

# Abstract

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Batch-service queues with batch-size-dependent service have widespread applications in group testing of blood samples for detecting syphilis/HIV, eliminating defective items in manufacturing system. These are also used in developing congestion control mechanisms in order to regulate transmission rates in packet-switched telecommunication system. The main focus of this thesis is to obtain the distribution of number of customers in the queue as well as with the server while analyzing some infinite-buffer batch-service queues with batch-size-dependent service.

In this thesis supplementary variable technique is used to derive a bivariate probability generating function of queue length and number with the departing batch. The complete joint distributions are extracted in terms of roots of the associated characteristic equation. Relations between the state probabilities at departure, arbitrary, and pre-arrival epochs have been developed. Significant numerical results demonstrate the analytic procedure and results.

This thesis consists seven chapters among them first chapter is introductory which clearly identifies the motivation of the work done and chapter 7 is about the conclusion and future scope of study. Chapter 2 analyzes a batch-size-dependent service queue with Poisson arrival where service rule follows general bulk service rule. In chapter 3 a batch-size-dependent service queue is analyzed where customers are served according to random serving capacity rule. Instead of individual arrivals batch-arrival has been introduced in chapter 4 to analyze a batch-size-dependent service queue with general bulk service rule. Chapter 5 analyzes a batch-size-dependent service queue with batch-arrival where customers are served according to random serving capacity rule. The Markovian arrival process is an excellent representation of bursty nature of traffics with correlated inter-arrival, which is mostly observed in high-speed teletraffic networks. In order to deal with such such scenarios where correlation occurs among the inter-arrival times, a batch-size-dependent service queue with Markovian arrival process has been analyzed in chapter 6.

**Keywords:** Batch-service; Batch-size-dependent; Embedded Markov chain; Infinite-buffer; Markovian arrival process; Poisson arrival; Probability generating function; Queue; Root; Single server; Steady-state; Supplementary variable.