

School/Department:	Department of Technology and Operations (TOM), Rotterdam School of Management (RSM)
Project Title:	<i>Predictive and Prescriptive Analytics in Patient-Centered Healthcare Planning and Delivery</i>
Abstract:	<p><i>Data and analytics are leading major shifts in the conduct of operations in many sectors today. A key sector is the healthcare sector, where the effectiveness of decision-making significantly affects healthcare expenditure, patient quality of life, and physician satisfaction. In this project, we seek ways to better utilize data and analytics to support public health policymaking and clinical decision making. We aim to create a patient-centered value-chain from prognosis to disease progression prediction to treatment decisions and patient communication. We broadly envision the project heading in at least two directions, with other directions to be jointly directed by the evolving interests of the candidate.</i></p> <p><i>The first direction is in the area of joint disease progression modelling and treatment decisions. Obtaining the best treatment decision for patients can be very challenging due to the uncertainty in disease progression and impact of interventions on disease progression. With the surge in chronic illnesses and the advent of personalized preventive medicine, learning how diseases progress and making the right types of interventions are increasingly critical. In the literature, disease progression models is often developed separately from treatment decisions. There is, however, increasing evidence in the literature that points to the benefits of making both progression modelling and treatment decisions simultaneously [1]. This direction will aim to propose frameworks for joint disease progression modelling and treatment decisions.</i></p> <p><i>The second direction is how to develop a framework that enables effective joint physician-patient decision-making to incorporate individualized patient needs and thus improve the overall quality of decisions for patients. It is vital in many clinical scenarios involving multiple alternatives, where each option entails different trade-offs that may impact patients differently. For example, for patients with cardiovascular disease, mortality may rapidly result from coronary occlusion. While direct intervention to address this can drastically reduce the risk of occlusions, it might entail a reduction in the patient's quality of life and potential treatment risks. Nonetheless,</i></p>

	<p><i>non-intervention can lead to further disease progression, thus raising the risk of occlusions in the future and adding constant psychological burden to patients. In this case, decision-making is often challenging for both physicians and patients, as the impact of the intervention can be difficult to quantify or predict. In this direction, we aim to examine more closely how better communication and joint decisions-making can be facilitated between physician and patients to arrive at high quality decisions.</i></p> <p><i>Other directions that can be considered will include how to use data and analytics to support early prognosis and how to allocate resources between preventive and curative medicine. The candidate is encouraged to seek directions that interest them and to propose topic areas.</i></p> <p><i>In the course of this project, the candidate will get to work with a multi-disciplinary team with expertise ranging from healthcare decision-making to innovation management and to robust optimization and contextual optimization. Ample training and guidance will be provided. By the end of the project, the candidate is expected to build research expertise in the domain of healthcare operations management.</i></p> <p><i>[1] D. Bertsimas, J. Dunn, N. Mundru. 2019. Optimal Prescriptive Trees. INFORMS Journal on Optimization,</i></p>
Requirements of candidate:	<p>Background: <i>Background in Mathematics (Analysis, Linear Algebra) with some knowledge in Statistics is highly preferred. Experience in coding is also preferred. It is not mandatory for candidates to have experience in optimization and/or operations management within or outside the healthcare sector, but candidates with these experiences will be more favourably considered. Candidates passionate about healthcare applications are favoured.</i></p> <p>Master's degree: Yes</p> <p>IELTS: 7.5 (min. 6.5 for all subs) TOEFL: 100 (internet) (min. 23 for all subs) GMAT-test or GRE-test: 85%</p>
Supervisor information:	<p><i>Daily Supervisor: Dr. Cynthia Kong</i> <i>Email address: c.kong@rsm.nl</i></p> <p><i>Daily Supervisor: Dr. Gar Goei Loke</i> <i>Email address: loke@rsm.nl</i></p> <p>Relevant publications in healthcare operations management:</p>

	<p>1. Zhou, M., <u>G. G. Loke</u>, C. Bandi, Z. Q. G. Liao, W. Wang. 2021. Intraday Scheduling with Patient Re-entries and Variability in Behaviours. Manufacturing & Service Operations Management. https://doi.org/10.1287/msom.2020.0959</p> <p>2. Xie, J., <u>G. G. Loke</u>, M. Sim, S-W. Lam. 2021. The Analytics of Bed Shortages – Coherent Metric, Prediction and Optimization. Operations Research. Forthcoming. Abstract available at https://papers.ssrn.com/abstract=3041878</p> <p>3. <u>Kong, Q.</u>, Li, S., Liu, N., Teo, C., & Yan, Z. (2020). Appointment Scheduling Under Time-Dependent Patient No-Show Behavior. Management Science, 66(8), 3480-3500. https://doi.org/10.1287/mnsc.2019.3366</p> <p>4. <u>Kong, Q.</u>, Lee, CY., Teo, CP. C-P., & Zheng, ZC. (2013). Scheduling Arrivals to a Stochastic Service Delivery System using Copositive Cones. Operations Research, 61(3), 711-726. https://doi.org/10.1287/opre.2013.1158</p> <p>Useful references in joint prediction and optimization: 1. <u>Loke, G. G.</u>, Q. Tang, Y. Xiao. 2020. Decision-driven Regularization: A Blended Model for Predict-then-Optimize. Working paper available at https://papers.ssrn.com/abstract=3623006</p> <p>Patient Choice and Behaviroal Analysis 1. <u>Kong, Q.</u>, Granic, G., Lambert, NS., & Teo, CP. C-P. (2019). Judgment Error in Lottery Play: When the Hot-Hand Meets the Gambler's Fallacy. Management Science, 66(2), 844-862. https://doi.org/10.1287/mnsc.2018.3233</p> <p>2. Liu, Y., <u>Kong, Q.</u>, & Grob, E. (2019). Public preferences for health care facilities in rural China: A discrete choice experiment. Social Science & Medicine, 237, [112396]. https://doi.org/10.1016/j.socscimed.2019.112396</p>
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