Data-driven appointment scheduling

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ABSTRACT

We consider the problem of evaluating and constructing appointment schedules for patients in a health-care facility where a single physician treats patients in consecutive order, as is common for general practitioners, clinics and for outpatients in hospitals. Specifically, given a fixed-length session during which a physician sees K patients, each patient has to be given an appointment time during this session in advance. Optimising a schedule with respect to patient waiting times, physician idle times, session overtime, etc. usually requires a heuristic search method involving a huge number of repeated schedule evaluations. Methods for lowering the computational cost of obtaining accurate predictions is the main thread of this talk.

Borrowing from queueing theory, we first show that a Lindley-type recursion in a discrete-time framework can be used to obtain accurate predictions for the moments of the patient waiting times and the doctor's idle times and overtime in the simplest setting where patients are identical, punctual and always show up. Unfortunately, in realistic scenarios, patients are neither statistically identical (in many scenarios, the consultation times of particular patients can be estimated based on the lengths of prior consultations of the same patient or of patients with similar conditions) nor punctual and a considerable number of patients do not show up. Various extensions to evaluate schedules with unpunctuality and no-shows are discussed, both completely numerical methods as well as methods which combine numerical results and Monte-Carlo simulation. The evaluation methods are then used in combination with a local search algorithm to optimise the schedule.

Finally, noting that it is often beneficial to be scheduled early during a session, we consider an appointment game in which patients can opt to be seen in a later session, as to reduce their waiting during the session. Both the unobservable and observable game are considered, i.e., the patients are either aware of the number of patients already scheduled in the future sessions, or they are not.

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