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 is then 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 to construct such a model; 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.) Moreover, the scenario that is explored is when two such systems exist, and we aim to distribute individuals among the two such that certain performance measures are optimised. 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 study's aim is to explore a queueing theoretic model with two waiting spaces and use it to inform a game theoretic system. This particular system can be applied in a healthcare scenario where it could capture the emergent behaviour between the Emergency Medical Service and the Emergency Department. The model will be used to form a 3-player game between the EDs of two neighbouring hospitals and the EMS.