Abstract

Batch-service queues in both continuous and discrete time have ubiquitous applications, which embraces modern digital communication systems, group testing for detecting defective items in manufacturing systems and contaminated blood samples in pathological labs for diagnosing HIV/syphilis, influenza. These helps in attenuating system-cost, reducing congestion, maintaining quality of service in facsimile systems. The cornerstones of this thesis are to obtain the state vectors in an implementable manner for infinite-buffer batch-service queues in both discrete and continuous time, and the study of an inventory system in a queue with batch-service facility.

In this thesis, in order to derive the state-vectors, different methodologies e.g., matrix geometric method, supplementary variable technique, renewal process, 'rate-in=rate-out' principle, probability generating function method, vector generating function method, difference equation method are quite successfully implemented. Cost models are constructed for some queues for possible utilization of the system in pre-implementation stage.

This thesis consists of eight chapters, in which the first chapter is introductory, which reflects the motivation of the thesis and chapter 8 discusses the conclusion and future scope of the study. In chapter 2, a queue wherein batch-size dependent versatile batch-service with Poisson arrival and exponential service time is considered. Chapter 3 introduces an '(s, S)' inventory system in a queue with general batch-service rule. In chapter 4 and chapter 5, a discrete time queue with Bernoulli arrival, arbitrary service time and versatile batch-size dependent service rule is considered. Whereas, in chapter 4, queue length distribution is obtained when the server is busy and idle, but in chapter 5, complete distribution of queue content and server content is obtained through the successful inversion of bivariate probability generating function. A discrete time renewal batch-arrival queue with geometric service time and random batch-service rule is considered and analyzed using difference equation method in chapter 6. Chapter 7 presents a comparison between two methods for analyzing queues with correlated arrival, based on computational simplicity.
Keywords: Queue; Inventory; Root; Steady-state; Single server; Batch-service; Batch-size dependent; Infinite-buffer; Matrix geometric; Supplementary variable; Embedded Markov chain; Bernoulli; Geometric; Poisson; Birth-death modulated Markovian arrival; Versatile service rule; Difference equation; Markovian arrival;