Stochastic Operating Room Scheduling under Emergency Arrivals with Integrated Block Assignments

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Abstract: Operating rooms provide crucial health services and generate significant hospital revenue. It is challenging to use operating rooms efficiently due to uncertainty in surgery durations and emergency patient arrivals.

In this study, we propose an operating room scheduling model that integrates the tactical decisions of assigning operating rooms to departments and the operational decisions of scheduling both planned and emergency patients. Our goal is to minimize expected undertime of the operating rooms while ensuring that the probability of overtime is sufficiently small.

We represent this operating room scheduling problem as a three-stage model and formulate it as a two-stage stochastic mixed-integer program.

We then present two value function reformulations that convert the model to a pure binary program. We describe a dynamic-programming-based approach to calculate the value functions. We present a numerical study using operational data from a major hospital that shows the substantial value of the integration of operating room assignments and the consideration of emergency surgery arrivals. We show that our approach gives optimal scheduling policies in a reasonable amount of time.

This work is in collaboration with Prof. Oleg A. Prokopyev (University of Pittsburgh) and Prof. Andrew J. Schaefer (Rice University).

Bio: Onur Tavaslıoğlu is a Ph.D. candidate at the Department of Industrial Engineering, University of Pittsburgh. He is currently a visiting scholar at the Department of Computational and Applied Mathematics, Rice University. He received his B.Sc. degree in industrial engineering from Middle East Technical University in Turkey. His research interests lie mainly in decision-making problems under uncertainty with healthcare and military applications. His methodological interests include developing solution approaches to large-scale mixed-integer, stochastic programming, bilevel programming, and distributionally robust optimization problems. His research interests also include inverse optimization and developing machine learning approaches to solve optimization problems.