International Journal of Statistics and Reliability Engineering
Vol. 8(2), pp.291-300, 2021 (ISSN(P): 2350-0174 ; ISSN(O):2456-2378)

IARS

ORIGINAL ARTICLE

Time Dependent Analysis for Retrial Priority Model with Single Vacation

S. Damodaran [1], A. Muthu Ganapathi Subramanian[2] and Gopal Sekar[3]
[1]Department of Mathematics
Tagore Govt. Arts and Science College, Puducherry, India
E-mail: *sreedamo@gmail.com*
[2,3]Kanchi Mamunivar Government Institute for Post Graduate Studies and Research, Puducherry, India
[2]E-mail: *csamgs1964@gmail.com*
[3]E-mail: *gopsek28@gmail.com*

Received: 18 January 2021 / Revised: 02 July 2021 / Accepted: 05 August 2021

Abstract

Transient behaviour of Single server Retrial Queueing problem with non-preemptive priority combined with single vacation is taken up for study in this paper. The arrival pattern of low priority customer follows Poisson distribution with arrival rate λ_1 and that of high priority also follows Poisson distribution with arrival rate λ_2. Service rates of low and high priority customers follow exponential distribution with rates $\mu_1$and μ_2 respectively. Retrial rate of customers from the orbit is σ. When there are no customers in both high and low priority queues, the server will go for a vacation. The server will return to the system to provide service with rate α. The transient solution to the model is obtained using matrix exponential method. The time dependent probabilities and system performance measures are computed.

Keywords: Retrial – Priority – Single Vacation – Transient solution.

1. Introduction

In standard Queueing theory, the server(s) always remain in the system to provide service to the customers. However, this is not the case in many practical queues which we come across in daily life. There are many factors due to which service is interrupted in the system. One of the reasons for interrupted service is when the server leaves for the vacation. When the system is empty, the server may go for vacation. After completing a service and finding the system empty, the server may go for the vacation. Doctor in a clinic, Teller in a bank, Booking clerk at the reservation counter takes a vacation when the system is empty. Thus vacation is inevitable in queueing system. The study of Queues is more realistic, when the vacations are incorporated in Queueing models.

Vacation Queueing models which started in 1970's were explored to a large extent in 1980's. The work and progress of Vacation queueing theory can be found from the survey Queueing systems with vacation by Doshi [8], Vacation Queueing models – Theory and Applications Tian and Zhang[27] , the short survey- Recent developments in Vacation Queueing models by Ke et al[17] and the Vacation and the Priority systems by Takagi[26]. Xu and Zhang[29] studied Multiserver queue with single vacation. Wozniak[28] found Analytical solution to Finite Buffer Queue with Single vacation policy. Madan et al[20] contributed to the study of two server queue with Bernoulli schedules combined with single vacation policy. Ke and Lin[16] studied batch arrival under N policy with Single vacation. Gupta et al[11,12] investigated MAP/G/1/N under single and Multiple vacations. Zhang[30] analyzed Queueing system with Synchronous single vacation. All these work provides only steadystate solutions.

Transient solution to vacation queueing models were dealt with to some extent in the last two decades. Indra and Bansal[13] found the Transient solution for unreliable M/G/1 Queue with vacations. MaragathaSundari and Srinivasan[21] analyzed the Transient Behaviour of M/G/1 queue with single vacation. Time dependent solution to M/M/1 queue with impatient behaviour combined with vacation is investigated by sheriff Ammar[23]. Sudhesh and Azhagappan[25] analyzed Transient behaviour of M/M/1 queue with server vacation. SherifAmmar[24] again in 2017, came out with transient solution of M/M/1 vacation queue with waiting server and impatient customers. Transient behavior of Markovian single vacation feedback queue with an interrupted closed down time is studied by Azhagappan and Deepa[7] in 2019.

Many of the queues which we found in real life resemble Retrial Queueing model rather than classical queueing model. The focus on research in Queueing theory is thus shifted to Retrial models. The survey of Retrial queueing models can be found in Artalejo[1,2] and Falin[9,10]. Ayyappan et al,[3] investigated Retrial queue with single vacation. Krishnakumar and Arivudainambi[18] worked on M/G/1 Retrial queue with Bernoulli vacation. Kasturi and Kalidass[15] investigated M/G/1 retrial queue under vacation. Lakshmi and KasturiRamanath[19] studied M/G/1 retrial queue with single vacation scheme.

Recently, few attempts have been made to provide Time dependent solution to Retrial Queueing models. Parthasarathy and Sudhesh[22] analyzed time dependent behavior of single server retrial queue. Azhagappan et al,[4]

S. DAMODARAN.

B7 Papers

Available online at http://scik.org
J. Math. Comput. Sci. 11 (2021), No. 3, 3276-3299
https://doi.org/10.28919/jmcs/5042
ISSN: 1927-5307

TIME DEPENDENT RETRIAL QUEUEING MODEL WITH ORBITAL SEARCH UNDER NON-PREEMPTIVE PRIORITY SERVICES

S. DAMODARAN[1,*], A. MUTHU GANAPATHI SUBRAMANIAN[2], GOPAL SEKAR[2]

[1]Department of Mathematics, Tagore Govt. Arts and Science College, Pondicherry, India

[2]Department of Mathematics, KMGIPSR, Pondicherry, India

Abstract: Transient solution of Single server Non-preemptive priority Retrial model with orbital search is studied using eigenvalues and eigenvectors. In this model, customers are arriving in Poisson process. Arrival rates of low priority and high priority customers are respectively λ_1 and λ_2. The service times for low and high priority customers follow exponential distribution with parameters μ_1 and μ_2 respectively. Customer finding the system busy, on arrival, goes to the orbit and form a virtual queue. In this model of orbital search, when the server becomes free, he has two options. Either the server search for the customer in the orbit with probability p to provide service for a customer in the orbit or remains idle with the probability 1-p. Whenever the server is free, customer from orbit try for service, under classical retrial policy with rate σ which follows Poisson process. In this paper, transient solution of average number of customers in the orbit and high priority queue, the probability of server being idle, the probabilities of server being busy with low and high priority customers for various values of λ_1, λ_2, μ_1, μ_2, σ, p and t are estimated.

Keywords: retrial; orbit; classical retrial policy; orbital search; transient solution.

2010 AMS Subject Classification: 60K25, 68M30, 90B22.

*Corresponding author
E-mail address: damodaran@dhtepdy.edu.in
Received December 14, 2021

S. DAMODARAN.

CREAT. MATH. INFORM.
Volume **31** (3022), No. 1,
Pages 57 - 70

Online version at https://semnul.com/creative-mathematics/
Print Edition: ISSN 1584 - 286X; Online Edition: ISSN 1843 - 441X
DOI: https://doi.org/10.37193/CMI.2022.01.06

Computational approach to Transient solution for single unreliable server Retrial Queue under non-preemptive priority

S. DAMODARAN[1], A. MUTHU GANAPATHI SUBRAMANIAN[2] and GOPAL SEKAR[2]

ABSTRACT. Single server Retrial Queueing model with system repair and breakdown under non-preemptive priority is considered in this paper. The study of the model so far is mostly explored only for steady state solutions with few exceptions to Transient solutions. Though some researchers have attempted transient solution to the model analytically, the solution thus obtained is more complicated that it cannot be solved. In this context, we have found the transient numerical solution to the model using eigenvalues and eigenvectors. Time dependent system performance measures and probability distributions are evaluated and validated with steady state solutions.

1. INTRODUCTION

In many practical queueing models, the occurrence of interruption is inevitable. Interruption arises due to either server break down or in case server goes for vacation. The impact of inclusion of interruption in Queueing models reflects in the characteristics of the queueing system. In most of the daily life queueing models such as Ticket reservation, Banking services, ATM services, Vending machines, Billing counters and Toll collection centres, often we come across the situation wherein either the server goes for vacation or the system breaksdown and the customers need to wait either for the server to return from vacation or the server to be made ready. Thus the study of system interruption become more significant.

Study of Interrupted Queueing models started way back in 1950's. Performance measures of a waiting line with interruptions are explored by Gaver [6]. By applying generating function method, White and Christie [13] investigated Queueing structure with breakdown. Queue length generating function of several breakdown models of queue were obtained by Thiruvengadam [11]. Explicit moment generating function of Queue size for many server queue with interruptions is found by Mitrany and Avi-itzhak [8]. Shengli and Jingbo [10] analyzed M/M/N queue with variable breakdowns.

Study of server breakdown interruption in Retrial Queueing models were initiated only in 1990's. By employing Markov regenerating processes, Kulkarni and Choi [7], derived stability and limiting behavior of Retrial queues with server subject to breakdowns and repairs. Artalejo [3] investigated the asymptotic behavior of Retrial queueing systems with breakdown of the servers. Applying the theory of piecewise Markovian Process, Aissani[1] analyzed Retrial queue with redundancy and unreliable server. Aissani and Artalejo [2] obtained expression of the generating function of the server state for the Single server retrial queue subject to breakdowns. Jinting Wang and Jinhua Cao [12] studied Reliability Analysis of Retrial Queue with server breakdown and repairs. Discrete time Geo/G/1 retrial queue with server Breakdown is investigated by Atencia and Moreno [4].

Received: 04.01.2022. In revised form: 05.01.2022. Accepted: 12.01.2022
2010 *Mathematics Subject Classification.* 60K25, 68M30, 90B22.
Key words and phrases. *Retrial, unreliable server, priority, transient solution.*
Corresponding author: S. Damodaran; damodaran@dhtepdy.edu.in