

## ABSTRACT

In real world, retrial queues have been widely used as models for stochastic phenomenon such as telephone switching systems, telecommunication networks and computer systems. Retrial queueing systems are characterized by this particular feature: arrivals who find the server busy leave the service area and join the retrial group to try again for their requests for service. This study discusses retrial queueing models with feedback, server breakdowns, vacations and control policies on arrivals. The proposed models of this research work have been theoretically developed and numerically justified.

The thesis starts with introductory concepts of retrial queues. It also presents a brief survey of some relevant existing research work on retrial queues.

In the proposed work, six different retrial queueing models have been analyzed. For all the models various performance measures, some special cases and particular cases are discussed. Numerical illustrations are also provided for all the models.

A single server non-Markovian retrial queue with working vacation and constant retrial policy is analyzed first. If the server is busy at the arrival time, the customer joins the orbit to repeat its request later. On the other hand, if the server is idle, then the arriving customer begins its service immediately.

The single server takes a working vacation at times when the customers being served depart from the system and no customers are in the orbit. The server works at a different service rate rather than completely stopping service during a vacation. After completing a vacation, the server stays idle in the system until a customer arrives from main pool or from the orbit.

Then a batch arrival retrial queueing model with two phase service under active server breakdowns, two types of repair and multiple vacations with N-policy is analyzed. If an arriving batch of customers finds the server idle, one of the arriving customers starts its service immediately and the rest joins a retrial group. However, if an arriving batch of customers finds the server busy, it joins the retrial group. The server provides preliminary first essential service (FES), second optional service (SOS) and may breakdown while serving customers. When the server fails, it is repaired immediately. The customer, who was being served during the server failure, chooses to enter the orbit (impatient customer) with probability 'q' and with complementary probability 'p' to remain in the server for repair in order to conclude its remaining service (patient customer). If the number of customers in the orbit is less than N, the server does a secondary job (vacation) repeatedly, until the orbit size reaches N. At a secondary job completion epoch, if the orbit size is at least N, then the server continues to remain in the system to render service.

Then the analytical development of an  $M^X/G/1$  feedback retrial queue with non-persistent customers and multiple vacations with N-policy is

discussed. If an arriving batch of customers finds the server idle, one of the arriving customers starts its service immediately and the rest joins a retrial group. Otherwise, if an arriving batch of customers on arrival finds the server busy, they become impatient and leave the system with probability  $(1-\alpha)$  and with probability  $\alpha$ , they enter into the orbit. At a service completion epoch, the server avails N-policy vacation as discussed in chapter 3. At a service completion epoch, the leaving customer may request for another service with probability 'f' or leave the system forever with probability 'd'.

An M/G/1 retrial queueing system with different classes of arrivals subject to breakdowns is proposed in the next chapter. The customers namely, positive, negative and partially negative arrive according to three independent Poisson processes. If an arriving positive customer finds the server idle, it starts the service immediately. If an arriving positive customer finds the server busy, it enters the retrial group. The arrival of a negative customer which does not receive service not only removes the customer under service, but also causes server break down. When the server fails, it is sent to repair immediately. If an arriving partially negative customer finds the server busy with regular service, it makes the system slow down. If an arriving partially negative customer finds the server busy with slow service, it breaks down the server.

The steady state behavior of single server retrial queue with multiple vacations and state dependent arrivals is analyzed in the next chapter. The customers arrive according to Poisson process with different arrival rates.

If the server is busy or on vacation at the arrival epoch, the customer joins the orbit, whereas if the server is idle, then the arriving customer begins its service immediately. Whenever the system is empty, the server immediately takes a vacation. If there is at least one customer found waiting in the orbit upon returning from a vacation, the server will be immediately activated for service. When the server is idle the primary arrival rate is  $\lambda_4$  and when the server is busy or on vacation the primary arrival rate is  $\lambda_5$  ( $\lambda_4 > \lambda_5$ ).

Further, an M/G/1 retrial queue with general retrial time, modified M-vacations and collision is proposed. If the server is idle, the arriving customer gets served completely and leaves the system. If the server is busy, the arriving customer collides with the customer in service resulting in both being shifted to the orbit. After the collision, the server becomes idle. Whenever the orbit is empty the server leaves for a vacation of random length V. When the server returns from a vacation, if no customers appear in the orbit, it again leaves for another vacation of same duration. This pattern continues until it returns from a vacation to find at least one customer recorded in the orbit or it has already availed M number of vacations. If the orbit is empty by the end of the M<sup>th</sup> vacation, the server remains idle in the system to render service.

Finally, the important features of the proposed models have been highlighted. A summary of major contribution of this research work and the possible directions for future work are also presented.