

PhD thesis subject

Title: Robust Optimization Approaches to Operating Room Planning and Surgery Scheduling with Consideration of Uncertainties and Downstream Capacity Constraints

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This subject is related to the scheduling of surgeries and management of operating rooms (ORs) in hospitals. It is the continuation of the previous work of Jian ZHANG. He proposed a stochastic programming (SP) model to address the weekly scheduling of elective surgeries in an operating theatre which is composed of multiple ORs and a downstream facility, i.e., the surgical intensive care unit (SICU). In this problem, every patient stays in the waiting list until his/her surgery is performed, then he/she recovers in SICU for some consecutive days before being discharged. For each week, the surgery planner should make the following decisions: 1) select the patients to be treated during the current week from the waiting list; 2) assign these selected patients to specific OR blocks (an OR block is the combination of an OR and a day). The objective is to minimize the waiting time of patients and the overuse of ORs, while ensuring that the capacity of SICU is not exceeded on each day. The studied problem is formulated as an SP model because the surgery durations and the length-of-stay in SICU are uncertain parameters. To address the stochasticity in the SP model. A sample average approximation (SAA) is first employed to translate the SP model into a solvable deterministic model, which is then solved by a column-generation-based heuristic (CGBH) approach.

The candidate of this subject will continue the aforementioned research which has already begun by Jian ZHANG. The objective is to develop robust optimization (RO) approaches to solve the studied problem. RO is a relatively new approach for decision-making under uncertainties. It does not rely on the probability distributions of the stochastic parameters and provides optimal solutions that are feasible for a user-defined set of values that the uncertain parameters can take. Therefore, the RO approaches to be developed require less statistical information and allow the surgery planner to adjust the risk level. To guarantee the computational performance of the RO approaches, high-performance algorithms should be proposed to balance the efficiency and accuracy. Besides, the studied problem can also be extended by taking into account more surgical resources, such as surgeons, nurses and wards, or more stochastic aspects, such as arrivals of emergency patients.

Some related references:

- [1] Neyshabouri, S., & Berg, B. P. (2017). Two-stage robust optimization approach to elective surgery and downstream capacity planning. *European Journal of Operational Research*, 260(1), 21-40.
- [2] Marques, I., & Captivo, M. E. (2017). Different stakeholders' perspectives for a surgical case assignment problem: Deterministic and robust approaches. *European Journal of Operational Research*, 261(1), 260-278.