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Quality Improvement of Service Industry Using Waiting Line Model for Selected Banks in Bangalore

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Abstract

Banking is one of the major financial service sector for investment based transactions. Customers are relied upon on banks for their various monetary and non-monetary transactions. The present study is designed to understand banking performance towards its services and its impact on customer satisfaction. Waiting lines in banks are one of the major challenge for the bank. The objective of this study is to estimate the performance of banking services by using the stochastic waiting line model and to analyse the gap between expected time and actual waiting time. In order to analyse the banking performance using a predictive analytic technique called queuing theory has been used to measure the performance of services offered by ICICI and Kotak Mahindra bank. Queuing theory examines the waiting line , the arrival process, and service process, number of customers etc.In this study, two private banks namely Kotak Mahindra bank and ICICI bank used to analyse the waiting line performance. According to the analysis the total expected time is more in ICICI bank when compared with Kotak Mahindra bank.

It is observed that number of customers arriving in a day for banking services is more in Kotak Mahindra bank than ICICI bank because ICICI bank has digitally updated many of its E – services as compared to Kotak Mahindra bank. So the theory of waiting line helps to analyse the average total expected time of a customer in a bank with which banks can improve its performance.

Keywords: Queuing theory, Simulation, M/M/S Model, Waiting time, Arrival and service rate

1. INTRODUCTION

The Indian economy is emerging as one of the resilient economy of the world with the GDP growth of more than 8 % every year. A bank is the financial institution who lends money to individuals and businesses. A strong financial industry is important in every country and can have a significant affect in supporting economic development through efficient financial services. Banking sector plays a crucial role in growth and development of Indian economy.

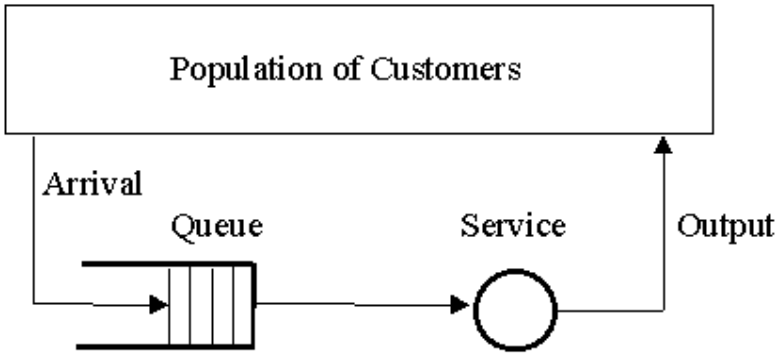
The financial banking sector aims to maximize profit, reduce cost and to satisfy customers optimally. Many business banks have done extraordinary exertion to build the administration

effectiveness and consumer loyalty however the majority of them are confronting a difficult issue of waiting line of clients/customers. In banks, the waiting line of customers may cause due to low efficiency of the system which may lead to low service rate.

Customers waiting for baking services has become a main issue. Queuing theory is one of the efficient and successful tool in analysing the waiting lines. Queuing theory is basically a mathematical approach applied to the analysis of waiting lines. It uses models to represent the various types of queuing systems. Queuing is one of the technique for maximizing the profit and minimizing the cost in order to reduce the waiting time of customers.

ELEMENTS OF QUEUING SYSTEM

To describe a queuing system, an input process and an output process must be specified.



Population of customers can be considered as unlimited number of people who arrive to avail the banking services.
Arrival defines the way customers enter into the process. Arrivals mostly are in random intervals.
Queue represents the number of customers waiting in line for the services. Waiting line is also known as Queue.
Service is the duration of time that takes place to server the customer needs. Service rate depends on the number of service stations available in an organisation. Systems with one server is called Single channel systems and systems with more serves are called Multi channel systems.
Output represents the way customers leave the system. Output is mostly ignored by theoretical models, but sometimes the customers leaving the server enter the queue again.

2. Literature Review

According to Muhammad Sani Burodo (2019), Queuing theory can improve the efficiency of banking services. Queuing model has become one of the most successful tool in operations research. The study focused on improving the efficiency in the Nigerian Banking system where the customers traffic is in huge number and the bank is always overcrowded. The service providers in Nigerian bank were unable to serve the customers with patience due to heavy work load which lead to poor service quality. Even after the emerge of ATM's the quality of banking system did not improve due to frauds. Hence, the analysis is being done on one of the most widely used quantitative analysis techniques – The theory of waiting lines. It focuses mainly on having a structured operation or a pattern to have a smooth service delivery in any situation. The study analyses the gap between the actual waiting time and expected waiting time and suggests to focus on having more servers to reduce the queues or waiting lines. Analysis is being done by using single server and multi-server model. It believes in multiple server model and has proved that queuing is a successful tool in analysing the waiting lines.

Suhel Ahmed, Md.and Iqbal Hossain Moral (2018),briefs an overview of current situation of banking service industry, which focuses on queues of waiting customers in front of banks. The purpose of this paper is to discover not just the typical measure of time a client needs to spend in a line at the bank's ATM, yet in addition the actual time required by the bank organization staff for providing the service. The study mainly focused on Bangladesh Banks as most of the banks in Bangladesh do not have office space and capabilities to serve the customer needs. In order to gain high productivity of banks it need to address the customer waiting line issues. As main goal they considered three characteristics of a queuing system-The arrival, Waiting line and The administration office. As there are two major methods of solving a queuing problem; mathematical model and simulation model. This research paper has used mathematical method of queuing to obtain approximate distributions for arrival and service. Queuing discipline was assumed to be first-come-first-serve (FIFO). The main objective of the paper is to optimize and reduce the service time. The paper concluded that the banks had to focus more on creating theoretical and practical guidelines for service quality and to improve customer satisfaction.

In Nityangini Jhala, Pravin Bhathawala (2017) view,today Queues are common in places like petrol filling stations, banks, super markets, hospitals, parking so on. The challenges are to have efficient queue management and to optimize the total cost. The study focused mainly on analysing two parameters (1) To find out the service rate of checking out by customers (2) To find out the gap between the customer arrival time. Data is being analysed through observation and questionnaire based on the Queuing assumptions. It briefs about the comparison study of single queue multi server and multi queue multi server queuing models and suggests to increase the number of servers in order to improve the customer service. It is proved that expected total cost is less in case of single queue multi server as compared to multi queue multi server model.

This study focuses on how one can overcome the waiting time in long queues in the airports. Air traffic has become more due to fluctuations of demand based on time and security. Mismatch between the departure schedule timings and overlapping of passenger arrivals lead to waiting time in airports. It stated that application of queuing theory can increase the service efficiency and customer satisfaction by reducing queuing length and actual waiting time. They used M/M/1 queuing model by considering few assumptions to analyse the data in different waiting phases of customers in the airport. Queuing discipline was assumed to be first-come-first-serve (FIFO) and they followed a Poisson probability distribution for the arrivals. They proposed queuing model based on three phases namely- Web check-in with baggage, Web security and mobile barcoding for boarding. The paper measured the performance in airports and to reduce the waiting time of passengers using the queuing model.

The applicability of queueing theory in a fast food restaurant was introduced by SeighaGumus, Gordon Monday Bubou, Mobolaji Humphrey Oladeinde (2017). It aims to reduce customers waiting time by queueing model. The study is done in Blue Meadows restaurant in the university of Benin which is one of the famous fast food restaurant. The customers who arrive at the restaurant experiences the delay in the service especially in peak hours. In order to manage the customer service and to improve the restaurant efficiency, this paper intended to show the numerical model using queuing theory in real case scenario. It briefs about the queuing characteristics to analyse the process. All the methodologies used like Chi square goodness of fit, M/M/s models help the restaurant in improving the service quality. Based on the analysis the restaurant has anticipated the number of customers arrive in a day in order to set the profit that should be achieved on daily basis.

Development of technologies such as android application and their role in enabling organizations transforming from their traditional methods of lining up of customers inside the banks are mentioned in Leena Bashier Eltayeb Bashier, Dr.Mohamed Abaker Hussein(2016).They developed android application in order to make customers convenient via mobile phones and internet banking without waiting in queues at banks for long hours. Mobile banking helps customers by allowing them to do financial transactions safely through a mobile device due to which banking services through internet banking is becoming user friendly. They stated that android application based services have the capability of satisfying customers by lowest costs using mobile applications. It manages the waiting time successfully. The study focused on limiting the number of customers waiting in lines to get served by banks. Virtual queuing model has been used in order to save the customers waiting time in banks. They designed a mobile based app named Q manager which helps the customers to book their queue number according to their convenient time. Q manager app provided good results by satisfying the customers.

Mathematical models for super market services is discussed byS. Vijay Prasad and V.H. Badshah (2014).It focuses on mathematical models for super market services. The paper analyses the impact of checkout waiting lines in super markets will increase the cost and also impacts the business as customers will not be willing to experience the service delay. It tries to reduce or minimize the waiting cost of the customers. It proves that by applying these queuing models in the markets we can decrease loss of high quality and potential clients. The paper proved that single queue – multi server model is better than multi queue – multi server model by deriving the mathematical equations for effective service management in supermarkets.

How queuing theory helps in improving the efficiency and performance of multi stage production lines is discussed by Muhammad Marsudi, Hani Shafeek (2014).The purpose of Queuing theory in manufacturing industries is to manage the assembly process in manufacturing plant by using analytical model of queuing theory. The paper focused on maintaining the efficient resource plan. They examined the performance of production line by using the developed queuing model in order to achieve the improvement of production line. They used this model with real life data to get better productivity by analysing the production system. They compared the results with standard data in the company which was 93.80%.
Main focus of H. R. Bakari, H. A. Chamalwa and A. M. Baba (2014)was on evaluating the customers' satisfaction on banking services and ATM. Customers do not like to wait in lines for long hours. Waiting time increases the cost of the management and reduces customer demand and revenues of the company. They believed that by applying queuing model it is easy to minimize the length of the waiting time in service facility. Queuing theory is extensively used to analyse production and service process. The study examined the performance characteristics on queuing models. The results showed the p value with 0.96 indicating that there is an effective or high utilization of bank systems.

Optimization queuing model helps many commercial banks which are suffering from a serious problem of waiting line of customers as stated by Toshiba Sheikh, Sanjay Kumar Singh, Anil Kumar (2013). Most of them are facing the problem of customer queuing which led to low service rate. The challenge is to increase the efficiency in service and customer satisfaction in banking services. It briefs about the optimization techniques of number of service stations, and service rates and proves that the model is feasible and effective.

Banking and its major practices have been discussed by Eze, Everestus Obinwanne, where he analyses the main problem of banking services. In this paper it clearly mentions how a banking performance can be measured using one of the mathematical operational model. Predicting the number of customers arrivals and the demand for banking services is very important to have optimum utilization of banking resources. In order to improve and to know the performance of banks in Nigeria, the methodology used in this study is about queuing theory which is one of the best used mathematical technique in operations research. It concludes that multiple server systems will help in managing the queues as customers will be moving to different servers according to their requirements.

3.Statement of the problem

Customer satisfaction plays major role in service industry. In banking services, customers always try to minimize their cost and expects minimum reasonable time to complete their process. In most service based enterprises like banks, waiting lines, poor service patterns are common features due to which customers are dissatisfied.

Customer experience has a direct impact on banking profitability, if customers are disappointed by service system, there is a possibility of customers switching to competitors' banks. Many customers go to banks to complete the process in a particular time period, but finally end up with incredible amount of time due to waiting lines. Even though banks have multiple servers they face the problem of long queues. Thus, this research aims at using queuing model to determine the extent of time a customer waiting for the banking services and the gap between expected and actual waiting time.

4. Objectives of the study

- To estimate the performance of banking services by using the stochastic waiting line model
- To ascertain the amount of customers in a waiting line and walk away from the bank due to service delays
- To analyse the gap between expected time and actual waiting time

5. Methodology

The process used to collect the information and the analysis is described in this section. Primary data is collected from the selected banks in Bangalore. The research is quantitative in nature. The research is undertaken to find out the number of customers arriving to the bank and the service rate in different servers. Quantitative research approach is to quantify the data and generalize the results. Data collection is in structured form. The arrival of customers and the services provided by banks is been collected and analysed using queuing theory to find out the average time of customers liking to wait in banks for the service to complete.

The methodology includes direct observation and the information is gathered from daily records of two private banks. Non – probability sampling, Convenience sampling has been used to collect data from the bank. The target group consists of all the customers who arrive at bank for banking services (Bangalore). Data is directly collected by personal observation and by daily records maintained by banks. This data helped to identify the average expected waiting time of customers in banks. Queuing model is being used to analyse the difference

between actual and expected waiting time of banking customers. Simulation model is used to simulate the number of arrivals of customers for the next week

The proposed Queuing model : Multi-server (M/M/S Model)

Tables and Bar charts are used to represent the data visually to compare the average arrival and service.

The research focuses on analysing the waiting lines at banks using queuing model. A week data of arrival and service is collected from two major banks, ICICI Private Limited and Kotak Mahindra Bank to examine the waiting lines of customers in Bangalore. The analysis is made on customer's arrivals and service rates based on specific time Frame.

H0: Remodelling customer administration using waiting line model could not considerably improve the quality of services offered by banks

H1: Remodelling customer administration using waiting line model could considerably improve the quality of services offered by banks

6. Limitations of the study

- This study is limited to only two private banks ICICI Private Limited and Kotak Mahindra in Bangalore, Karnataka.
- The study is limited to only three servers.

7.Discussion and Analysis

The research method used is quantitative approach. The data is gathered from both the banks is being used to apply the queuing technique. Data is collected for five days from Monday to Friday (10th November, 2019 to 16th November, 2019)

Queuing model

Kotak Mahindra bank

Table 1 : Analysis of Queuing system

Average						
	Server One		Server Two		Server Three	
	Arrival	Service	Arrival	Service	Arrival	Service
Monday	9.4	10.6	9	10.6	7.8	9.2
Tuesday	15	17.2	7.4	8.2	4.4	5.2
Wednesday	17.6	19	9.8	10.8	8.6	9.2
Thursday	11.2	12	8.4	9.8	6.2	7
Friday	10.6	12.4	8.4	10.6	7	8.6
Total	63.8	71.2	43	50	34	39.2

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QUEUEING OUTPUT ANALYSIS

Title: Queuing Kotak
Comparative Analysis

Scenario	c	Lambda	Mu	L'da eff	p0	Ls	Lq	Ws	Wq
1	1	63.80000	71.20000	63.80000	0.10393	8.62162	7.72555	0.13514	0.12109
2	1	43.00000	50.00000	43.00000	0.14000	6.14286	5.28286	0.14286	0.12286
3	1	34.00000	39.20000	34.00000	0.13265	6.53846	5.67111	0.19231	0.16680

Queuing model notation:

λ: mean arrival rate

μ : mean service

Ls : average number of customers in the system (waiting or being served)
Lq: average number of customers waiting in the queue
Ws : average time customers spend in the system
Wq:average time customers wait in the queue
ρ : system utilization
P0: The probability that there are zero customers in the system
The value of ρ is been ascertained from each server by using μ and ƛ

Server 1	**Server 2**	**Server 3**
0.896067416	1.655814	0.86

Average time spent in the system : ***Ws = Ls/ ƛ = 1/μ-ƛ***

Server 1	**Server 2**	**Server 3**
0.13514hours	0.14286 hours	0.19231 hours
8.1084 minutes	8.5716 minutes	11.5386 minutes

The average total unit time spent is = (8.1084+8.5716+11.5386) / 3
= 9.4062
Hence, the total expected time of a customer in a bank is 9.4062 minutes.

Interpretation :
It shows that the value of power (ρ) for each server using **μ** and **ƛ** with 0.896067416 in server one, 1.655814 in server two and 0.86 in server three. The average time spent in the system in hours and minutes for each server with 8.1084 minutes in server one, 8.5716 minutes with server two and 11.5386 minutes in server three. As per the analysis the total expected time of a customer in Kotak Mahindra bank is 9.4062 minutes. This is the maximum time that a customer is expected to be served by the bank.

Table 2 :Forecasting of values for next five days using queuing simulation

Server 1							
Inter arrival time	Frequency	Cumulative frequency	Cumulative probability	Cumulative probability *100	Random number interval	random number	simulated value
1	47	47	0.1473	14.7335	0-15	34	75
2	75	122	0.3824	38.2445	16-39	74	56
3	88	210	0.6583	65.8307	40-66	63	88
4	56	266	0.8338	83.3855	67-85	22	75
5	53	319	1	100	85-100	82	56

Server 2							
Inter arrival time	Frequency	Cumulative frequency	Cumulative probability	Cumulative probability *100	Random number interval	random number	simulated value
1	45	45	0.2093	20.9302	0-20	21	37
2	37	82	0.3813	38.1395	21-40	83	42
3	49	131	0.6093	60.9302	41-61	16	45
4	42	173	0.8046	80.4651	62-80	15	45
5	42	215	1	100	81-100	60	42

Server 3							
Inter arrival time	Frequency	Cumulative frequency	Cumulative probability	Cumulative probability *100	Random number interval	random number	simulated value
1	39	39	0.2294	22.9411	0-23	43	43
2	22	61	0.3588	35.8823	24-36	73	31
3	43	104	0.6117	61.1764	37-62	87	35
4	31	135	0.7941	79.4117	63-80	45	43
5	35	170	1	100	81-100	60	43

In the above table we have generated the random numbers based on the collected frequency in order to simulate the number of arrivals of customers to the bank. For each server we have simulated the customer arrivals using random number interval.

ICICI bank

Table 3 : Analysis of Queuing system

Average						
	Server One		Server Two		Server Three	
	Arrival	Service	Arrival	Service	Arrival	Service
Monday	9.6	11	9.8	11	8.8	9.6
Tuesday	13	14	8.8	10.2	7	7.6
Wednesday	18.4	19.4	11.4	11.8	9.2	9.6
Thursday	11.6	12.6	8.8	11.2	7	7.8
Friday	11.2	12.6	10.2	11.2	8.6	9.2
Total	63.8	69.6	49	55.4	40.6	43.8

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QUEUEING OUTPUT ANALYSIS

Title: Queuing ICICI
Comparative Analysis

Scenario	c	Lambda	Mu	L'da eff	p0	Ls	Lq	Ws	Wq
1	1	63.80000	69.60000	63.80000	0.08333	11.00000	10.08333	0.17241	0.15805
2	1	49.00000	55.40000	49.00000	0.11552	7.65625	6.77177	0.15625	0.13820
3	1	40.60000	43.80000	40.60000	0.07306	12.68750	11.76056	0.31250	0.28967

Server 1	**Server 2**	**Server 3**
0.916667	1.420408	0.884477

Average time spent in the system : $Ws = Ls/ \lambda = 1/\mu-\lambda$

Server 1	**Server 2**	**Server 3**
0.17241 hours	0.15625 hours	0.3125 hours
10.3446 minutes	9.375 minutes	18.75 minutes

The average total unit time spent is = (10.3446+9.375+18.75) / 3
= 12.8232
Hence, the total expected time of a customer in a bank is 12.8232 minutes.

Interpretation :
It shows the value of power (ρ) for each server using μ and λ where server one is 0.916667, server two is 1.420408 and server three is 0.884477. The average time spent in the system in server one is 10.3446 minutes, in server two it is 9.375 minutes and in server three it is 18.75 minutes. As per the analysis, the total expected time of a customer in ICICI bank is 12.8232 minutes. This is the maximum time that a customer is expected to be served by the bank.
Hence, ICICI and Kotak Mahindra bank can improve its performance to satisfy the customers who arrive for banking services.

Table 4 :Forecasting of values for next five days using queuing simulation

Server 1							
Inter arrival time	Frequency	Cumulative frequency	Cumulative probability	Cumulative probability *100	Random number interval	random number	simulated value
1	48	48	0.1504	15.0470	0-15	82	58
2	65	113	0.3542	35.4231	16-35	56	92
3	92	205	0.6426	64.2633	36-65	34	65
4	58	263	0.8244	82.4451	66-83	85	56
5	56	319	1	100	84-100	32	92

Server 2							
Inter arrival time	Frequency	Cumulative frequency	Cumulative probability	Cumulative probability *100	Random number interval	random number	simulated value
1	49	49	0.2	20	0-20	30	44
2	44	93	0.3795	37.9591	21-38	99	51
3	57	150	0.6122	61.2244	39-62	84	51
4	44	194	0.7918	79.1836	63-80	77	44
5	51	245	1	100	81-100	35	44

Server 3							
Inter arrival time	Frequency	Cumulative frequency	Cumulative probability	Cumulative probability *100	Random number interval	random number	simulated value
1	44	44	0.2167	21.6748	0-22	35	35
2	35	79	0.3891	38.9162	23-39	21	44
3	46	125	0.6157	61.5763	40-62	42	46
4	35	160	0.7881	78.8177	63-79	36	35
5	43	203	1	100	80-100	89	43

In the above table we have generated the random numbers based on the collected frequency in order to simulate the number of arrivals of customers to the bank. For each server we have simulated the customer arrivals using random number interval.

8. CONCLUSION

Waiting lines in queue is one of the issue particularly in banks. In order to maintain the service quality and customer satisfaction banks should handle the customer waiting times properly to avoid the waiting costs. Queuing is one of the mathematical technique and a quantitative approach which helps in analysing the waiting lines using various parameters of queuing and also reduces the waiting costs.

The analysis of both banks brings us the average waiting time of customers using (WS). For Kotak Mahindra bank the average time a customer can spent is 9.4062 minutes and for ICICI private limited bank the average time a customer can spent is 12.8232 minutes. It is observed that the customer's arrival is more in Kotak Mahindra bank. In order to optimize the operations over the waiting line the serving time can be improved.

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