

Dynamic resource allocation with advance and short-notice demand based on predictions

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In appointment scheduling, it is a common practice to reserve a number of slots for (semi-)urgent demand arrivals, that require service quickly. The other slots are then given to clients that request an appointment upfront. To determine the number of reserved slots, the (semi-)urgent demand arrivals are often modelled as a distribution with static or seasonal distribution parameters. However, in many appointment scheduling processes, more information becomes available about the urgent demand arrivals over time. An example of these processes is a radiology department, where the number of patients present in the hospital could forecast the required number of emergency scans.

In this study, we propose near-optimal scheduling policies that reserve slots for (semi-)urgent clients, using updated information on the arrival distribution of (semi-)urgent clients in the near future. We formulate the sequential decision-making problem as a Markov decision process and solve this with batch approximate value iteration. Our results show that the scheduling policies that use updated information outperform the scheduling policies without this knowledge when the predictions on the arrival distributions are accurate. We discuss these results on theoretical instances, present managerial implications of our near-optimal policies and show the practical impact of this study in a Dutch hospital.