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Analysis of the emergency service applying the queueing theory

Análisis del servicio de urgencias aplicando teoría de líneas de espera

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Abstract

Those responsible for the decision-making in hospitals are becoming more aware of the need to efficiently manage hospital systems. One option is the queueing models. In this work, the Emergency service of a public hospital is analyzed by applying the concepts and relations of queues. Based on the results of the model, it is concluded that the Emergency area does not count with the minimum number of doctors necessary for a constant flow of patients. The minimum number of doctors necessary to satisfy the current and future service demand, with the same service times and service disciplines, is calculated using the model. The analytical models allow to directly understand the existing relations between service demand, number of doctors and the attention priority of the patient seen as a system of queues. The work is of use to managers and those responsible for the management of hospital systems.

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Keywords: Hospital systems; Hospitals; Emergencies; Management; Queueing theory; Cycle time

JEL classification: I1; C02; C44

Resumen

Los responsables de la toma de decisiones de los hospitales son cada vez más conscientes de la necesidad de administrar de manera eficiente los sistemas hospitalarios. Una opción son los modelos de líneas de espera. En el presente trabajo se analiza el servicio del área de Urgencias de un hospital público aplicando

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los conceptos y relaciones de líneas de espera. A partir de los resultados del modelo se concluye que en el área de Urgencias no se cuenta con la cantidad mínima necesaria de médicos para permitir un flujo constante de pacientes. Con el modelo se calcula el número mínimo de médicos necesarios para satisfacer la demanda actual y futura de servicio, con los mismos tiempos de servicio y la misma disciplina de servicio. Los modelos analíticos permiten entender directamente las relaciones existentes entre demanda de servicio, número de médicos y prioridad de atención del paciente vistos como un sistema de líneas de espera. El trabajo es de utilidad para los administradores y responsables de la gestión de sistemas hospitalarios.

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Palabras clave: Sistemas hospitalarios; Hospitales; Urgencias; Administración; Control teoría de líneas de espera; Tiempo de ciclo

Códigos JEL: I1; C02; C44

Introduction

Those responsible of the decision-making in hospitals are becoming more aware of the need to more efficiently manage the hospital resources under their control. To provide a good service, those responsible must use tools that allow them to analyze, program, plan, prioritize and, in general, decide on the best way to manage the available resources (Vissers & Beech, 2005; Abraham, Byrnes, & Bain, 2009). An example of the type of problems to be analyzed is that of estimating the level of service provided to the patients, the average waiting time, the number of patients queued, the capacity used, and the probability that the patient needs to wait. In hospital systems, the waiting time to receive attention is a key element in measuring the quality of the service. Therefore, the decrease of said waiting time has become a significant factor in the management of these types of systems (Green, 2005, 2010).

To obtain the abovementioned properties, analytical means derived from the queueing theory can be used. Analytical tools make it possible to understand the existing relations between each of the elements of a system, unlike other analysis approaches which are usually similar to black boxes (Hopp & Spearman, 2008). Although the simulation approach makes it possible to obtain the same properties, it is advisable to use it when there is no analytical model for the system that is going to be analyzed (Law & Kelton, 2000). On the other hand, not all hospital systems are expected to have a specialized simulation program, whereas access to analytical formulas is universal and free. As is mentioned in the work of Song, Tucker, and Murrell (2013), empirical studies (such as this) in hospital systems are proportionately fewer than their counterpart in the areas of manufacture and production, which generates an area of opportunity for the professionals that manage these types of systems to apply different analytical tools that are well known in other areas.

In this vein, this work presents the method to analyze the Emergency service by applying the concepts and relations of the queueing theory. The Emergency service of a public hospital in the city of Celaya in Guanajuato—where the managers of the area receive a great number of patients that wait in line to be taken care of—is taken as case study for this work.

The study is pertinent to administrators, engineers, doctors and, in general, to all those professionals in charge of the decision-making in health systems and those who wish to analyze the service demand as well as the capacity to provide said service.

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