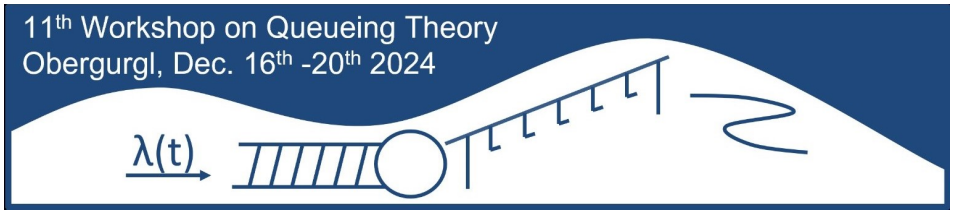
Lehrstuhl für BWL, insb. Produktionsmanagement
Prof. Dr. Justus Arne Schwarz
https://www.uni-regensburg.de/wirtschaftswissenschaften/bwl-schwarz/

Universität Regensburg



Optimizing patient-room allocations in hospital wards using Markov Decision Processes

Philipp Pelz
Chair of Production Management, University of Regensburg

Justus Arne Schwarz
Chair of Production Management, University of Regensburg

Abstract

Effective bed planning in hospitals is becoming increasingly crucial due to rising bed utilization. Allocating patients to rooms in hospital wards is a complex daily task that must consider three key factors: (i) stochastic influences, such as the arrival for emergency patients and the variability in the length of stay and severity changes for already allocated patients; (ii) constraints, including the number of available beds in specific rooms and gender-specific room occupancy; and (iii) handling of overflow situations. To offer patients the best treatment, negatively perceived actions, such as reallocations, allocations to an overflow area or even rejections should be avoided.

The literature focuses on deterministic planning approaches to allocate patients to rooms. The stochastic nature of the problem is either neglected by a static problem formulation in which all stochastic arrival times and lengths of stay of the entire planning horizon are assumed to be known in advance, or covered by dynamic approaches that utilize a rolling planning horizon. The later approaches solve a deterministic problem with updated current state each time a stochastic event occurs.

We propose a Markov Decision Process (MDP) formulation for the patient to room allocation problem in hospital wards. Our approach is designed to explicitly account for stochastic influences within a finite planning horizon. Actions involve whether a patient is allocated to a regular room, the overflow area, or rejected based on the current state. Additionally, our model allows for reallocations of patients initially allocated to the overflow area to regular rooms and reallocations between regular rooms. The objective is to minimize allocations to the overflow area, reallocations, and rejections. An efficient state space formulation avoiding symmetries is presented.