IOSR Journal of Mathematics (IOSR-JM)
e-ISSN: 2278-5728, p-ISSN: 2319-765X. Volume 12, Issue 2 Ver. II (Mar. - Apr. 2016), PP 73-75
www.iosrjournals.org

Application Of Queuing Theory In Banking Sector

Nityangini Jhala[1], Pravin Bhathawala[2]
[1] *Assistant Professor, Applied Sciences and Humanities Department, Parul University, Waghodia, Vadodara, Gujarat, India*
[2] *Retd. Professor & Head, Department of Mathematics, VNSGU, Surat, Gujarat, India*

Abstract: *This paper describes a methodology designed to support the decision-making process by the banks to meet the demand. In order to determine an optimum number of servers, queuing theory is applied. The effect of queuing in relation to the time spent by customers to access bank services is increasingly becoming a major source of concern. This is because keeping customers waiting too long could result to cost to them (waiting cost). Providing too much service capacity to operate a system involves excessive cost. But not providing enough service capacity results in excessive waiting time and cost. In this study, the queuing characteristics at XYZ bank was analyzed using a Multi-server queuing Model. The Waiting and service Costs were determined with a view to determining the optimal service level.*
Keywords: *Service; FIFO; M/M/s; Poisson distribution; Queue; Service cost; Utilization factor; Waiting cost; Waiting time, optimization.*

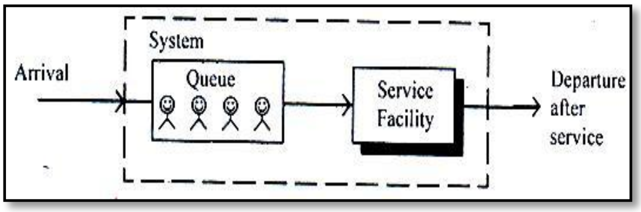
I. Introduction

Queues (waiting line) are a part of everyday life. Providing too much service involves excessive costs. And not providing enough service capacity causes the waiting line to become excessively long. The ultimate goal is to achieve an economic balance between the cost of service and the cost associated with the waiting for that service. Queuing theory is the study of waiting in all these various guises. Forming a Queue being a social phenomenon, it is essential to the society if it can be managed so that both the unit that waits and the one which serves get the most benefit.

II. Cash Transaction Model:

The Queuing model is commonly labeled as M/M/c/K, where first M represents Markovian exponential distribution of inter-arrival times, second M represents Markovian exponential distribution of service times, c (a positive integer) represents the number of servers, and K is the specified number of customers in a queuing system.

M/M/1 queuing model:



M/M/1 queuing model means that the arrival and service time are exponentially distributed (Poisson process). For the analysis of the cash transaction counter M/M/1 queuing model, the following variables will be investigated:

λ: The mean customers arrival rate
μ: The mean service rate
$\rho = \frac{\lambda}{\mu}$: utilization factor
Probability of zero customers in the bank:
$P_0 = 1 - \rho$
The probability of having n customers in the bank:
$P_n = P_0 \rho^n$
The average number of customers in the bank:
$L_s = \frac{\rho}{1-\rho} = \frac{\lambda}{\mu-\lambda}$
The average number of customers in the queue:

$L_q = L \times \rho = \frac{\rho^2}{1-\rho} = \frac{\rho\lambda}{\mu-\lambda}$

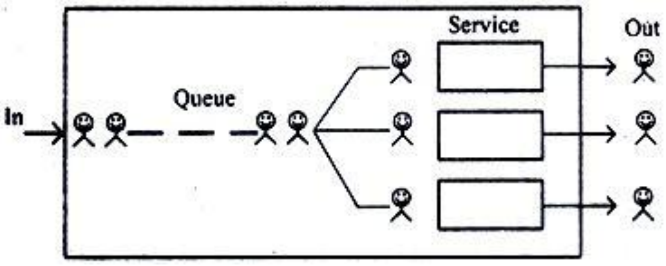
W_q: The average waiting time in the queue:

$W_q = \frac{L_q}{\lambda} = \frac{\rho}{\mu-\lambda}$

W_s: The average time spent in the bank, including the waiting time

$W_s = \frac{L}{\lambda} = \frac{1}{\mu-\lambda}$

Now, we discuss the same for **M/M/s Model**



:

All customers arriving in the queuing system will be served approximately equally distributed service time and being served in an order of first come first serve, whereas customer choose a queue randomly, or choose or switch to the shortest length queue. There is no limit defined for number of customers in a queue or in a system. We will discuss the case for s = 2.

λ: The mean customers arrival rate

μ: The mean service rate

$\rho = \frac{\lambda}{s\mu}$: utilization factor

Probability of zero customers in the bank:

$P_0 = \left[\sum_{n=0}^{s-1} \frac{(s\rho)^n}{n!} + \frac{(s\rho)^s}{s!(1-\rho)}\right]^{-1}$

The probability of having n customers in the bank:

$P_n = P_0\rho^n$

The average number of customers in the bank:

$L_s = L_q + \frac{\lambda}{\mu}$

The average number of customers in the queue:

$L_q = P_s \frac{\rho}{(1-\rho)^2}$

The average waiting time in the queue:

$W_q = \frac{L_q}{\lambda} = P_s \frac{1}{s\mu(1-\rho)^2}$

The average time spent in the bank, including the waiting time:

$W_s = \frac{L_s}{\lambda} = W_q + \frac{1}{\mu}$

III. Method

Data for this study were collected from XYZ Bank. The methods employed during data collection were direct observation and personal interview and questionnaire administering by the researcher. Data were collected for (4) weeks. The following assumptions were made for queuing system which is in accordance with the queue theory. They are:

1. Arrivals follow a Poisson probability distribution at an average rate of λ customers per unit of time.
2. The queue discipline is First-Come, First-Served (FCFS) basis by any of the servers. There is no priority classification for any arrival.
3. Service times are distributed exponentially, with an average of μ customers per unit of time.
4. There is no limit to the number of the queue (infinite).
5. The service providers are working at their full capacity.
6. The average arrival rate is greater than average service rate.
7. Servers here represent cash transactors.
8. Service rate is independent of line length; service providers do not go faster because the line is longer.

IV. Introducing Costs

In order to evaluate and determine the optimum number of servers in the system, two opposing costs must be considered in making these decisions: (i) Service costs (ii) Waiting time costs of customers. Economic analysis of these costs helps the management to make a trade-off between the increased costs of providing better serviceand the decreased waiting time costs of customers derived from providing that service

Expected Service Cost $E(SC) = SC_s$ (1)

Where, S= number of servers, C_S= service cost of each server

Expected Waiting Costs in the System $E(WC) = (\lambda W_S)C_W$ (2)

Where λ =number of arrivals, W_S = Average time an arrival spends in the system

C_W = Opportunity cost of waiting by customers.

Adding (1) and (2) we have,

Expected Total Costs E (TC) = E (SC) + E (WC) (3)

Expected Total Costs E(TC) = $SC_S + (\lambda W_S)$.

V. Analysis Of Data

The XYZ Bank had two tellers. The first teller handled only withdrawals and the second one handled only deposits. Service time distribution for both withdrawers and depositors was μ = 3 minutes/customer.

The arrival rate for the depositors was λ = 16/hour and that for the withdrawers was λ = 14/hour. We have assumed the opportunity cost of waiting by customers as Rs.1.5 per minute or Rs. 90/hour

Performance Measures	For withdrawers (per hour)	For depositors (per hour)
Arrival rate (λ)	14 customers	16 customers
Service rate(μ)	20 customers	20 customers
E(Service Cost)	Rs.500	Rs.500
E(Waiting Cost)	Rs.215	Rs.360
E(Total Cost)	Rs.715	Rs.860
E(GrandTotal)	Rs.1575	

If both the tellers handle deposits as well as withdrawals, the following results are obtained using M/M/s model:

Performance Measures	s=2
Arrival rate (λ)	30 customers
Service rate(μ)	20 customers
E(Service Cost)	Rs.1000
E(Waiting Cost)	Rs. 307
E(Total Cost)	Rs.1307

VI. Discussion Of Result

The results show that optimal server level is achieved when both the tellers handle deposits as well as withdrawals with a minimum total cost of Rs.1307 per hour against the present total cost of Rs.1575 per hour.

VII. Conclusion

The queuing characteristics at the XYZ bank were analyzed using a Multi-server queuing Model and the Waiting and service Costs were determined with a view to determining the optimal service level. The results of the analysis showed that average queue length, waiting time of customers as well as total cost could be reduced when both the tellers in the bank handle deposits as well as withdrawals. The operation managers can recognize the trade-off that must take place between the cost of providing good service and the cost of customers waiting time. Service cost increases as a firm attempts to raise its level of service. As service improves, the cost of time spent waiting on the line decreases. This could be done by expanding the service facilities or using models that consider cost optimization.

References

[1]. Kembe, M. M, Onah, E. S, Iorkegh, S ; A Study of Waiting And Service Costs of A Multi-Server Queuing Model In A Specialist Hospital; International Journal of Scientific & Technology Research; Volume 1, Issue 8(2012)

[2]. Mohammad Shyfur Rahman chowdhury, Mohammad Toufiqur Rahman and Mohammad Rokibul Kabir; Solving Of Waiting Lines Models in the Bank Using Queuing Theory Model the Practice Case: Islami Bank Bangladesh Limited, Chawkbazar Branch, Chittagong; IOSR Journal of Business and Management; Volume 10, Issue 1 (2013)

[3]. Ajay Kumar Sharma, Dr.Rajiv Kumar, Dr.Girish Kumar Sharma; Queuing theory approach with Queuing Mode; International Journal of Engineering Science Invention; Volume 2, Issue 2(2013)

[4]. M.E. El-Naggar; Application of Queuing Theory to the container terminal at Alexandria seaport; Journal of Soil Science and Environmental Management; Volume 1, Issue 4 (2010)

[5]. Operations Research – Theory and Application by J.K.Sharma, Macmillan Publishers, 2013 Edition, Page;559-61