UW Industrial and Systems Engineering Presents:

From Data to Decision Making in Health and Humanitarian Logistics: Insights and Challenges

Abstract:

Decision making to satisfy the basic human needs of health, food, and education is complex. We present an overview of two illustrative studies using data to inform decision making in health care delivery associated with sepsis and hunger relief.

In the first study, we integrate electronic health record (EHR) data with clinical expertise to develop a continuous-time Markov decision process model of the natural history of sepsis. We use this model to better understand the stochastic nature of patients' health trajectories and determine the optimal treatment policy to minimize mortality and morbidity. We formulate this as a stopping problem in which the patient leaves the system when he or she receives the first treatment (intervention) and receives a lump sum reward. Our objective is to find the optimal first intervention for health states to minimize expected mortality and morbidity. We explore the effect of the complex trade-offs associated with the intervention costs and patient disposition costs which are subjective and difficult to estimate. The model translates observations of patient health as defined by vitals and laboratory results recorded during hospitalization in the EHR to capture the complex evolution of sepsis within a patient population. This framework provides key insights into sepsis patients' stochastic trajectories and informs clinical decision making associated with caring for these patients as their health dynamically evolves.

In the second study, in collaboration with our food bank partner in North Carolina, we develop a single-period, weighted multi-criteria optimization model that provides the decision-maker the flexibility to capture their preferences over the three criteria of equity, effectiveness, and efficiency, and explore the resulting trade-offs. Food banks are challenged with juggling multiple criteria such as equity, effectiveness, and efficiency when making distribution decisions. Models that assume predetermined weights on multiple criteria may produce inaccurate results as the preference of food banks over these criteria may vary over time, and as a function of supply and demand. We introduce a novel algorithm to elicit the inherent preference of a food bank by analyzing its actions within a single-period. The algorithm does not require direct interaction with the decision-maker. The non-interactive nature of this algorithm is especially significant for humanitarian organizations such as food banks which lack the resources to interact with modelers on a regular basis. We explore the implications of different decision-maker preferences for the criteria on distribution policies.

Bio

Julie Simmons Ivy, Ph.D., is a Professor and Chair of the Department of Industrial and Operations Engineering at the University of Michigan. Dr. Ivy is also the Edgar S. Woolard Professor Emerita of the Edward P. Fitts Department of Industrial and Systems Engineering at North Carolina State University. She joined the University of Michigan faculty after 16 years on the NC State faculty and several years on the faculty of the Ross School of Business at the University of Michigan. Dr. Ivy received her B.S. and Ph.D. in Industrial and Operations Engineering from the University of Michigan. She also received her M.S. in Industrial and Systems Engineering from Georgia Tech.

Dr. Ivy is an active member of the Institute of Operations Research and Management Science (INFORMS), Dr. Ivy served as the 2007 Chair (President) of the INFORMS Health Applications Society and the 2012 – 13 President for the INFORMS Minority Issues Forum. Dr. Ivy was elected as a 2022 INFORMS Fellow and as a 2023 Institute of Industrial & Systems Engineers (IISE) Fellow. In February 2023, Dr. Ivy was nominated to the National Academies Board on Mathematical Sciences and Analytics (BMSA). Dr. Ivy's service has focused on empowering women of color and underrepresented minorities in IE, OR, and STEM through INFORMS Minority Issues Forum (MIF), NSF ADVANCE grants, and various workshops supporting the professional development of minority graduate students, faculty, and working professionals over the past 25+ years. She was selected as an inaugural INFORMS 2021 MIF Fellow and as a 2020 and 2021 INFORMS DEI Ambassador. She received the INFORMS 2020 WORMS Award for the Advancement of Women in OR/MS.