Chapter 5

Analysis of Feedback Retrial Queue with Starting Failure and Server Vacation: Retrial Queue with Starting Failure

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ABSTRACT

In this chapter we discuss a batch arrival feedback retrial queue with Bernoulli vacation, where the server is subjected to starting failure. Any arriving batch finding the server busy, breakdown or on vacation enters an orbit. Otherwise one customer from the arriving batch enters a service immediately while the rest join the orbit. After the completion of each service, the server either goes for a vacation with probability or may wait for serving the next customer. Repair times, service times and vacation times are assumed to be arbitrarily distributed. The time dependent probability generating functions have been obtained in terms of their Laplace transforms. The steady state analysis and key performance measures of the system are also studied. Finally, some numerical illustrations are presented.

INTRODUCTION

Retrial queues have been widely used to model many problems in telephone switching systems, telecommunication networks and computers competing to gain service from a central processor unit. A remarkable and unavoidable phenomenon in the service facility of a queuing system is its breakdown. These models arise naturally in telecommunication and computer systems, in production and quality control problem, etc. Kulkarni and Choi (1990), Mian Zhang and Zhengting Hou (2010), Choudhury, G & Deka, K. (2012) and Shan Gao and Zaiming Liu, (2013) have analysed the M/G/1 queue with server

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subjected to repairs and breakdowns. Aissani and Artalejo (1998), Amar Aissani (2009), Artalejo (2010) and Artalejo and Gomez-Corral (2008) have considered a retrial queue in which immediately after a service completion the server searches for customer from the orbit or remains idle.

Ke, J., C. C.U.Wu., & Zhang, Z. G., (2010) discussed recent developments in vacation models. One of the most important characteristic in the service facility of a queueing system is its starting failures. An arriving customer who finds the server idle must turn on the server. If the server is started successfully the customer gets the service immediately. Otherwise the down for the server begins and the customer must join the orbit. The server is assumed to be reliable during service. Such systems with starting failures have been studied as queueing models by Yang and Li (1994), Krishna Kumar et al. (2002b), Mokaddis et al. (2007), Ke and Chang (2009) and Sumitha and Udaya Chandrika (2012).

In this chapter, we consider $M^{(X)}_G / G / 1$ retrial queue, subject to starting failures and Bernoulli vacation. The customers arrive to the system in batches of variable size, but served one by one on a first come - first served basis. We assume that there is no waiting space and therefore if an arriving customer finds the server busy or down, the customer leaves the service area and enters a group of blocked customers called orbit in accordance with an FCFS discipline. That is, only the customer at the head of the orbit queue is allowed for access to the server where the arrival follows Poisson. As soon as the completion of service, if the customer is dissatisfied with his service, he can immediately join the retrial group as a feedback customer for receiving the same service with probability $p$ or to leave the system forever with probability $q(=1-p)$. The successful commencement of service for a new customer who finds the server idle and sees no other customer in the orbit with probability $\delta$ and is $\alpha$ for all other new and returning customers. After the completion of each service, the server either goes for a vacation with probability $\beta$ or may wait for serving the next customer with probability $1-\beta$. Repair times, service times and vacation times are assumed to be generally (arbitrary) distributed.

Here we derive time dependent probability generating functions in terms of Laplace transforms. We also derive the average orbit size, system size and average waiting time in the queue, the system. Some particular cases and numerical results are also discussed.

The rest of the chapter is organized as follows. Model description is given in section 2. Definitions and equations governing the system are given in section 3 and 4 respectively. The time dependent solution have been obtained in section 5. Corresponding steady state results have been derived explicitly in section 6. Average orbit size, system size and average waiting time are computed in section 7. Particular cases and numerical results are discussed in section 8 and 9 respectively.

MODEL DESCRIPTION

We assume the following to describe the queueing model of our study.

a) Customers arrive at the system in batches of variable size in a compound Poisson process and they are provided one by one service on a FCFS basis. Let $\lambda c_i dt \ (i = 1, 2, \ldots)$ be the first order probability that a batch of $i$ customers arrives at the system during a short interval of time $(t, t + dt)$, where $0 \leq c_i \leq 1$, $\sum_{i=1}^{\infty} c_i = 1$ and $\lambda > 0$ is the arrival rate of batches.