Operations Management Summer Camp 2023

Date: Friday, 11 August 2023

Venue: Singapore Management University
             Lee Kong Chian School of Business
             Level 2, Seminar Room (SR) 2.1

Programme	
9.30am - 10.00am	**Registration** (outside SR 2.1) **Morning Refreshment** @ Catering area 2A/2B, near SR 2.8, Level 2
10.00am - 10.15am	**Opening address by Professor Melvyn Teo, Deputy Dean of Lee Kong Chian School of Business, Singapore Management University**
10.15am - 11.15am	**Paper 1** Presenter: **Zhaowei SHE, Singapore Management University** Discussant: **Sarang DEO, Indian School of Business** **Small Area Estimation of Case Growths for Timely COVID-19 Outbreak Detection** Abstract: The COVID-19 pandemic has dealt a devastating blow to the world economy and continues to take a massive toll on human lives. To swiftly detect and contain the resurgence of outbreaks, the COVID-19 case growth rate is a key epidemiological parameter to monitor and estimate. A fundamental challenge in growth rate estimation and hence outbreak detection is balancing the accuracy-speed tradeoff, where accuracy typically degrades with shorter fitting windows. In this paper, we develop a machine learning (ML) algorithm, which

we call *Transfer Learning Generalized Random Forest* (TLGRF), that balances this accuracy-speed tradeoff. Specifically, we estimate the instantaneous COVID-19 exponential growth rate for each U.S. county by using TLGRF that chooses an adaptive fitting window size based on relevant day-level and county-level features affecting the disease spread. Through transfer learning, TLGRF can accurately estimate case growth rates for counties with small sample sizes. Out-of-sample prediction analysis shows that TLGRF outperforms established growth rate estimation methods. Furthermore, we conducted a case study based on outbreak case data from the state of Colorado and show that the timely detection of outbreaks could have been improved by up to 224% using TLGRF when compared to the decisions made by that of Colorado's Department of Health and Environment (CDPHE). To facilitate implementation, we have developed a publicly available outbreak detection tool for timely detection of COVID-19 outbreaks in each U.S. county, which received substantial attention by policymakers.

| 11.15am - 12.15pm | **Paper 2** |

Paper 2

Presenter: **Pascale CRAMA, Singapore Management University**
Discussant: **Sameer HASIJA, INSEAD**

R&D Project Portfolio Collaboration: How to Structure the Strategic Alliance?

Abstract:
Firms target innovative firms with valuable R&D projects to rejuvenate their product portfolio. Such strategic alliances create value by combining the innovator's research expertise with the partner firm's superior marketing capability. The partner firm chooses the timing and payment terms of the strategic alliance while accounting for innovator firm and project portfolio characteristics, such as the innovator's marketing capability and R&D budget and the projects' expected revenue and variability and product market interactions. We find that the partner firm may prefer late-stage alliances post R&D completion for innovator firms with high marketing capability in the presence of high revenue variability concerns or for innovator firms with sufficient budget to finance both projects. Early-stage strategic alliances – prior to the R&D stage – are always preferred when the innovator's marketing capability is low to cement the partner's commitment to payments that incentivize R&D. The partner also contracts early when projects exhibit strong

	market interactions yet the innovator is budget-constrained, as including an upfront fee augments the innovator's R&D budget. Finally, the parties may fail to form a strategic alliance for projects with intermediate revenue variability and low market interactions when the innovator firm's marketing capability is low. Interestingly, the partner's profit does not always decrease in the innovator firm's outside option, i.e., its marketing capability, and the partner may prefer a firm with intermediate marketing capability when there is significant revenue variability. Furthermore, while the partner's profit weakly increases as the innovator commands a greater budget up to a threshold, the partner's profit may exhibit a discontinuous jump/drop at that threshold for an innovator with high marketing capability.
12.15pm - 1.45pm	**Lunch** @ Catering area 2A/2B, near SR 2.8, Level 2
1.45pm – 2.45pm	**Paper 3** Presenter: **Meichun LIN, Singapore Management University** Discussant: **Andrew LIM, National University of Singapore** **Uncertain Search with Knowledge Transfer** Abstract: We consider a sequential search over a group of similar alternatives. The individual value of an alternative contains two components, an observable utility and an idiosyncratic value. Once an alternative is searched, the utility can be fully revealed, but the idiosyncratic value is unobservable and needs to be learned gradually by sampling. The utilities share an unknown population distribution, which captures the similarity across the alternatives and allows for knowledge transfer within the group. The goal is to select an alternative with the highest individual value while accounting for the sampling and search costs. A novel feature of this problem is the combination of the individual and population levels of learning. We formulate the problem as a Bayesian dynamic program and characterize the optimal policy by a threshold structure. We show that it depends on the difference between the mean estimates of the current alternative and the population. It is optimal to continue sampling if the difference is between a threshold pair; otherwise, accept the current alternative if it exceeds the upper threshold and switch to a new one if it is below the lower threshold. Other structural properties are also derived to shed light on the effects of the two levels of learning. Moreover, we

extend our model and structural results to practical variants where (i) the sample precision is unknown, (ii) the population distribution is high-dimensional, and (iii) the goal is to select multiple alternatives.

2.45pm – 3.45pm	**Paper 4 -** Presenter: **Bhavani Shanker UPPARI, Singapore Management University** Discussant: **Christopher TANG, University of California, Los Angeles** **Designing Payment Models for the Poor** Abstract: Several basic services, such as energy, clean water, and cooking gas, are currently out of reach for millions of people living in poverty. Governments in low-income countries have been unsuccessful in delivering these services because of their resource constraints, and so there has been an emergence of several private firms that offer these services by, for example, selling solar home systems and operating localized water and gas supply solutions. These firms deploy a pay-as-you-go (PAYGo) model in which the consumers are given the flexibility to pay how much and when they want or are able to, which helps match their erratic cash flows with the payments that they make to the firms. Yet, using remote lockout technologies, firms restrict consumers' access to devices (e.g., a solar panel or a prepaid meter) if they are lagging on payments. Given that the consumers have the flexibility to pay but the firm can never really observe how much money they have, they can pay sub-optimally and turn their income toward other needs, thus resulting in a dynamic moral hazard problem. Payment defaults and device confiscations are pervasive in the PAYGo industry, which hurt the firms' long-term sustenance. We investigate the incentives that must be included in a payment contract to mitigate the misuse of flexibility, and to that end, we take the optimal contracting approach. The optimal contract that we derive puts forward several insightful and implementable features. It summarizes a consumer's payment history with a single score, which we call v-score: the better the payment history, the higher the v-score. The score helps effectively communicate to a consumer her current standing. Given that the firm in our setting can offer only nonmonetary rewards for payments, the contract incentivizes payments through updates to vscores. The higher the payment, the higher the updated v-score; yet, the contract drops the score for low payments to moderate the agency issue. The contract offers stronger payment incentives to consumers with intermediate values of

v-scores, because they require an extra push to pay, when compared to the ones who are closer to termination (through either device confiscation or ownership transfer if possible). The incentive-compatible payment scheme suggested by the contract respects consumers' liquidity constraints and offers payment flexibility. The lower the v-score, the higher the flexibility. The contract also offers threshold-based guidance on when to terminate, and how much access to grant. The contract proposes an inclusive downpayment scheme to initiate the contract, wherein consumers with varying levels of liquid assets could purchase their initial v-scores. We also discuss how different business models (rent-to-own, rental, and sales models) emerge from our contracting framework. Overall, our results guide the design of efficient payment contracts, which are key to delivering life-improving goods and services to low-income consumers.

3.45pm - 4.15pm	**Tea Break** @ Catering area 2A, near SR 2.8, Level 2
4.15pm - 5.15pm	**Paper 5** Presenter: **Leon Liang XU, Singapore Management University** Discussant: **Zhixi WAN, University of Hong Kong** **Auto-Replenishment with Human Oversight** Abstract: Many organizations employ artificial intelligence and machine learning algorithms for operational decision-making but grant managerial discretion to override. While managers' oversight can mitigate potential algorithmic errors, they may also deviate due to inherent behavioral biases. Two questions naturally arise: Is managers' deviation beneficial and what is the exact value of algorithms if managers tend to deviate? This inquiry leads us to study an auto-replenishment system that recommends ordering decisions but allows managerial discretion to override. Specifically, we conducted a randomized field experiment in which the auto-replenishment system was implemented in 20 treatment stores, with the other 20 as controls. Prior to the system, managers tended to place large and ad-hoc orders due to the cognitive complexity of managing thousands of items in a store, resulting in excessive inventory and low service levels. The auto-replenishment system has the advantage of automating the ordering process, thereby mitigating managers' neglecting bias by prompting them to order when inventory levels are low and improving ordering frequency by recommending smaller order quantities as an

	anchor. As a result, the stores can improve service levels by 4.3% without increasing overall inventory by reallocating cycle stock with safety stock. While it is commonly believed that the auto-replenishment system should be more value-added for popular items as they typically account for 80% of sales, its value for these items is discounted since managers are more likely to deviate due to their accumulated experience in making replenishment decisions for such items. In contrast, managers are more inclined to adhere to the recommendations for non-popular items because of the challenging nature of the decision task faced by managers themselves. Thus, our study helps understanding the human-algorithm interactions in inventory management and highlights the importance of improving algorithmic precision for non-popular items, for which the recommendations are adopted without much human intervention.
5.15pm - 5.30pm	**Concluding Remarks** **End of OM Summer Camp**

Discussants' Profile:

Sarang DEO

I am Professor of Operations Management at the Indian School of Business. I currently serve as the are leader of OM, Executive Director of the Max Institute of Healthcare Management and Deputy Dean for Faculty and Research. My primary area of research is health care delivery systems, wherein I focus on investigating the impact of operations decisions on population level health outcomes. Some of the healthcare contexts that I have studied include the influenza vaccine supply chain and the phenomenon of ambulance diversion in the US, HIV early infant diagnosis networks in sub-Saharan Africa, formal and informal pathways for TB diagnosis, and community-based models of care delivery for non-communicable diseases in India. I regularly collaborate with international public health funding and implementation agencies such as Bill & Melinda Gates Foundation (BMGF), Clinton Health Access Initiative (CHAI) and PATH for my research.

Prior to joining the ISB, I was Assistant Professor at the Kellogg School of Management. I obtained a PhD from UCLA Anderson School of Management, MBA from IIM Ahmedabad, and B. Tech. from IIT Bombay. Before entering academics, I worked with Accenture as a management consultant.

Sameer HASIJA

Sameer Hasija is a Professor of Technology and Operations Management at INSEAD. He earned his PhD in Operations Management and MS in Management Science Methods from the Simon School of Business at the University of Rochester and his BTech from the Indian Institute of Technology Madras.

Sameer's teaching focusses on using a process lens to understand new levers of innovation. Using a systematic analysis of processes within and across firm boundaries, he emphasises the role of process-based innovation in creating new business models and/or fresh competitive positioning for existing business models. Sameer conducts workshops for executives on understanding the latest developments in technology and their role in radically disrupting and/or transforming businesses.

Sameer's current research uses an economics lens to understand the design and management of technology, knowledge, and information intensive service systems.

Andrew LIM

I am a Professor in the Department of Analytics and Operations and the Department of Finance. I'm also a member of the Institute for Operations Research and Analytics where I serve as the Director of the PhD program. From 2002-2014, I was on the faculty of the Department of Industrial Engineering and Operations Research at the University of California (Berkeley).

I am interested in stochastic control, stochastic models, robust decision making and learning, and decentralized optimization and control of stochastic systems, and applications in financial engineering and operations research. My papers have appeared in journals including Operations Research, Management Science, the IEEE Transactions on Automatic Control, the SIAM Journal on Control and Optimization, Mathematics of Operations Research, Mathematical Finance and Insurance: Mathematics and Economics.

I am a past recipient of the National Science Foundation CAREER Award, serve on the editorial boards of Operations Research and Management Science, and was formerly on the editorial board of the IEEE Transactions on Automatic Control.

Christopher TANG

A foremost scholar of global supply chain management, Chris Tang focuses his current research on social innovation in developing countries, identifying how companies operate in the environment to do good while doing well at the same time — "where corporate responsibility, social justice and environmental stewardship can go hand in hand," as he says.

Tang's interest in his field began in the private sector when he worked for IBM to solve internal production planning problems. Exposure to real-life industry projects motivated his academic research, where he developed teaching cases on a variety of concerns such as microfinancing for the poor, mobile platforms for developing economies, creating shared values and direct procurement of agricultural products, response management in disasters and new business models in the age of the Internet. These cases exceeded the traditional topics of operations management, addressing the trendy and pressing issues faced by supply chain executives, as well as innovations that industry leaders use to create higher values in the global market.

World-renowned in the field of global supply chain management, Tang has been a consultant to numerous corporations such as Amazon, HP (California, Singapore, South Korea), IBM (New York, San

Jose), Nestlé (USA), GKN (UK) and Accenture. He has taught courses at Stanford University, UC Berkeley, Hong Kong University of Science and Technology, National University of Singapore, MIT (Zaragoza) and London Business School, and served as a visiting professor at Cambridge University (UK) and the Institute of Advanced Study (IAS) at HKUST. He has delivered more than 200 keynote speeches and seminars at conferences and universities worldwide; chaired numerous advisory committees at various universities in the United States, Europe and Asia; been interviewed and quoted by international press over 100 times; and served on the boards of various nonprofit organizations.

Tang's research contribution to global supply chain management is recognized by all three major academic societies in the fields of operations research, management science and operations management. He was recently distinguished for research exploring the impact of regulatory policies on the welfare of different stakeholders in on-demand ride service platforms. He has published six books, 30 book chapters, over 100 online blogs and over 160 research articles in various leading academic journals. He has written for the Wall Street Journal, Barron's,Financial Times (UK), China Daily, Fortune, Bloomberg Law,Los Angeles Times, SanFrancisco Chronicle, Business Times (Singapore) and The Guardian (UK).

Zhixi WAN

Zhixi Wan is a professor in the area of Innovation and Information Management at the HKU Business School. His expertise includes supply chain management, value chain strategies, and marketplace economics and operations. His research on these topics has been published in top-tier research journals including Management Science, Operations Research, Manufacturing and Service Operations Management, Strategic Management Journal, and Production & Operations Management. He received his Ph.D. in Operations and Management Science from the Ross School of Business at the University of Michigan, Ann Arbor. Before joining the University of Hong Kong, he was a tenured associate professor at the University of Oregon, and an assistant professor at HEC Paris and an assistant professor at the University of Illinois, Urbana-Champaign. He was on academic leave and worked in Didichuxing, a leading ride-hailing platform firm in China, as a DiDi Economist and the head of the company's research center of Innovation and Operations Management. Professor Wan obtained his Bachelor of Engineering degree from the Tsinghua University, and studied in the area of Automation Engineering (1999-2003).

~ Thank you ~