October 20, Tuesday, 2020

8:45-9:00 AM (Eastern Time)	**Opening Remarks** **Dean Morty Yalovsky,** Desautels Faculty of Management **Dr. Louise Poissant,** Scientific Director of the Fonds de recherche du Québec – Société et culture (FRQSC)
9:00-9:30 AM	**Saif Benjaafar, University of Minnesota** Dimensioning On-Demand Vehicle Sharing Systems
9:30-10:00 AM	**Chung-Piaw Teo, National University of Singapore** Last Mile Innovation: The Case of the Locker Alliance Network
10:00-10:30 AM	**Ho-Yin Mak, University of Oxford** Dimensionality Reduction for Stochastic Optimization
10:30-10:45 AM	**Break**
10:45-11:15 AM	Panel Discussion I
11:15-11:45 AM	**David Simchi-Levi, Massachusetts Institute of Technology** A New Approach for Vehicle Routing with Stochastic Demand: Combining Route Assignment with Process Flexibility
11:45 AM-1:00 PM	**Lunch Break**
1:00-1:30 PM	**Maxime Cohen, McGill University** Incentivizing Commuters to Carpool: A Large Field Experiment with Waze

1:30-2:00 PM	**Anton Kleywegt, Georgia Institute of Technology** Infrastructure-Guided Self-Driving Vehicle Flow on a Street Network
2:00-2:30 PM	**Zhenhui (Jessie) Li, Pennsylvania State University** Reinforcement Learning for Traffic Signal Control
2:30-2:45 PM	**Break**
2:45-3:30 PM	Panel Discussion II
3:30-4:00 PM	**Ming Hu, University of Toronto** Temporal or Spatial Pooling Solves the Wild Goose Chase
4:00-4:30 PM	**Marta C. Gonzalez, University of California, Berkeley** Deconstructing Laws of Accessibility and Facility Distribution in Cities
4:30-5:00 PM	**Peter I. Frazier, Cornell University** Fighting COVID-19 with Testing
5:00 PM	**Closing Remark**

Abstracts and Speaker Bios

9:00-9:30 AM

Saif Benjaafar

Dimensioning On-Demand Vehicle Sharing Systems

Abstract: We consider the problem of optimal fleet sizing in a vehicle sharing system. Vehicles are available for short-term rental and are accessible from multiple locations. A vehicle rented at one location can be returned to any other location. We model the dynamics of the system using a closed queueing network and obtain explicit and closed form lower and upper bounds on the optimal number of vehicles (the minimum number of vehicles needed to meet a target service level). Specifically, we show that starting with any pair of lower and upper bounds, we can always obtain another pair of lower and upper bounds with gaps between the lower and upper bounds that depend only on the service level. We show that the generated bounds are asymptotically exact under several regimes. We use features of the bounds to construct a simple and closed form approximation that we show to be always within the generated lower and upper bounds and is exact under the asymptotic regimes considered. The approximation is highly interpretable with buffer capacity expressed in terms of three explicit terms that can be interpreted as follows: (1) standard buffer capacity that is protection against randomness in demand and rental times, (2) buffer capacity that is protection against vehicle roaming, and (3) a correction term. Our analysis reveals important differences between the optimal sizing of standard queueing systems (where servers always return to the same queue upon service completion) and that of systems where servers, upon service completion, randomly join any one of the queues in the system. We show that the additional capacity needed to buffer against vehicle roaming can be substantial even in systems with vanishingly small demand. (joint work with Shining Wu, Hanlin Liu, and Einar Gunnarson; a related can be downloaded from here: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3535577)

Bio: Saif Benjaafar is Distinguished McKnight University Professor at the University of Minnesota. He is Head of the Department of Industrial & Systems Engineering at the University of Minnesota, where he also directs the Initiative on the Sharing Economy. He is a founding member of the Singapore University of Technology and Design where he served as Pillar Head (at the rank of Dean) of Engineering Systems and Design. He is the Editor in Chief of the INFORMS journal Service Science. He serves on the board of directors of Hourcar, a social car sharing organization. His research is in the area of operations management broadly defined, with a current focus on sustainable operations and innovation in business models, including sharing economy, on-demand services, and digital marketplaces. He is a Fellow of INFORMS and IISE.

9:30-10:00 AM

Chung Piaw TEO

Last Mile Innovation: The Case of the Locker Alliance Network

Abstract: Under its Smart Nation Initiative, the Singapore government has recently proposed the concept of “Locker Alliance" (LA), an interoperable network of lockers in residential areas and hot spots, to improve the efficiency of last mile parcel delivery operations. We focus on the issues of “proximity to customers" to determine the appropriate coverage of the LA network - How close to customers do we need to ensure adoption? The problem is complicated by the fact that customers can pick up parcels either from the lockers near their homes or work places, or in other hot spots. Without knowing the consideration set of the customers, how do we design the LA network to ensure that its utilization will be maximized?

Bio: Chung Piaw TEO is Provost’s Chair Professor and Executive Director of the Institute of Operations Research and Analytics (IORA) in the National University of Singapore. Prior to the current appointments, he was a Head of Department, Acting Deputy Dean, Vice-Dean of the Research & Ph.D. Program as well as Chair of the Ph.D. Committee in the NUS Business School. He was a fellow in the Singapore-MIT Alliance Program, an Eschbach Scholar in Northwestern University (US), Professor in Sungkyunkwan Graduate School of Business (Korea), and a Distinguished Visiting Professor in YuanZe University (Taiwan).

He is currently spearheading an effort to develop the IORA, as part of the University’s strategic initiatives in the Smart Nation Research Program, as well as a department editor for MS (Optimization), and a former area editor for OR (Operations and Supply Chains). He studied issues in service and manufacturing operations, supply chain management, discrete optimization, and machine learning. He has also served on several international committees such as the Chair of the Nicholson Paper Competition (INFORMS, US), member of the LANCHESTER and IMPACT Prize Committee (INFORMS, US), Fudan Prize Committee on Outstanding Contribution to Management (China).

10:00-10:30 AM

Ho-Yin Mak

Dimensionality Reduction for Stochastic Optimization

Abstract: Optimization problems in smart city operations settings often involve high-dimensional data. A common data science approach involves first performing dimensionality reduction on the data, and then subsequently solving the optimization problem with the low-dimensional representation. However, standard dimensionality reduction methods are designed to maximize the amount of information retained in the representation, which do not generally reflect performance in the subsequent optimization task (i.e., the importance of such information in the optimization problem). In this work, we aim to develop an alternative dimensionality reduction method that minimizes the degree of suboptimality in the optimization phase. We show that this can be done via solving a distributionally-robust optimization problem, which admits a semidefinite programming relaxation. We shall discuss some computational results based on a vehicle repositioning problem. This is a joint work with Long He (National University of Singapore).

Bio: Ho-Yin Mak is Associate Professor in Management Science at the Saïd Business School, University of Oxford. His recent research tackles operations problems arising in smart city settings, with a focus on the transportation and energy domains, as well as the interfaces with supply chain management and the sharing economy.

11:15-11:45 AM

David Simchi-Levi

A New Approach for Vehicle Routing with Stochastic Demand: Combining Route Assignment with Process Flexibility

Abstract: In this talk, we propose a new approach for the vehicle routing problem with stochastic demands. Our approach combines ideas from vehicle routing and manufacturing process flexibility to propose overlapped routing strategies with customer sharing. We characterize the asymptotic performance of the overlapped routing strategies under probabilistic analysis. Using this characterization, we demonstrate that our overlapped routing strategies perform close to the theoretical lower-bound derived from the re-optimization strategy, and significantly outperforms the routing strategy without overlapped routes. The effectiveness of the proposed overlapped routing strategies in non-asymptotic regimes is further verified through numerical analysis.

Bio: David Simchi-Levi is a Professor of Engineering Systems at MIT and serves as the head of the MIT Data Science Lab. He is considered one of the premier thought leaders in supply chain management and business analytics. His Ph.D. students have accepted faculty positions in leading academic institutes including U. of California Berkeley, Carnegie Mellon U., Columbia U., Duke U., Georgia Tech, Harvard U., U. of Illinois Urbana-Champaign, U. of Michigan, Purdue U. and Virginia Tech. Professor Simchi-Levi is the current Editor-in-Chief of Management Science, one of the two flagship journals of INFORMS. He served as the Editor-in-Chief for Operations Research (2006-2012), the other flagship journal of INFORMS and for Naval Research Logistics (2003-2005). He is an INFORMS Fellow, MSOM Distinguished Fellow and the recipient of the 2014 INFORMS Daniel H. Wagner Prize for Excellence in Operations Research Practice; 2014 INFORMS Revenue Management and Pricing Section Practice Award; 2009 INFORMS Revenue Management and Pricing Section Prize and Ford 2015 Engineering Excellence Award. He was the founder of LogicTools which provided software solutions and professional services for supply chain optimization. LogicTools became part of IBM in 2009. In 2012 he co-founded OPS Rules, an operations analytics consulting company. The company became part of Accenture in 2016. In 2014, he co-founded Opalytics, a cloud analytics platform company focusing on operations and supply chain intelligence. The company became part of the Accenture Applied Intelligence in 2018.

11:45 AM-1:00 PM LUNCH BREAK

1:00-1:30 PM

Maxime Cohen

Incentivizing Commuters to Carpool: A Large Field Experiment with Waze

Abstract: Traffic congestion is a serious global issue. A potential solution, which requires zero investment in infrastructure, is to convince solo car users to carpool. In this paper, we leverage the Waze Carpool service and run the largest ever digital field experiment to nudge commuters to carpool. We identify users who can save a significant commute time by carpooling through the use of an high-occupancy vehicle (HOV) lane, users who can still use an HOV lane but with a low time saving, and users who do not have access to a HOV lane on their commute. We then send in-app notifications to examine the tradeoff between mentioning the HOV lane, highlighting the time saving, emphasizing the monetary incentive, and showing a generic message. We find a strong relationship between the affinity to carpool and the potential time saving through an HOV lane. Specifically, we estimate that mentioning the HOV lane increases the click-through rate and conversion rate by 133-185% and 64-141%, respectively relative to sending a generic message. (joint work with Michael-David Fiszer, Avia Ratzon, and Roy Sasson)

Bio: Maxime Cohen is an Associate Professor of Retail Management and Operations Management, the co-director of the McGill Retail Innovation Lab, and a Bensadoun Faculty Scholar at McGill University. His core expertise lies at the intersection of data science and operations. He has collaborated with Google, Waze, Oracle Retail, IBM Research, Via, Spotify, Aldo Group, Staples as well as several startups. He holds a Ph.D. in Operations Research from MIT and a BS and MS from the Technion.

1:30-2:00 PM

Anton Kleywegt

Infrastructure-Guided Self-Driving Vehicle Flow on a Street Network

Abstract: Traffic flow can be made more efficient and more equitable with the use of infrastructure-guided self-driving vehicles. For example, if infrastructure controls the flow of vehicles, it is possible for vehicles to flow from trip origins to trip destinations through a street network without needing to stop until the destination is reached. This can improve network efficiency, and reduce energy consumption and pollution. A major challenge that remains for this possibility to become reality is to devise algorithms fast enough and reliable enough to control the flow of self-driving vehicles on a street network. We will discuss the importance of this question for the development of self-driving vehicles and supporting infrastructure. We also propose an optimization problem as well as heuristics for the control of traffic flow.

Bio: Anton Kleywegt is a faculty member in the School of Industrial and Systems Engineering at the Georgia Institute of Technology. He does research on transportation, marketplace analytics, and stochastic optimization. During the 2017-2018 academic year he worked at Uber Technologies.

2:00-2:30 PM

Zhenhui (Jessie) Li

Reinforcement Learning for Traffic Signal Control

Abstract: This talk presents how to utilize mobility data and advanced learning methods for traffic signal control. First, I will discuss why today we have the opportunity for a potential breakthrough in traffic signal control. Second, the talk presents our recent research results in traffic signal control via reinforcement learning which are published in recent KDD, CIKM, and AAAI conferences. Finally, I would like to discuss the open challenges in this research topic and its implications for smart city applications.

Bio: Dr. Zhenhui (Jessie) Li is a tenured associate professor of Information Sciences and Technology at the Pennsylvania State University. She is Haile family early career endowed professor. Her research has been focused on mining spatial-temporal data with applications in transportation, ecology, environment, social science, and urban computing. She is a passionate interdisciplinary researcher and has been actively collaborating with cross-domain researchers. To learn more, please visit her homepage: https://faculty.ist.psu.edu/jessieli

3:30-4:00 PM

Ming Hu

Temporal or Spatial Pooling Solves the Wild Goose Chase

Abstract: The so-called "wild goose chase" phenomenon arising in the sharing system of vehicles such as cars, bicycles, and scooters refers to the long pickup time wasted on the road. With queueing theory adopted to capture vehicles' spatial movements, it is shown that both temporal and spatial pooling, as concepts central to operations management, can solve the "wild goose chase" problem to a large extent.

Bio: Ming Hu is the University of Toronto Distinguished Professor of Business Operations and Analytics, and a professor of operations management at the Rotman School. He was named as one of Poets & Quants Best 40 Under 40 business school professors in 2018. Most recently, his research has focused on operations management in the context of the sharing economy, social buying, crowdfunding, crowdsourcing, and two-sided markets, with the goal to exploit operational decisions for social good. He recently edited a book titled Sharing Economy: Making Supply Meet Demand on operations management in the age of the sharing economy. He is the recipient of Wickham Skinner Early-Career Research Accomplishments Award by the POM Society (2016) and Best Operations Management Paper in Management Science Award by INFORMS (2017). He currently serves as the editor-in-chief of Naval Research Logistics, editor of a special issue of Manufacturing & Service Operations Management on sharing economy and innovative marketplaces, department editor of Service Science, associate editor of Operations Research, and senior editor of Production and Operations Management. He is also currently serving as the Chair of Revenue Management and Pricing Section at INFORMS.

4:00-4:30 PM

Marta C. Gonzalez

Deconstructing Laws of Accessibility and Facility Distribution in Cities

Abstract: The era of the automobile has seriously degraded the quality of urban life through costly travel and visible environmental effects. A new urban planning paradigm must be at the heart of our road map for the years to come, the one where, within minutes, inhabitants can access their basic living needs by bike or by foot. In this work, we present novel insights of the interplay between the distributions of facilities and population that maximize accessibility over the existing road networks. Results in six cities reveal that travel costs could be reduced in half through redistributing facilities. In the optimal scenario, the average travel distance can be modeled as a functional form of the number of facilities and the population density. As an application of this finding, it is possible to estimate the number of facilities needed for reaching a desired average travel distance given the population distribution in a city.

Bio: Marta C. Gonzalez is Associate Professor of City and Regional Planning at the University of California, Berkeley, and a Physics Research faculty in the Energy Technology Area (ETA) at the Lawrence Berkeley National Laboratory (Berkeley Lab). With the support of several companies, cities and foundations, her research team develops computer models to analyze digital traces of information mediated by devices. They process this information to manage the demand in urban infrastructures in relation to energy and mobility. Her recent research uses billions of mobile phone records to understand the appearance of traffic jams and the integration of electric vehicles into the grid, smart meter data records to compare the policy of solar energy adoption and card transactions to identify habits in spending behavior. Prior to joining Berkeley, Marta worked as an Associate Professor of Civil and Environmental Engineering at MIT, a member of the Operations Research Center and the Center for Advanced Urbanism. She is a member of the scientific council of technology companies such as Gran Data, PTV and the Pecan Street Project consortium.

4:30-5:00 PM

Peter Frazier

Fighting COVID-19 with Testing

Abstract: COVID-19 has killed over 1 million people worldwide. At the same time, social distancing restrictions necessary for saving lives have significantly damaged economic activity. We argue that repeated large-scale asymptomatic screening, enabled through pooled testing, is a way to improve safety for at-risk subpopulations while simultaneously allowing more social contact as we wait for a vaccine.

We base our argument on experiences with Cornell's Fall 2020 reopening, in which operations research and data science played a critical role. Models developed by Cornell's COVID-19 Mathematical Modeling Team were used to design the testing interventions that are a cornerstone of Cornell's COVID-19 control strategy: targeted asymptomatic screening that tests all undergraduates twice per week and an adaptive testing program that goes beyond traditional contact tracing to test the full social circle of positive cases. These models were also the basis for Cornell's decision to reopen for residential instruction rather than remaining virtual. Despite the increase in social contact brought by

undergraduates returning to campus, regular asymptomatic screening with prompt results from an on-campus laboratory prevented viral spread on campus. Cornell has seen fewer than 100 cases in the first month of the semester within a population of 30K.

We argue that these results generalize to other subpopulations, especially in urban environments and among essential workers, where frequent asymptomatic testing with prompt results can be brought to bear and where either increased safety or increased social contact would provide significant value.

This is joint work with the other members of the Cornell COVID-19 Mathematical Modeling Team: Massey Cashore, Ning Duan, Alyf Janmohamed, Jiayue Wan, Yujia Zhang, Shane Henderson, and David Shmoys.

Bio: Peter Frazier is an Associate Professor in Cornell ORIE and a Staff Data Scientist at Uber. He received a Ph.D. in Operations Research and Financial Engineering from Princeton University in 2009. Since spring 2020, he has led Cornell's COVID-19 Mathematical Modeling Team. His academic research during more ordinary times is on the optimal collection of information, including Bayesian optimization, incentive design for social learning and multi-armed bandits, with applications in applications in e-commerce, the sharing economy and materials design. At Uber, he managed UberPool's data science group and currently helps to design Uber's pricing and incentive systems.

Invited Panelist

Elena Belavina

Bio: Elena Belavina is an Associate Professor at the SC Johnson College of Business. She collaborates with startups, established companies and public agencies to study issues of sustainable urban transportation, food waste, grocery retail and supply chains. Her recent research has studied how the grocery industry's structure and pricing policies influence food waste, the environmental impact of online grocery shopping and the design of bike-share systems. She has also studied sustainable sourcing, relational contracts and supply network design including the role of supply chain intermediaries. Methodologically, her research involves holistic analysis of logistic and economic systems, and econometric analysis of large datasets to advise on system improvements and policies.