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Simulation of a single-server Queueing system relevant to hospital services

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Abstract: The system is simulated until a fixed number of patients have completed their delays in queue with the help of FORTRAN PROGRAM. The simulation stops when the nth patient enters service. The time the simulation ends is a random variable, depending on the observed values for the inter-arrival and service time random variables.

Keywords : Queueing models, Single-doctor, Simulation

1. Introduction :

Due to wide scope and applications of queueing models in health services, consider a single-doctor queueing system for which the interarrival times $A_1, A_2, ...$ are independent, identically distributed (IID) random variables. ("Identically distributed" means that the interarrival times have the same probability distribution). A patient, who arrives and finds the doctor idle enters service immediately, and the service times $S_1, S_2, ...$ of the successive patients are IID random variables that are independent of the interarrival times. A patient who arrives and finds the doctor busy joins the end of a single queue. Upon completing service for a patient, the doctor chooses a patient from the queue (if any) in a first-in, first-out (FIFO) manner.

The simulation will begin in the "empty-and-idle" state; i.e., no patients are present and the doctor is idle. At time 0, we will begin waiting for the arrival of the first patient, which will occur after the first interarrival time, A_1, rather than at time 0 (which would be a possibly valid, but different, modeling assumption). We wish to simulate this system until a fixed number (n) of patients have completed their delays in queue; i.e., the simulation will stop when the nth patient enters service. Note that the time the simulation ends is thus a random variable, depending on the observed values for the interarrival and service-time random variables.

To measure the performance of this system, we will look at estimates of three quantities. First, we will estimate the expected average delay in queue of the n Patients completing their delays during the simulation; we denote this quantity