S.m.10. JACOB, M.J.–Probabilistic Analysis of Some Queuing and Inventory Models–1988–Dr. A. Krishnamoorthy

This thesis considers a number of models in Queues and Inventories. The (s,S) policy is followed for the inventory problems.

The interarrival time between demands are assumed to be i.i.d.r.vs following a general distribution. Lead times are also i.i.d. independent of the demand process. The server goes on vacation if the inventory becomes dry. All demands that arise during the server vacation are lost. The inventory level deistributions, are obtained. This is modified to allow an agent supplying S-i units of the item when inventory level is, $0 < i \leq s$. When inventory becomes dry server goes on vacation. The server on return allows a maximum number S-s-1 demands to queue up, if the replenishment has not yet taken place. Both the system size probabilities and queue size probabilities are computed. Yet another modification considered is local purchase of the item at an extra cost, if the item is available, as soon as inventory size becomes zero. Otherwise server goes on vacation. Here again the system size probabilities are computed.

The correlation between lead time and dry period for inventory is established in the case when both interarrival times and lead times are assumed to have exponential distribution.

An inventory problem with compound renewal demand is another model that is considered. the lead times are i.i.d.r.vs independent of the demand process. Convolution of matrices whose entries are probabilities is used to calculate the system size probabilities.

Yet another inventory model discussed is the following. The ordering levels vary according to the number of demands that occur during the previous lead time. The lead times and interarrival times between demands are assumed to be independent sequences of i.i.d.r.vs. Expressions for the stock level distribution and the correlation between the number of demands during a lead time and the next inventory dry period are obtained. This again is done using the convolution of matrices whose entries are probabilities.

The following queueing models are analysed.

Units arrive to a single server system according to a general rule. Services are in batches of size atleast 'a' and atmost 'b'. Service times are exponentially distributed and depends on the size of the batch being served. If the number of units waiting in the queue at a service termination point is found to be less than a, then the server goes on vacation of duration having exponential distribution. If on return the queue size is less than a then the server remains idle until the queue size accumulates to a. A two dimensional Markov chain is embedded in the continuous time process representing the number of units undergoing service or the servers condition such as idle or on vacation as one of the coordinates and number in the queue as ther other co-ordinate. The steady state probability distribution is computed using the matrix-geometric method. The waiting time distribution of an arriving unit is also computed.

Another problem that is attempted is the computation of time dependent probability distribution of the system size in a finite capacity queue. The arrival process is Poisson. Service times have arbitrary distribution. The server goes on vacation of a random duration whenever the number waiting at a service completion point is less than the minimum batch size 'a' to start service. The vacation rule is of the multiple type. Using convolution of matrices of probabilties, the system size probabilities are obtained. The virtual waiting time is also computed. As a particular case the single service situation is also discussed.