Analysis of a Discrete-time Geo/G/1 Queue Integrated with (s, Q) Inventory Policy at a Service Facility

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Abstract : This study examines a discrete-time Geo/G/1 queueing-inventory system attached with (s, Q) inventory policy. Assume that the customers follow the Bernoulli process on arrival. Each customer demands a single item with arbitrarily distributed service time. The inventory is replenished by an outside supplier, and the lead time for the replenishment is determined by a geometric distribution. There is a single server and infinite waiting space in this facility. Demands must wait in the specified waiting area during a stock-out period. The customers are served on a first-come-first-served basis. With the help of the embedded Markov chain technique, we determine the joint probability distributions of the number of customers in the system and the number of items in stock at the post-departure epoch using the Matrix Analytic approach. We relate the system length distribution at post-departure and outside observer's epochs to determine the joint probability distribution at the outside observer's epoch. We use probability distributions at random epochs to determine the waiting time distribution. We obtain the performance measures to construct the cost function. The optimum values of the order quantity and reordering point are found numerically for the variety of model parameters.

Keywords : discrete-time queueing inventory model, matrix analytic method, waiting-time analysis, cost optimization

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