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Application of Queuing Theory for the Circulation of Books in Libraries

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ABSTRACT

The purpose of this paper is to study how the Queuing theory is applied in library to know about the different parameters which gives the information for the process of circulation of books. By using Morse's circulation model the rate of satisfied and unsatisfied customers coming to the library has been calculated. It will help to determine the effectiveness of service utilization in the library operation process and to reduce the waiting time of customer.

1. Introduction

Queuing theory comes in existence when the service facility is not working up to the mark. Every person facing this problem in our day to day life as the population increases and demand for the facility increases. Queuing models are helping in the proper management of the working system. In 1909, Agner Krarup Erlang, first introduced this theory called Queuing Theory had its beginning in the research on the Waiting Line Theory. Queuing theory helps to take the proper decision in the field of business management, education sector, information technology, electronics, library operations, banking sector and many more. In this paper by reviewing the article Ref. [1] and Ref. [10] we discuss about the various parameters in the library operation of circulating the books. Here the Queuing model is single server and finite population. It gives the idea about the rate of satisfaction of the customer who comes to the library to borrow the books and the rate of unsatisfied demand if the book is not available due to circulation. Queuing theory helps the library management to study the process of library operations and to overcome the existing problem.

2. Basic Parameters to be analyze in Library Operations:

1. λ -rate of arrival of a customer to borrow book
2. μ -rate of return books
3. $\frac{1}{\mu}$ -mean circulation time
4. R- rate of circulation of book per year
5. $\frac{R}{\mu}$ -book is not available in the library
6. $\lambda\frac{R}{\mu}$ -number of customers not getting book
7. $\lambda-\lambda\frac{R}{\mu}$ -number of customers getting the books
8. $P_0=\frac{\lambda}{\lambda+\mu}$ =Probability that no book is available
9. $P_1=\frac{\mu}{\lambda+\mu}$ =Probability that atleast one book is available
10. $L_q=\frac{R^2}{\mu(\mu-R)}$ =number of customers in the queue to borrow the book
11. $W_q=\frac{R}{\mu(\mu-R)}$ =waiting time of customer in the queue to borrow the book
12. $U=\frac{\lambda^2}{\lambda+\mu}$ =average unsatisfied demand of the customer

3. Morse's Circulation Model

In 1969 Phillip Morse gives first time the application of Queuing theory in academic libraries for the circulation of book as

$$R=\lambda-\lambda\frac{R}{\mu}=\frac{\lambda\mu}{\lambda+\mu}$$

4. Methodology

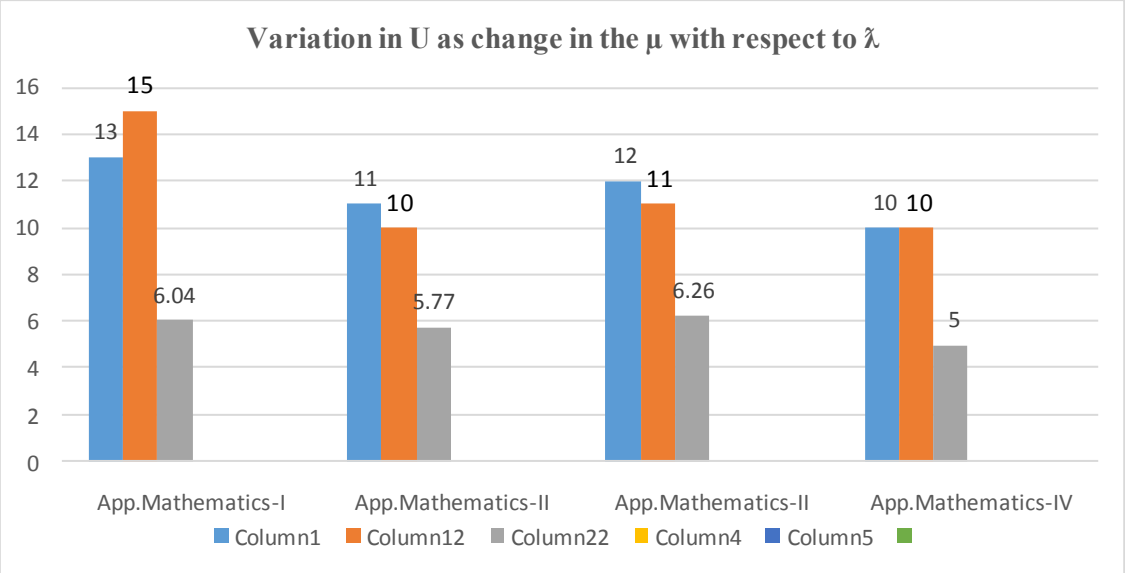
We collect the one year data from library of Smt. Radhikatai Pandav College of Engineering, Nagpur, for the subject of Applied Mathematics. We collect data after the issue of all the volumes. It is not possible to collect the data before the issue of all the volumes because it is the case where arrival rates always greater than the rate of return the books and the average unsatisfied demand increases.

One year Data of Circulation of books of App. Mathematics

Name of Book	No. of Volumes	Total number of times all books issued	Average No. of times a book issued λ	Total number of times all books returns	Average No. of times a book returned μ
App. Mathematics-I	55	728	13	800	15
App. Mathematics-II	60	655	11	600	10
App. Mathematics-III	45	530	12	510	11
App. Mathematics-IV	50	495	10	520	10

Calculation Table

Name of Book	λ	μ	R	U	P_0	P_1	L_q	W_q
App. Mathematics-I	13	15	6.96	6.04	0.46	0.54	0.37	0.0056
App. Mathematics-II	11	10	5.24	5.77	0.52	0.48	0.58	0.1101
App. Mathematics-III	12	11	5.74	6.26	0.52	0.48	0.57	0.0992
App. Mathematics-IV	10	10	5.00	5.00	0.50	0.50	0.50	0.1000



5. Conclusion

From the above results it has been observed that when the arrival rate is smaller than the rate of return book then the rate of unsatisfied customer is less than the satisfied customer and probability of availability of books increases than the probability of non-availability. To improve the system to decrease the unsatisfied rate in App. Mathematics-II and App. Mathematics-III there should be increase in the number of volumes of the books or impose the rule to return the books in allotted time.

References

1. Acharya U. H.,Ravindran G (1999), "Application of Queuing Theory to Libraries and Information Centres", DRTC Workshop on Information Management.
2. Anish Amin, Piyush Mehta , AbhilekhSahay, Pranesh Kumar And Arun Kumar (2014),"Optimal Solution of Real Time Problems Using Queuing Theory", International Journal of Engineering and Innovative Technology,Vol. 3 Issue 10, pp.268-270.
3. Babes M, Serma GV (1991), "Out-patient Queues at the Ibn-Rochd Health Centre", Journal of the Operations Research 42(10), pp.1086-1087.
4. Bose K. Sanjay (2002), "An Introduction to Queuing System", Springer US.
5. Davis M.M., Maggard M.J. (1990), "An Analysis of Customer Satisfaction with Waiting Time in a Two-Stage Service Process", Journal of Operation Management,9(3),pp.324-334.
6. Dhari K, Tanzina Rahman (2013), "Case Study For Bank ATM Queuing Models", IOSR Journal of Mathematics, pp.01-05.
7. Hana Sedlakova (2012), "Priority Queuing Systems M/G/I",Thesis, University of West Bohemia.

8. Janos Sztrik (2010), “Queuing Theory and Its Application”, A Personal View, 8th International Conference on Applied Infomatics, Vol. 1, pp.9-30.
9. Kantiswarup, Gupta P.K., Manmohan (2012), “Operations Research”, Excel Books Private Ltd. New Delhi, pp.215-231.
10. MandiOrlic, MarijaMarinovic (2012), “Analysis of Library Operation Using the Queuing Theory”,Informatol. 45,4, pp.297-305.
11. Mital K.M. (2010), “Queuing Analysis For Out Patient and Inpatient Services: A Case Study”, Management Decision, Vol. 48, No. 3 , pp.419-439.
12. Mohamad F (2007), “Front Desk Customer Service for Queue Management System”, Thesis, University Malaysia Pahang.
13. Muhammad Imran Qureshi, Mansoor Bhatti, Aamir Khan and Khalid Zaman (2014), “Measuring Queuing System and Time Standards: A Case Study of Student Affairs In Universities”, AfricanJournal of Business Management Vol.8(2),pp.80-88.
14. Patel B.,Bhathawala P.(2012), “Case Study for Bank ATM Queuing Model”, International Journal of Engineering Research and Application, Vol.2, pp.1278-1284.
15. Pieter-Tjerk de Boer’s (2000), “Analysis And Efficient Simulation of Queuing Models of Telecommunication Systems”, ISBN 90-365-1505-X, ISSN 1381-3617, CTIT Ph.D.-Thesis Series No. 00-01.
16. Pokley S.S.,Gakhare S.S.(2002), “Waiting Line Theory Applied To Adequate Requirement Of Beds In Hospital”, “Business Perspectives”,BirlaInst.of Management Technology, Vol 4,No.2,pp.77-80.
17. Prabhu N.U.(1997), “Foundation of Queuing Theory”, Dordecht Netherlands; Kluwer Academic Publishers.
18. Sharma J.K., (2001), “Operations Research Theory and Applications”, pp.597-665 Macmillan India Ltd, pp.597-665.
19. Shastrakar D. F., Pokley S.S., Patil K.D. (2016), “Literature Review of Waiting Lines Theory and its Applications in Queuing Model”,International Journal of Engineering Research and Technology, Special Issue-2016, IC-QUEST-2016 Conference Proceeding, pp.13-15.
20. Shastrakar D. F., Pokley S.S.,(2017), “Study of Different Parameters for the Electricity Bills Cash Counter Queuing Model”,International Journal of Innovations in Engineering and Science, Vol.2 N0. 6, e-ISSN: 2456-3463, pp.195-197.
21. Shastrakar D. F., Pokley S.S.,(2017),“Analysis of Different Parameters of Queuing Theory for the Waiting Time of Patients in Hospital”,International Conference On Emanations in Modern Engineering Science and Management,Vol.5, Issue:3,ISSN: 2321-8169, pp. 98-100.
22. Shastrakar D. F.,PokleyS.S.,(2017),“Application of Queuing Theory to Minimize the Waiting Time of Customer at Bill Paying Counter of Supermarket”,International Journal for Research in Applied Science & Engineering Technology,Vol.5, Issue:IX,ISSN: 2321-9653, pp. 8-10.
23. Shastrakar D. F.,PokleyS.S.,(2018),”Applications of New Methodology Applied to Reduce the Waiting Time of Customer in QueuingModel”Global journalof Enginering science and researches, ISSN:2348-8034, pp.26-29.
24. Shastrakar D. F.,PokleyS.S.,(2018),” Contribution of Queuing Theory to Analyze Various Aspects of Queuing Model” International Journal of Scientific Research in Science and Technology, Print ISSN: 2395-6011 | Online ISSN: 2395-602X, Volume 4, Issue 7 , pp.203-206.
25. Shastrakar D. F.,PokleyS.S.,(2018),” Analysis of Arrival and Service Distribution of Finite Population Queuing Model by using Binomial Distribution and Uniform Distribution” Journal of Emerging Technologies and Innovative Research , ISSN:2349-5162, Vol.5, Issue 5 pp.298-303.
26. Shastrakar D. F.,PokleyS.S.,(2018),” Analysis of Different Parameters of Finite Population Queuing Model by Using Waiting Time Distribution” Journal of Emerging Technologies and Innovative Research , ISSN:2349-5162, Vol.5, Issue 5 pp.298-303.
27. Shastrakar D. F.,PokleyS.S.,(2018) ,“Application of Binomial Distribution and Uniform Distribution to Study the Finite Queue Length Multiple Server Queuing Model” (2018), International Journal of Pure and Applied Mathematics, ISSN:1314-3395, Volume 120, No.6, Special Issue, pp-10189-10205.
28. Syed Shujauddin Sameer (2014), “Simulation: Analysis of Single Server Queuing Model”, International Journal on Information Theory (IJIT), Vol.3, No.3,pp 47-54.
29. Taylor S. (1995), “The Effect of Filled Waiting Timeand Service provider Control Over the Delay on Evaluation of Service” Journal of Academic Market. Sci.23,pp.33-46.

