On a $M^x/(G_1,G_2)/1$ Queue with Third-Stage Optional Service and Deterministic Server Vacations

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Abstract

We study a single server queueing system with Poisson arrivals in batches of variable size, assuming that customers in a batch are pre-ordered for the purpose of service. The server provides two stages of general heterogeneous service to all customers one by one on the basis of first come, first served rule. A customer whose two stages of service are complete, may decide to take the third stage optional service with a certain probability or may just leave the system without taking the third stage service. Every time when a customer’s required number of services (two or three as the case may be) is complete, the server has the option to take a vacation with a certain probability or continue staying in the system to serve the other customers. We further assume that whenever the server takes a vacation, it is a vacation of fixed length ‘d’. We find steady state probability generating function of number of customers in an explicit form, the steady state probabilities of various states of the system, the average queue size, the average system size, and the average waiting time in the queue as well as the average waiting time in the system.