A 3-player game theoretic model of a choice between two queueing systems with strategic managerial decision making

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Abstract

The main focus of this study is the construction of a 3-player game theoretic model between two queueing systems and a service that distributes individuals to them. The resultant model will then be used to explore dynamics between all players.

The first aspect of this work is the development of a queueing system with two waiting spaces and two types of individuals. Two modelling techniques were used, discrete event simulation and Markov chains. The state probabilities of the Markov chain system have been used to extract the performance measures of the queueing model (e.g. mean time in each waiting room, mean number of individuals in each room, etc.). Given two such systems, the scenario explored is how to distribute individuals among the two in order to optimise certain performance measures. A 3-player game theoretic model is proposed between the two queueing systems and the service that distributes individuals to them. In particular this can be seen as a 2-player normal-form game where the utilities are determined by a third player with its own strategies and objectives. A backwards induction technique is used to get the utilities of the normal-form game between the two queueing systems.

This particular system can be applied in a healthcare scenario where it could capture the emergent behaviour between the Emergency Medical Service (EMS) and the Emergency Department (ED). The model will be used to form a 3-player game between the EDs of two neighbouring hospitals and the EMS.