ANALYSIS OF DISCRETE AND CONTINUOUS TIME QUEUES WITH SERVER BREAKDOWN AND VACATIONS

ABSTRACT

Submitted by

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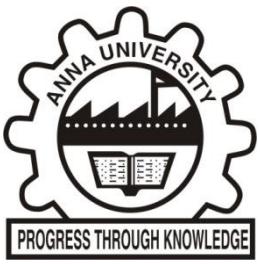

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ABSTRACT

Discrete and continuous time queueing models have been widey used to provide stochastic modelling of many real world problems arising in telecommunications, computer networks and manufacturing systems. In this thesis, analysis of discrete and continuous time queueing models with server breakdown and vacations are discussed. The proposed models of this research work are theoretically developed and numerically justified. All the models are motivated by real time examples.

The thesis examines introductory concepts of classical queues with continuous and discrete times. It also presents a brief survey of some relevant existing research work on classical queues. In the proposed work, six different classical queueing models with continuous and discrete times have been analysed. Variants in arrivals such as negative, impatient and feedback of customers are also considered. Continuous time queueing models are analysed in the first three chapters of the thesis and discrete time queueing models are analysed in the last three chapters of the thesis.

A finite capacity single server general service queue with an additional second phase of optional service in which customers arrive according to Markovian arrival process is analysed first. It is assumed that a single server provides the first phase of essential service (FPES) to all arriving customers and the second phase of optional service (SPOS) to the customers who are in need. On completion of FPES or SPOS, if the number of waiting

customers is at least one, the server starts FPES according to first in first out rule. On the other hand, if the server finds an empty system at any service completion epoch (either FPES or SPOS), he avails single or multiple vacations according to the indicator function δ_s. If a customer on arrival finds N customers in the waiting room, then the customer leaves the system without being served and this is assumed to be a loss to the system. This model is motivated by real time example. Various performance measures are also obtained. Numerical illustrations are also presented with graphs.

Cost analysis of a finite capacity queue with batch service, multiple vacations and closedown times with the arrival of customers with Markovian arrival process (MAP) is considered in the next chapter. The following chapter considers, all the arriving customers are served by a single server in batches of maximum size ‘b’ with the minimum threshold value ‘a’. On completion of a service, if the queue length is less than 'a', then the server performs a closedown work and leaves for a vacation of random length. On completion of a vacation, if the queue length is still less than 'a', the server avails another vacation until the server finds at least 'a' customers waiting for service in the queue. After the completion of a service or a closedown job, if the number of customers in the queue is at least a specified value 'a', then the server immediately starts service according to general bulk service rule. Some key performance measures are also obtained. Cost model is discussed with Numerical illustration.

A multi server non-Markovian loss system with pre-emptive priority and server breakdown is analysed in the next chapter. It is assumed that two types of customers arrive, namely, high priority customers (type 2)

and low priority customers (type 1). The arriving type 1 and type 2 customers are served immediately if the servers are available. However, if all 'C' servers are busy, then on the arrival of a high priority customer, the service of a low priority customer is pre-empted. On the other hand if all the servers are busy with high priority customers, arrival of low and high priority customers are a loss to the system. During service, if any of the server breaks down they are immediately sent to the repair station for repairs. Some of the performance measures are obtained. A numerical illustration of the obtained results is also presented graphically. The results are validated using simulation.

The discrete time infinite capacity queueing system with correlated arrival and negative customers served by two state Markovian server is investigated in the next chapter. Positive customers are generated according to the first order Markovian arrival process with lengths of *On* periods and *Off* periods. The arrival of positive customers are considered in the stochastic manner and are stored in the infinite waiting room on a first-come, first-serve basis. In the waiting room, these positive customers have to wait for some time, until finally they receive service from the two state Markovian server. The server state is a two state Markov chain which alternates between *Good* and *Bad* states. Further, the arrival of a negative customer to the system removes the positive customers if any, and has no effect when the system is empty. Some particular cases are discussed. Other performance measures are also obtained. The effects of several parameters on the proposed model are analysed numerically with graphs.

A discrete time single server general service infinite capacity queueing system with O*n*-*Off* source arrivals, negative customers and

Bernoulli feedback is investigated in the next chapter. Using first order Markovian arrival process, the positive customers are generated with *On* and *Off* periods respectively. Service times of these positive customers are generally distributed. After service completion, an unsatisfied customer immediately joins the queue and a satisfied customer leaves the system permanently. Further, the arrival of negative customer removes the positive customers if any, and has no effect when the system is empty. Some particular cases and performance measures of the proposed model is obtained. The proposed model is illustrated numerically with graphs using various parameters.

The discrete time finite buffer queue with server, subject to starting failures and impatient customers is studied in the final phase. Upon the arrival of a customer, whenever the starting failure occurs, the server is immediately sent to repair station and customers who are patient can join the queue and obtain service from the server and the impatient customers may leave the system without availing service from the server. The inter arrival time of customers are assumed to be discrete time renewal process and service/repair times are mutually independent and are geometrically distributed. Performance measures are also obtained. The effective analysis of the proposed model is discussed through numerical illustration with graphs.

To sum up, the important features of the proposed continuous and discrete time queueing models are highlighted. The major contribution of this research work is summarized and scope for future enhancements is also presented.