ISSN : 2347 - 8446 (Online)
ISSN : 2347 - 9817 (Print)
Vol. 2, Issue 2, Ver. 3 (April - June 2014)
International Journal of Advanced Research in Computer Science & Technology (IJARCST 2014)

Application of Queuing Theory to The Congestion Problem in Banking Sector (A Case Study of First Bank PLC. ILORIN)

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Abstract
This research application of queuing theory to the congestion problem in banking sector was aimed to ascertain the efficiency in the banking sector. The data for this research is obtained from First Bank of Nig eria, Ilorin branch. Due to the operations of the bank that is multiple queue multiple services, multiple queue theory was used to analyze the data with help of TORA software. The result of the analysis indicate that utilization factor is 0.2763. which implies that the service is efficient and that the arrival does not follow a poison distribution. It was therefore recommend that First Bank of Nigeria should maintain their services in order to maintain there standard and that there should be a standby server in case the utilization factor increases.

Keywords
Application ,Efficiency, queue ,Multiple, Bank

I. Introduction

A queuing process is characterized by the arrival of units which requires service at one or more service facilities. The units demanding service may be people, machines or other elements. Whatever is the nature of the units demanding service they are called customers[2],[4]. The services offered are provided by the servers, the servers can be machine or persons[1]. Furthermore, both the arrival patterns and service patterns are often not deterministic. Thus in most queuing processes, either some customer have to wait in order to obtain service or the servers are idle waiting for customers to arrive. Both type of waiting are costly. The problem is to strike a balance between both types of costs. Queuing theory deals with the development and analysis of mathematical models of queuing processes[3],[5]. The aim is to provide information on the behaviour of queuing system. A queuing system is defines to include the waiting time or (queue) and the service facilities (or channels). In this research, we shall consider different ways of which we can use the multiple queuing models.

II. Methodology

Multiple Channel Service System

Arrival rate = λ
Service rate = μ

i. The utilization factor

$$\rho_k = \frac{\lambda}{k\mu}$$

ii. The average idle time

$$\rho_0 = \frac{1}{\sum_{n=0}^{k-1}\left[\frac{1}{n!}\left[\frac{\lambda}{\mu}\right]^n + \frac{1}{k!}\left[\frac{\lambda}{\mu}\right]^k\left[\frac{k\mu}{k\mu-\lambda}\right]\right]}$$

iii. Expected number of customers in the system

$$E(n) = \frac{\lambda\mu\left[\frac{\lambda}{\mu}\right]^2\rho_0}{(k-1)!(k\mu-\lambda)^2} + \frac{\lambda}{\mu}$$

iv. Expected number of customer waiting to be served

$$E(q) = E(n) - \frac{\lambda}{\mu}$$

v. Expected time a customer spends in the system

$$E(ts) = \frac{E(n)}{\lambda}$$

vi. Expected waiting time

$$E(tq) = \frac{E(q)}{\lambda}$$

vii. Total time spent each week

$$\rho_k = \frac{\lambda}{k\mu}$$

viii. Probability that an arrival has to wait p ($n \geq k$).

$$p(n \geq k) = \frac{\mu\left[\frac{\lambda}{\mu}\right]^k}{(k-1)!(k\mu-\lambda)} * p_0$$

ISSN : 2347 - 8446 (Online)
ISSN : 2347 - 9817 (Print)

III. Presentation of Data Obtained

Table 1: Data collected on monday january 6th 2014 between 8:00am to 10:40am at the banking hall as an arrival of customer

	Time interval		First service point	Second service point	Total
S/No	10 Minutes Interval	Fre	Freq	Freq	Total Freq
1	8:00-8:10am	20	7	12	19
2	8:10-8:20am	16	8	7	15
3	8:20-8:30am	20	10	9	19
4	8:30-8:40am	22	12	9	21
5	8:40-8:50am	20	8	12	20
6	8:50-9:00am	15	5	10	15
7	9:00-9:10am	18	9	8	17
8	9:10-9:20am	14	7	6	13
9	9:20-9:30am	15	7	7	14
10	9:30-9:40am	9	4	5	9
11	9:40-9:50am	10	4	5	9
12	9:50-10:00am	12	6	5	11
13	10:00-10:10am	11	6	5	11
14	10:10-10:20am	8	4	4	8
15	10:20-10:30am	11	6	4	10
16	10:30-10:40am	10	4	5	9
Total		231			220

Table 2: Data collected on monday january 6th 2014 between 8:00am to 10:40am at the banking hall as an arrival of customer

	Time interval		Third service point	Fourth service point	Total
S/No	10 Minutes Interval	Fre	Freq	Freq	Total Freq
1	8:00-8:10am	16	9	7	16
2	8:10-8:20am	12	7	5	12
3	8:20-8:30am	22	10	11	21
4	8:30-8:40am	18	8	10	18
5	8:40-8:50am	8	4	4	8
6	8:50-9:00am	11	5	6	11
7	9:00-9:10am	7	3	4	7
8	9:10-9:20am	18	9	9	18
9	9:20-9:30am	6	3	3	6
10	9:30-9:40am	5	2	3	5
11	9:40-9:50am	9	4	5	9
12	9:50-10:00am	12	6	6	12
13	10:00-10:10am	25	11	13	24
14	10:10-10:20am	16	9	7	16
15	10:20-10:30am	10	6	4	10
16	10:30-10:40am	14	7	7	14
Total		209			207

Table 3 : Data collected on monday january 13th 2014 between 8:00am to 10:40am at the banking hall as an arrival of customer

	Time interval		First service point	Second service point	Total
S/No	10 Minutes Interval	Fre	Freq	Freq	Total Freq
1	8:00-8:10am	15	8	7	15
2	8:10-8:20am	10	4	6	10
3	8:20-8:30am	14	7	7	14
4	8:30-8:40am	12	7	5	12
5	8:40-8:50am	10	6	4	10
6	8:50-9:00am	17	8	8	16
7	9:00-9:10am	12	5	7	12
8	9:10-9:20am	11	5	6	11
9	9:20-9:30am	16	8	8	16
10	9:30-9:40am	12	6	6	12
11	9:40-9:50am	11	5	6	11
12	9:50-10:00am	14	6	8	14
13	10:00-10:10am	19	7	11	18
14	10:10-10:20am	15	8	7	15
15	10:20-10:30am	10	6	4	10
16	10:30-10:40am	17	8	9	17
Total		215			213

Table 4: Data collected on monday january 13th 2014 between 8:00am to 10:40am at the banking hall as an arrival of customer

	Time interval		Third service point	Fourth service point	Total
S/No	10 Minutes Interval	Fre	Freq	Freq	Total Freq
1	8:00-8:10am	26	12	13	25
2	8:10-8:20am	18	10	8	18
3	8:20-8:30am	20	9	10	19
4	8:30-8:40am	14	7	7	14
5	8:40-8:50am	16	8	8	16
6	8:50-9:00am	18	10	8	18
7	9:00-9:10am	21	10	10	20
8	9:10-9:20am	26	13	12	25
9	9:20-9:30am	10	6	4	10
10	9:30-9:40am	13	7	6	13
11	9:40-9:50am	8	4	4	8
12	9:50-10:00am	10	4	6	10
13	10:00-10:10am	9	5	4	9
14	10:10-10:20am	9	4	5	9
15	10:20-10:30am	12	6	w6	12
16	10:30-10:40am	9	6	4	9
Total		239			235

Table 5:Data collected on monday january 20th 2014 between 8:00am to 10:40am at the banking hall as an arrival of customer

	Time interval		First service point	Second service point	Total
S/No	10 minutes interval	Fre	Freq	Freq	Total Freq
1	8:00-8:10am	10	5	4	9
2	8:10-8:20am	14	6	7	13
3	8:20-8:30am	18	8	9	17
4	8:30-8:40am	12	5	6	11
5	8:40-8:50am	16	8	7	15
6	8:50-9:00am	12	6	5	11
7	9:00-9:10am	20	10	9	19
8	9:10-9:20am	15	7	7	14

9	9:20-9:30am	10	6	4	10
10	9:30-9:40am	10	5	5	10
11	9:40-9:50am	13	7	6	13
12	9:50-10:00am	9	5	4	9
13	10:00-10:10am	8	4	4	8
14	10:10-10:20am	13	6	7	13
15	10:20-10:30am	9	5	4	9
16	10:30-10:40am	12	6	6	12
Total		201			193

Table 6:Data collected on monday january 20th 2014 between 8:00am to 10:40am at the banking hall as an arrival of customer

	Time interval		Third service point	Fourth service point	Total
S/No	10 minutes interval	Fre	Fre	Freq	Total Freq
1	8:00-8:10am	25	11	10	21
2	8:10-8:20am	15	7	7	14
3	8:20-8:30am	12	6	6	12
4	8:30-8:40am	18	9	7	16
5	8:40-8:50am	21	10	9	`9
6	8:50-9:00am	30	13	13	26
7	9:00-9:10am	24	12	12	24
8	9:10-9:20am	8	4	4	8
9	9:20-9:30am	10	6	4	10
10	9:30-9:40am	7	3	4	7
11	9:40-9:50am	5	2	3	5
12	9:50-10:00am	10	4	6	10
13	10:00-10:10am	9	5	4	9
14	10:10-10:20am	12	6	6	12
15	10:20-10:30am	11	5	6	11
16	10:30-10:40am	6	2	4	6
Total		224			210

Table 7: Data collected on monday january 27th 2014 between 8:00am to 10:40am at the banking hall as an arrival of customer

	Time interval		First service point	Second service point	Total
S/No	10 Minutes Interval	Freq	Freq	Freq	Total Freq
1	8:00-8:10am	20	8	8	16
2	8:10-8:20am	14	6	4	10
3	8:20-8:30am	26	12	10	22
4	8:30-8:40am	30	12	13	25
5	8:40-8:50am	22	10	7	18
6	8:50-9:00am	16	6	6	12
7	9:00-9:10am	20	8	8	16
8	9:10-9:20am	13	6	7	13
9	9:20-9:30am	10	4	6	10
10	9:30-9:40am	21	9	9	18
11	9:40-9:50am	7	3	4	7
12	9:50-10:00am	15	10	5	15
13	10:00-10:10am	6	3	3	6
14	10:10-10:20am	12	6	6	12
15	10:20-10:30am	5	2	3	5
16	10:30-10:40am	8	5	3	8
Total		245			213

Table 8: Data collected on monday january 27th 2014 between 8:00am to 10:40am at the banking hall as an arrival of customer

	Time interval		Third service point	Fourth service point	Total
S/No	10 minutes interval	Fre	Freq	Freq	Total Freq
1	8:00-8:10am	28	10	8	18
2	8:10-8:20am	22	8	8	16
3	8:20-8:30am	25	9	9	18
4	8:30-8:40am	30	10	10	20
5	8:40-8:50am	15	6	4	10
6	8:50-9:00am	10	2	3	5
7	9:00-9:10am	28	8	10	18
8	9:10-9:20am	14	5	4	9
9	9:20-9:30am	32	11	9	20
10	9:30-9:40am	16	6	5	11
11	9:40-9:50am	18	7	6	13
12	9:50-10:00am	26	8	7	15
13	10:00-10:10am	19	7	7	14
14	10:10-10:20am	10	6	4	10
15	10:20-10:30am	16	5	6	11
16	10:30-10:40am	11	3	3	6
Total		320			214

Table 9: Combine Data Obtained

Date	Time	Arrival freq.	Service freq.
6/01/2014	8:00-10:40am	231	220
9/01/2014	8:00-10:40am	209	207
13/01/2014	8:00-10:40am	215	213
16/01/2014	8:00-10:40am	239	235
20/01/2014	8:00-10:40am	201	193
23/01/2014	8:00-10:40am	224	210
27/01/2014	8:00-10:40am	245	213
30/01/2014	8:00-10:40am	320	214
TOTAL		1884	1705

Table 10: Result Obtained

	SYMBOL	RESULT
Mean arrival rate	λ	58.88
Mean service rate	μ	53.28
The utilization factor	ρ	0.2763
Expected number of customer in the system	Ls	3.59080 ≈ 4
Expected queuing length	Lq	4.8569
Expected time a customer spends in the system	Ws	0.0625 X 160=10minutes
Expected waiting time	Wq	0.02702 X 106=5minutes

ISSN : 2347 - 8446 (Online)
ISSN : 2347 - 9817 (Print)

IV. Conclusion

At any point in time four customer is on the line no queue is observed throughout the day, which means that the customer cannot complain of in efficient of the staff no customer stays too long not even delay before been served.The system is efficient since $\rho = 0.55255 < 1$ .Since E(n) i .e average number of customer in the system is equal to the number of channel in station (k) hence this agreed with the result above and conclude that there is no queue,the result indicate, an arrival does not wait too long before he/she is been served.

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