions, and we devise a novel online learning policy based on Thompson Sampling that significantly outperforms the currently employed policy.

### TC3 - HC15: Healthcare innovations

Time: Tuesday, 28/June/2022: TC 14:00-15:30  ·  Location: Forum 7
Session Chair: Andreas K. Gernert

Reverse cross subsidization in healthcare capitation programs: evidence from Medicare Advantage

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Capitation payment models have been increasingly adopted by the payers in the U.S. healthcare market during the past decade. Through a Difference-in-Difference (DID) design, this paper empirically demonstrates that Medicare Advantage (MA), the largest healthcare capitation program in the U.S., inadvertently incentivizes MA health plans to reallocate parts of the capitation payments from the sick to cross subsidize the healthy, a practice to which we refer as reverse cross subsidization.

Business model innovation for ambulance systems in developing Countries: ``Coordination and Competition"

Andreas K. Gernert1, Andre P. Calmon2, Gonzalo Romero3, Luk N. Van Wassenhove4

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Emergency transportation systems in developing countries often lack the capacity and coordination to serve patients.

We study the market entrance decision of an entrepreneur into an ETS in a region where independent ambulance providers compete for demand. The entrepreneur may decide (i) to acquire own ambulances to become a competing service provider, (ii) to operate a pure platform that exclusively coordinates existing providers, or (iii) to coordinate and compete by combining both strategies.

### TC4 - BO7: Customer behavior and populations

Time: Tuesday, 28/June/2022: TC 14:00-15:30  ·  Location: Forum 8
Session Chair: Freddy Lim

Silent abandonment in contact centers: estimating customer patience from uncertain data

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Contact centers face operational challenges - proxies for customer experience are subject to uncertainty. A main source is silent abandonment customers (Sab). Sab leave while in queue with no indication. As a result, capacity is wasted. We develop methodologies to identify Sab and to estimate patience. We show how accounting for Sab in a queueing model improves the estimation accuracy of key measures of performance. Finally, we suggest strategies to operationally cope with Sab.

On the impact of behavior-aware customer assignments for human-centered routing: Evidence from an experimental investigation

Christian Jost, Rainer Kolisch, Sebastian Schiffels, Maximilian Schiffer

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In the service industry, it is common that companies send agents to perform tasks at customer locations. Thereby, many companies rely on their agent's ability to construct tours manually. These manual tours are often non-optimal, causing high travel cost. In our work, we developed a new agent-to-customer assignment approach, designed to promote the manual construction of distance minimal tours. In our experimental study we investigate its effect on the human routing performance.

Loyalty currency and mental accounting: do consumers treat points like money?

So Yeon Chun, Freddy Lim, Ville Satopaa

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We study how consumers decide to pay with loyalty points or money by developing a model and estimating it on airline loyalty program data. We find that mental accounting, subjective perceived value, and reference exchange rate of points play important roles, and consumers’ primary points earning source and total earning level are jointly associated with their attitudes toward points and money. We show how a firm can implement pricing policies to efficiently influence consumers’ payment choices.

### TC5 - EF4: Supply Chain Finance

Time: Tuesday, 28/June/2022: TC 14:00-15:30  ·  Location: Forum 9
Session Chair: David Wuttke

An operational perspective on micro-financing in developing countries

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We compare two microfinancing structures in developing countries where an entrepreneur with zero initial budget borrows a loan to start a business. The entrepreneur faces a Newsvendor problem with finance and effort considerations. We characterize conditions under which a community bank, which can apply social pressure on the entrepreneur to pay all of its debt back, improves individual and social welfare in comparison with a social bank, which has no such mechanism.

Supply chain finance hedging: designing data-driven contracts

Seyyed Hossein Alavi, Manish Verma

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Loans can cause bankruptcy risk in capital constrained businesses. This study presents three data-driven contracts that enable us to capture the trade credit and bank credit risks by trade credit insurance and payment protection insurance, respectively. Analyses underscore the significance of using insurance services as risk hedging tools and ensuring the business continuity of supply chain players. Moreover, retailer prefers to receive trade credit if supplier purchase insurance services.

Empirical evidence about payment term extensions in the reverse factoring context

David Wuttke

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Reverse factoring is increasingly relevant in the industry and examined in academia. We complement the extant analytical studies on reverse factoring with empirical evidence and determine whether theoretical predictions of those models are consistent with industry practice. Some of our corresponding hypotheses are indeed supported, whereas in other cases, we find the opposite direction significant. Based on our analysis, we derive several implications for managers and researchers.

### TC6 - PF6: Online platforms

Time: Tuesday, 28/June/2022: TC 14:00-15:30  ·  Location: Forum 10
Session Chair: Yeqing Zhou

Leveraging consensus effect to optimize feed sequencing in online discussion platforms

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We will use data from a structured online discussion forum to understand what the key engagement drivers in online discussions are, and how we can leverage these drivers to improve the operations and performance of online discussion platforms. We will present both empirical and theoretical results characterizing strategies to guide discussions optimally - a crucial feature in an age where communications in both business and educational settings are increasingly moving to online settings.

Pricing strategies for online dating platforms

Titing Cui, Michael Hamilton

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Online dating apps are the most common way for couples to meet. Many of these dating apps use subscription based pricing (SP), where subscriptions to the app are sold at a fixed price. In online dating (SP) is controversial as it misaligns the incentives of the platform and its users. Another strategy is contract pricing (CP), where the dating app is contracted at a one time price. We study the profit and welfare trade-offs associated with either pricing strategy for online dating platforms.

Herding, learning and incentives for online reviews

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We study the herding and learning effects on the incentives for online reviews. We model the evolution of sales and reviews for a seller by a generalized Polya urn process and evaluate the profit for three incentive policies: incentivize before purchase, after purchase, or only if they write positive, possibly fake, reviews. We obtain conditions that each type of incentive is profitable and optimal. The results imply that platforms can curb fake reviews if allowing pre-purchase incentives.

### TC7 - SM8: Queuing models in services 1

Time: Tuesday, 28/June/2022: TC 14:00-15:30  ·  Location: Forum 11
Session Chair: Jingui Xie

Designing service menus for bipartite queueing systems

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We consider a multi-class multi-server queueing system, in which customers of different types have heterogenous preferences over the many servers available. A service provider designs a menu of service classes that balances maximizing the customers’ average service reward and minimizing customers’ average waiting time. Customers act as rational self-interested utility maximizing agents when choosing which service class to join. We study the problem under heavy traffic conditions.

Dynamic payment and lead-time control in queueing systems with heterogeneous customers and strategic delay

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We consider a first-come-first-serve single-server system in which heterogeneous customers. Customers are both payment and lead-time sensitive and are heterogeneous in both immediate service valuation and lead-time sensitivity. The service provider considers incentive-compatible price/lead-time menus based on the system congestion to maximize revenue. The optimal policy suggests the timing to offer a state-independent inflated lead-time option which may be easy to implement in practice.

The impact of prolonged service time under off-service placement on flexibility configurations

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Recent empirical observations find that the service time at the non-dedicated service provider is significantly prolonged compared with that at the dedicated service provider. This study models these empirical observations by developing stochastic models to assess the impact of the prolonged service time and other parameters (system workload and asymmetry level) on flexibility configurations. We obtain conditions characterizing the optimal flexibility design in the parameter space.

### TC8 - RM6: Choice and promotions

Time: Tuesday, 28/June/2022: TC 14:00-15:30  ·  Location: Forum 12
Session Chair: Yi Chen

Fulfillment by platform: Antitrust and upstream market power

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We examine whether mere adoption of fulfillment services offered by

platforms distorts competition by using data from a leading online retailing marketplace to empirically evaluate the effect on upstream

supply echelons. We find that evidence for regulatory views as the surplus welfare is absorbed by the platform. Smaller merchants with lower margin, are forced to increase price to remain profitable with platform fulfillment, leading to a price disadvantage compared to the bigger suppliers.

Contracting Strategies for Price competing Firms under Demand Uncertainty

You Wu, Anne Lange, Benny Mantin

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Capacity-constrained asset providers (APs) often compete over prices when they trade their transport capacities with logistics service providers (LSPs) via spot markets. To circumvent demand uncertainty, an AP and an LSP can negotiate a contract to secure sales and capacity, respectively. We propose a two-stage game theoretical model to study the trade-off of balancing the contract and spot market by characterizing the contracting and pricing strategies under competition and demand uncertainty.

How to display promotions when customers search?

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We study the impact of promotion display for online retail platforms where customers search. Utilizing a dataset set which contains detailed behavior information, we estimate a search and purchase model. Accurate estimation also enables us to evaluate different promotion display schemes and design policies that can improve the revenue. Through counterfactual analysis, we demonstrate that our policies can improve the revenue for some product categories by 2-4%.

### TC9 - SM5: Service operations applications 2

Time: Tuesday, 28/June/2022: TC 14:00-15:30  ·  Location: Forum 13
Session Chair: Jun Li

Stopping the revolving door: An empirical and textual study of crowdfunding and teacher turnover

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The public K-12 education system has been plagued by high teacher turnover and poor retention rates, a problem that traditional school systems have not been able to address. By contrast, we show that education crowdfunding portals that match teachers directly with resources significantly reduces teacher turnover. Textual analysis on crowdfunded projects demonstrates that this is achieved by alleviating two root causes of turnover: inadequacy of working environment and lack of teacher autonomy.

### TC10 - RT7: Environmental and financial aspects in retail

Time: Tuesday, 28/June/2022: TC 14:00-15:30  ·  Location: Forum 14
Session Chair: Afshin Mansouri

Supplying Cash-Constrained Retailers: Shopkeeper Behavior at the Bottom of the Pyramid

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Nanostore shopkeepers face complex inventory decisions how to manage their limited cash to acquire products from multiple suppliers. We conduct two studies to understand the drivers of shopkeepers’ behavior. In an empirical study, we find nanostore orders to be severely impacted by supplier visit frequency. In a laboratory experiment, we find that shopkeepers diversify their supply by deviating from optimal replenishment decisions.

The impact of trade credits on nanoretail supply chain performance

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Millions of nanostores sell basic items to bottom of the pyramid consumers in emerging markets. Their suppliers struggle with high operational costs because of shopkeepers’ cash constraints. We investigate the impact of trade credits on supply chain performance using difference-in-differences with matching. We find that nanostores receiving a credit transact more often, place larger orders and reject less orders. Trade credits create efficiency gains for suppliers that justify their extension.

Environmental impact of competition among online grocery retailers

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We model the competition between online grocery retailers leading to extra emissions from home delivery fleets as a war of attrition. By analyzing the equilibrium strategies of retailers, we estimate the emissions attributable to competition. Our numerical study using data from an online grocery retailer in London shows significant potential for CO2 reduction. Our results can inform policies to reduce the negative environmental impacts of competition in the online grocery retailing sector.

### TC11 - RT10: Food waste 1

Time: Tuesday, 28/June/2022: TC 14:00-15:30  ·  Location: Forum 15
Session Chair: Tobias Winkler

Coordinate or collaborate? food waste reduction in perishable product supply chains

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To limit food waste, retailers require suppliers to only send products with a remaining shelf life of at least a minimum life on receipt (MLOR). Such agreements may, however, substantially increase waste at suppliers. We analyze two scenarios of (1) coordinating the supply chain (SC) and (2) collaborating on setting the MLOR level. We show coordinating is neither the only nor always the best way to reduce waste. In some cases, just collaboration can be an excellent way to reduce waste in the SC.

Cosmetic quality standard and implications on food waste

Pascale Crama1, Yangfang Helen Zhou2, Manman Wang3

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A significant amount of fresh produce is wasted in upstream of the food supply chain due to the high cosmetic standard set by retailers. We examine the economic incentives for retailers to adopt such high standards and their impact on food loss. We show how the retailer’s cosmetic standard decision as well as food loss are affected by rejection rate due to high cosmetic standards and consumers’ willing-to-pay for cosmetic-pleasing products.

Picking for expiration dates - the behavior of customers in food retail and implications on food waste

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Grocery retailers target high inventory levels to avoid out-of-stock situations. A side effect thereof is an undesirable customer picking behavior for the freshest or rearmost item. Products with shorter expiration dates remain at the shelf and convert into food waste over time. Prevailing literature related to food waste in retail neglects this impact. Our paper fills this gap by revealing customer picking behavior in retail stores and by connecting this phenomenon to food waste occurrence.

### TC12 - FL7: Flash: Services 1

Time: Tuesday, 28/June/2022: TC 14:00-15:30  ·  Location: Forum 16
Session Chair: Eunji Lee

E-commerce assortment optimization and personalization with multiple-choice rank list model

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This paper proposes a multiple-choice rank list model to extend the classic discrete choice model by allowing customers to choose multiple distinct alternatives. In addition, we propose a framework to extract customers' preferences from the clickstream data. The corresponding assortment optimization and personalization problems can be solved by mixed-integer linear programs. Numerical experiments based on Cainiao Network showcase the predictive power of the proposed model.

Benefit of sequential estimation: robust sample size selection

Jeunghyun Kim1, Chihoon Lee2, Dongyuan Zhan3

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We propose and analyze a sequential design of price experimentation that balances the learning and earning trade-off in revenue management. Assuming the demand function belongs to a parametric family with an unknown parameter value, we derive a closed-form stopping rule based on the observed Fisher information. The decision maker adaptively stops learning and optimizes a price based on the cumulative information and there is no need to find an optimal “fixed” sample size a priori.

When the newsvendor is a broker

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A broker matches suppliers with a single buyer in an industrial market by submitting bids to procure goods to the suppliers. After bids are evaluated, the broker learns the quantities procured and ships the goods to the buyer to meet its demand. Modeling the broker’s problem as a new type of newsvendor network problem, we study the effect of problem parameters and uncertainty on the optimal bids as well as conditions under which it is optimal for the broker to bid at multiple supply locations.

Trading flexibility for adoption: Dynamic versus static walking in ridesharing

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Ridesharing platforms have traditionally implemented dynamic walking, which asks passengers to walk a little towards the car in order to achieve more efficient matches. Using novel models and extremely detailed Lyft data, we propose the new paradigm of static walking, which communicates a predetermined pickup location to the rider.

Discovering opportunities in New York City's discovery program: \\ an analysis of affirmative action mechanisms

Yuri Faenza1, Swati Gupta2, Xuan Zhang1

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Discovery program is an affirmative action policy used by NYC Department of Education to increase the number of disadvantaged students at specialized high schools. We show that the discovery program suffer many drawbacks both in practice and in theory, and explore possible replacements. We propose a minimal yet powerful modification of the current implementation via the joint seat allocation mechanism, which we show would improve the welfare of disadvantaged students maximally.

Teacher workarounds and educational inequality: A comparative study of workarounds at poorer versus wealthier public schools

Samantha Keppler

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In this paper, we study how schools work around insufficient government funding with supplemental resources from nonprofits. We ask: (i) How do resource-supplementing workarounds differ across schools with different socioeconomic advantage? (ii) What policies can ensure workarounds do not exacerbate educational inequities? We answer thee questions by applying Little's Law with validation from 62 interviews from six strategically sampled schools with different levels of socioeconomic advantage.

### TD1- SO6: Environmental strategies

Time: Tuesday, 28/June/2022: TD 16:00-17:30  ·  Location: Forum 1-3
Session Chair: Ece Gulserliler

Improving smallholder welfare while preserving natural forest: intensification vs. deforestation

Xavier S Warnes1, Joann F de Zegher3, Dan A Iancu1,2, Erica Plambeck1

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Smallholder farmers find themselves at the crossroads of the global efforts to reduce worldwide poverty and hunger, as well as the urgent need to prevent deforestation and the associated environmental consequences. In this work, we study how the smallholder farmers' welfare can be improved while preventing deforestation. For this, we propose a detailed operational model of a farmer’s dynamic decisions of land-clearing and production, under liquidity constraints and random cost and yield shocks.

Group incentives for preventing deforestation and improving smallholder farmer welfare

Dan Iancu1,2, Erica Plambeck1, Xavier Warnes1, Joann de Zegher3

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Many multinational buyers of agricultural commodities have made commitments to halt deforestation and improve farmer livelihoods in their supply chains. We propose group incentives conditional on forest protection requirements as a feasible mechanism for achieving this. We develop an analytical model and characterize the cases when group incentives dominate individual incentives, and use data collected from field research in Indonesia to assess the effectiveness of the approach.

Business model choice under Right to Repair: Economic and environmental consequences

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Right-to-Repair regulations require producers to supply necessary information and parts for consumers to independently undertake repairs. These regulations aim to prolong product lifetimes through repairs, but they may have adverse consequences such as cloning. This may encourage producers to reconsider their business model choices between ownership and non-ownership models. We analyze the effect of RTR on business model choice, and the implications for producers, consumers, and the environment.

### TD2 - HC8: Healthcare applications 2

Time: Tuesday, 28/June/2022: TD 16:00-17:30  ·  Location: Forum 6
Session Chair: Sandeep Rath

System Impact of Multi-channel healthcare

Sokol Tushe1, Hao Ding1, Diwas KC1, Suephy C. Chen2,3, Howa Yeung4,5

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This paper studies a multi-channel healthcare system with both a telemedicine and an in-person channel. Using a DID identification strategy, we find that introducing multiple channels has significant impact on the in-person channel and system level, including an increase in case complexity and planned consultation time by 20% for in-person consultations. In addition, we observe an increase in system capacity, a reduction in wait time for in-person appointments by 37.5%.

The role of physician integration in alternative payment models: the case of the comprehensive joint replacement program

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In this paper, we provide an empirical investigation into the role of horizontal and vertical integration of orthopaedic surgeons in driving heterogeneity in the impact of the Comprehensive Joint Replacement (CJR) program. Using a difference-in-differences approach, we find hospitals with high horizontal and vertical integration see an increase in both hospital costs and complication rates of 3.17% 1.17, respectively, while others see either a decrease or no change in these measures.

Managing collaborative care for diabetes and depression

Sandeep Rath1, Jayashankar Swaminathan1, Charles Coleman2

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Comorbid depression could lead to a 100% increase in the cost of care for diabetes. Clinical trials have demonstrated that depression care through care managers in a primary care setting (called Collaborative Care) leads to faster depression remission. We present a mathematical modeling approach that determines the optimal allocation of care managers' time to enrolled patients towards improving clinic revenue and patient health outcomes.

### TD3 - HC16: Healthcare analytics

Time: Tuesday, 28/June/2022: TD 16:00-17:30  ·  Location: Forum 7
Session Chair: Jiatao Ding

Delta coverage the analytics journey to implement a novel nurse deployment solution

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In partnership with IU Health, the largest health system in Indiana with 16 hospitals, we jointly developed a suite of advanced data and decision analytics to support a novel internal travel nursing program. This work addresses a long-standing gap in healthcare between state-of-art data decision support analytics and operational processes. Four months after implementation of our integrated machine learning and optimization tool demonstrated 5% lower understaffing and annualized savings of $900K.

A framework for optimal recruitment of temporary and permanent healthcare workers in uncertain environment

Saha Malaki, Navid Izady, Lilian M. de Menezes

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Given the increase in the demand for temporary healthcare workers and their additional cost burden, we propose a two-stage stochastic optimization framework to inform recruitment decision making for a provider facing a period of highly uncertain demand. The optimal recruitment decisions are analytically characterized under a general setting. A case study is conducted to illustrate the application of our framework in an inpatient ward. We also show potential savings from adoption of our model.

Can predictive technology help improve acute care operations? Investigating the impact of virtual triage adoption

Jiatao Ding, Michael Freeman, Sameer Hasija

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This paper develops a queueing game model to investigate the impact of virtual triage in the acute care setting. We find that, when virtual triage excessively recommends emergency (primary) care, it could bring about a decrease in ED (GP) visits. Another finding is for arbitrary self-triage accuracy, the adoption of informative virtual triage can worsen system performance. To unlock the operational benefits, we characterize the optimal virtual triage accuracy subjective to the ROC curve.

### TD4 - BO8: Innovation and projects in behavioral operations

Time: Tuesday, 28/June/2022: TD 16:00-17:30  ·  Location: Forum 8
Session Chair: Ramazan Kizilyildirim

One size does not fit all: Strengths and weaknesses of the agile approach

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Agile project management techniques have become commonplace in many organizations. We experimentally examine how these techniques affect performance in two innovation settings: (1) a design setting and (2) a search setting. Our results caution against uniform adoption of the Agile approach, and suggest that the choice of the approach should depend on the nature of the project and on the risk appetite of the project manager.

Exclusive or not an experimental analysis of parallel innovation contest

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We study multiple parallel innovation contests where contest organizers elicit solutions to a set of problems from solvers. Prior theoretical work shows that if problem solution requires less novelty then organizers should restrict participation with one contest. We experimentally show that this may not hold true in practice due to the heterogenity of solver efforts and encouraging solvers to participate in multiple contests can yield a larger organizer profit even for less novel problems.

### TD5 - EF5: Financial performance

Time: Tuesday, 28/June/2022: TD 16:00-17:30  ·  Location: Forum 9
Session Chair: Guillaume Lapierre-Berger

The role of Supply Networks in Managing net Operating Working Capital

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In this article, we investigate how the working capital management practice of a firm impacts its upstream and downstream supply chain partners.

We propose a Cash Conversion Distance (CCD) metric that identifies the degree with which a firm practices aggressive (or lax) working capital management.

We use secondary empirical data to show how firm's profitability as well as that of its partners varies as a function of this measure and its `importance' in the network.

When firms go public, standards drop

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Online platforms screen users who wish to benefit from their marketplaces. We show that when a platform transitions from private to public ownership, it will drop its screening standards, thus admitting otherwise unqualified users. Dropping standards ahead of an initial public offering allows platforms to increase their user base, leading stock investors to overvalue the stock (while imposing a cost on their users). We substantiate this hypothesis with data from p2p lending platforms.

### TD7 - SM9: Queuing models in services 2

Time: Tuesday, 28/June/2022: TD 16:00-17:30  ·  Location: Forum 11
Session Chair: Ricky Roet-Green

Advance selling and upgrading in priority queues

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We study advance selling and upgrading in a priority queue setting that emerges in the amusement park industry. Waiting sensitive customers who purchase cheaper advance tickets may suffer from demand uncertainty when consuming the service. Customers can purchase regular tickets in advance and upgrade to fast-track tickets on-site. We find if there are some offline customers who cannot purchase in advance, then allowing upgrading generates more revenue for the service provider.

Dynamic control of service systems with returns

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We study a queueing system with returns where at each service completion epoch, the decision maker can choose to reduce the probability of return for the departing customer at a cost that is convex increasing in the amount of reduction in the return probability. We characterize the structure of optimal long-run average and bias-optimal transient control policies for associated fluid control problems. Our results provide insights on the design of post-service intervention programs.

Foresee the next line: on information disclosure in tandem queues

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We consider a system where customers have to go through two service stages. We study the fully-observable model, in which queue-length information of both queues is available at arrival: customers observe the state of the entire system and decide whether to join or not. To learn the value of information we compare the fully observable system with the partially observable system in which, instead of observing the full system state, customers observe queue length only at arrival to each queue.

### TD8 - RM7: Pricing

Time: Tuesday, 28/June/2022: TD 16:00-17:30  ·  Location: Forum 12
Session Chair: Chung Piaw Teo

Model-free assortment pricing with transaction data

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We study the problem when a firm sets prices for products based on past transaction data. We do not impose a model on the distribution of the customers' valuations and only assumes purchase choices satisfy incentive-compatible constraints. The valuation of each past customer can be encoded as a polyhedral set, and our approach maximizes the worst-case revenue. We show optimal prices in this setting can be approximated by solving a compact mixed-integer linear program.

Component pricing with bundle size discount

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We study a bundle pricing policy, Component Pricing with Bundle Size Discount (CPBSD). It sells bundles at the sum of component prices minus a discount depending on the bundle size. It subsumes many mechanisms including Component Pricing and Bundle Size Pricing. We show that CPBSD attains the optimal profit asymptotically among all pricing policies under a weak condition. We formulate MILP for the optimal CPBSD. Comprehensive numerical experiments demonstrate the good performance of CPBSD.

Product and ancillary pricing optimization: market share analytics via perturbed utility model

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We consider a firm that sells some primary and ancillary products (services) to heterogeneous customers. The challenge is to determine the prices for all the products and services simultaneously, to optimize profits to the firm. We consider random utility model for customers' choice problem, and show that the choice model can be reformulated into a perturbed utility model (PUM) over the convex hull of the feasible solutions. Furthermore, we demonstrate how we can obtain a good approximation.

### TD9 - SM6: Performance evaluation for services

Time: Tuesday, 28/June/2022: TD 16:00-17:30  ·  Location: Forum 13
Session Chair: Cornelia Schön

Aligning frontline worker decisions to balance service quality and delivery cost

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A driver of service value, relevant in practice but understudied in the literature, is the experience of the customer while the service is performed. The design of the service experience is nontrivial given that it needs to tie in pricing and service delivery, and requires carefully designed incentives for the service workers to deliver the experience promised to customers. In this paper we use a novel framework that helps firms understand the essential tradeoffs underlying these choices.

A moment for reflection: de-biasing server evaluations

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This paper investigates how service evaluations, often collected as star ratings and comments, are biased and how this bias can be mitigated through the ordering of questions. Our findings suggest that writing comments first provides the time and space for the participants to reflect on their entire experience and allows the subsequent star ratings to capture a more holistic assessment of server quality.

Customization-responsiveness trade-offs in services

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Service providers are challenged by the demand to deliver near-customized services without noteworthy wait times, known as the “customization-responsiveness (CR) squeeze”. The approaches so far to manage the CR squeeze are mostly conceptual, or focused on a single dimension. Using choice-based offer selection and queuing theory, we develop a mathematical model to address the CR squeeze from a formalized perspective, and derive managerial insights and recommendations for specific applications.

### TD10 - RT8: Assortment planning 2

Time: Tuesday, 28/June/2022: TD 16:00-17:30  ·  Location: Forum 14
Session Chair: Arash Asadpour

Assortment planning with n-pack purchasing consumers

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We study the assortment planning problem for a single product category when a retailer faces multi-item purchasing, so-called “n-pack” consumers as introduced by Fox et al (2017). We obtain interesting properties of the product demand functions and establish that the optimal assortment is a popular set. We evaluate our model on a real-life data set and find that the demand proportions predicted by our model can be made extremely close to the actual proportion of sales.

Optimizing retail assortment and replenishment

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Determining the assortment and inventory levels based on their shelf life is essential for retailers to maximize profits while avoiding food waste. Assortment and inventory decisions are interrelated by the limited shelf space. A joint approach is needed that defines the assortment size and the maximum possible inventory levels while considering product ages. We develop the first multi-period approach to integrate product shelf life and product outdating.

Sequential Submodular Maximization andApplications to Ranking an Assortment of Products

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Motivated by the product ranking in online retail, we introduce and study the "sequential submodular maximization problem". Given an ordered list of products, a user inspects first $k$ products in the list for a $k$ drawn from a given distribution, and decides whether to purchase an item based on a choice model. The goal is to find an ordering maximizing the probability of purchase. We design near-optimal approximation algorithms for this problem, with or without group fairness constraints.

### TD11 - RT11: Food waste 2

Time: Tuesday, 28/June/2022: TD 16:00-17:30  ·  Location: Forum 15
Session Chair: Nina Mayer

Fighting imperfect produce: Grocery retailing strategies and the battle against food waste

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We examine grocery retailer's selling strategies of cosmetically imperfect produce. We consider three strategies: (1) Discarding of the imperfect produce; (2) Differentiating perfect and imperfect produce and selling at different prices; (3) Bunching strategy where perfect and imperfect produce are sold together. We identify when each strategy is optimal under quality uncertainty and varying degrees of consumer valuations and price sensitivity.

Channel choice under esthetic specifications and producer information in agricultural supply chains

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Growing consumer demand for sustainable food and transparent supply chains, makes direct-to-consumer sales an attractive alternative for farmers, next to the retail market. We study how a dual-channel structure can improve an agricultural food supply chain’s profitability and sustainable transformation, considering the effect of random crop-yield, customer appreciation of additional producer information, and esthetical requirements of retailers.

### TD12 - FL8: Flash: Services 2

Time: Tuesday, 28/June/2022: TD 16:00-17:30  ·  Location: Forum 16
Session Chair: Donghao Zhu

Search and matching for adoption from foster care

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We perform a game-theoretic analysis of two approaches to finding adoptive parents for children in foster care. We develop a new search-and-matching model and provide analytical results that suggest several advantages of having children's caseworkers drive the search process rather than prospective parents. Numerical case studies show that caseworker-driven search can result in both reduced search efforts and better matches for children.

Courier sharing in food delivery

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The food delivery market migrates to platforms that allow optimizing courier routing by sharing couriers among many restaurants. We address the question: how courier sharing contribute to the reduction of delivery costs? We consider a spatial queuing model in which couriers are servers. We show that in several scenarios dedicated courier system achieves higher profit than a shared courier system. This result can be attributed to the imbalance in the courtier allocation that sharing creates.

Serving advanced booking customers in platforms: Analysis of commission rate contracts

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Many platforms let guests reserve assets ahead of the rental start time. We find that this feature also allows hosts to decide when to create a listing of their asset, especially given most platforms use a commission contract along with dynamic prices. We use a game-theoretic framework to model such platforms. We theoretically find conditions where the hosts withhold asset availability information and find empirical support for the same. We find the optimal contract for such platforms.

Selling personalized upgraded substitutes and co-purchases in online grocery retail

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We propose, analyze and solve three decision optimization models for online retailers to make personalized upgraded substitution and co-purchase recommendations. Specifically, we explore: (i) pure expected revenue maximization, (ii) maximization of a weighted average of the expected revenue and the expected consumer surplus, and (iii) maximization of the expected revenue with a constraint on the minimum expected size of the shopping basket.