EPSTEIN INSTITUTE SEMINAR ▪ ISE 651

An Inverse Optimization Approach to Measuring Clinical Pathway Concordance

ABSTRACT - Clinical pathways outline standardized processes in the delivery of care for a specific disease. Patient journeys through the healthcare system, however, can deviate substantially from these pathways. Given the positive benefits of clinical pathways, it is important to measure the concordance of patient pathways so that variations in health system performance or bottlenecks in the delivery of care can be detected, monitored, and acted upon. This paper proposes the first data-driven inverse optimization approach to measuring pathway concordance in any problem context. Our specific application considers clinical pathway concordance for stage III colon cancer. We develop a novel concordance metric and demonstrate using real patient data from Ontario, Canada that it has a statistically significant association with survival. Our methodological approach considers a patient's journey as a walk in a directed graph, where the costs on the arcs are derived by solving an inverse shortest path problem. The inverse optimization model uses two sources of information to find the arc costs: reference pathways developed by a provincial cancer agency (primary) and data from real-world patient-related activity from patients with both positive and negative clinical outcomes (secondary). Thus, our inverse optimization framework extends existing models by including data points of both varying "primacy" and "alignment." Data primacy is addressed through a two-stage approach to imputing the cost vector, whereas data alignment is addressed by a hybrid objective function that aims to minimize and maximize suboptimality error for different subsets of input data.

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SPEAKER BIO – Timothy Chan is the Canada Research Chair in Novel Optimization and Analytics in Health, a Professor in the department of Mechanical and Industrial Engineering, the Director of the Centre for Healthcare Engineering, and the Director of the Centre for Analytics and AI Engineering at the University of Toronto. He received his BSc in Applied Mathematics from the University of British Columbia (2002), and his PhD in Operations Research from the Massachusetts Institute of Technology (2007). Professor Chan was an Associate in the Chicago office of McKinsey and Company, a global management consulting firm (2007-2009). During that time, he advised leading companies in the fields of medical device technology, travel and hospitality, telecommunications, and energy on issues of strategy, organization, technology and operations.

Professor Chan's primary research interests are in optimization under uncertainty and the application of optimization methods to problems in healthcare, medicine, global engineering, sustainability, and sports. He received the George B. Dantzig Dissertation Award from INFORMS (2007), an Early Researcher Award from the Ministry of Economic Development and Innovation of Ontario (2012), an Early Career Teaching Award from both the U of T Department of Mechanical and Industrial Engineering (2012) and the U of T Faculty of Applied Science & Engineering (2013), second place in the INFORMS Section on Public Programs, Service and Needs best paper competition (2012), and first place in the MIT Sloan Sports Analytics Conference research paper competition (2013). His research has been featured by the CBC, CTV News, the Toronto Star, and Canadian Business magazine.

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TUESDAY, APRIL 5, 2022
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