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The Average Time the Customers Spend in ECOBANK Bénin, Djassin Agency, during a Banking Transaction

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Abstract- In this paper, we deal with the waiting time of the customer in the queue, the duration of the operation in a bank and especially, if need be, the lost time, that everyone has with a teller, in ECOBANK Benin, Djassin agency. It is indeed a problem of waiting at a station and we have M/M/1 Model.

Keywords- *Queues in Bank,M/M/1 Model, Waiting Time*

I. Introduction

The phenomena of waiting are common in our daily life. People wait for serves and they form a queue called the waiting line. Hence, a proper discipline is maintained [1, 2, 3, 4, 5, 6].

In waiting lines theory one can do the statistical description of the behaviour of queues [1].

The queuing system consist of arriving units or using customers waiting for a service facility; thus, the queuing system is described by the arrival pattern, the service pattern, the queue discipline where customers are selected from a queue for service and the customer's behaviour [1, 2].

Here we study the time spent by customers during their operations in the Bank, especially, if need be, the lost time. It is a (open) queuing system [1, 2, 3, 7, 8, 9].

II. TERMINOLOGY, NOTATIONS, M/M/1 MODEL.

A. Terminology and Notations

The following terminology and notations will be used in the model formulation and calculations:

Arrival Process: Customers arrivals are controlled. The arrival process is random and described by the probability models. The probability distribution of the arrival process is derived [1, 6, 7].

Service: The service time process is described by probability and is random, excepted in special situations [1, 3, 4, 6,7].

λ: number of arrivals per unit time.

μ**:** number of customers served per unit of time.

L_S: average number of customers in the system.

W_t**:** waiting time of the tellers in the system.

W_q**:** average waiting time of customer in the queue.

W_s**:** waiting time of customers in the system.

FIFO: First In First Out.

B. M/M/1 Model, FIFO

For this model, customers arrive in a Poisson fashion at rate λ at a single service channel having exponential service time distribution with rate μ, while the customers are served on a FIFO basis.

The expected inter-arrival time is $\frac{1}{\lambda}$ and the expected service time is $\frac{1}{\mu}$ [3, 4, 7].

III. PROBLEM

For the operation in a bank at Djassin agency of ECOBANK Bénin, we determine the average number of customers in the system, the average waiting time of a customer in the queue, the waiting time of the customers during a day's work and the average waiting time of the tellers. It is a problem of waiting at a station.

IV. ARRIVAL PROCESS

During 100 intervals of 10 minutes, all located in the period of stationarity, the number of customers arriving during each ten-minute interval was counted.

The results are given in the followings table:

TABLE I. DATA I

Number of customers arriving for a period of 10 minutes	Observed frequencies : f_n
0	31
1	35
2	23
3	8
4	3
	Total:100

The average of this distribution law is λ t =1, 17.

We check if the observed law is close to a classical theoretical law, namely Poisson law.

The formula

$q_n(t) = \frac{(\lambda t)^n}{n!} e^{-\lambda t}$, with λ t = 1, 17 and $e^{-1,17} = 0.3104$ allows to calculate the theoretical frequencies of a Poisson's law of average 1, 17 arrivals / 10 min.

q_0= 0, 3104; q_1= 0, 3631; q_2=0,2124; q_3 = 0, 0828;

q_4= 1-($q_0 + q_1 + q_2$+q_3) = 0, 0313.

We use the Pearson's χ^2 test.

TABLE II. PEARSON χ^2 TEST WITH POISSON LAW.

N	Observed frequencies (f_n)	theoretical frequencies (f_{th})	| Δ|	Δ^2	$\frac{\Delta^2}{f_{th}}$
0	31	31,04	0,04	0,0016	0
1	35	36,31	1,31	1,7161	0.0472
2	23	21,24	1,76	3,0976	0.1458
3	8	8,28	0,28	0,0784	0,0094
4	3	3,13	0,13	0,0169	0,0053
					∑=0.2077 = χ^2 calculated

The number of degrees of freedom is 3.

Referring to a table of χ^2, we find for 3 degrees of freedom:

${\chi^2}_{0,95}$ = 0,352 [10].

As the calculated χ^2 is less than this value, the observed phenomenon follow a Poisson law with 95% confidence level. The customers arrive following Poisson process at average rate of $\lambda = \frac{1,17}{10}$ =0,117 arrivals per minute.

V. SERVICE DISTRIBUTION

One hundred times in the stationary period, we notice the time spent by customer to a service.

The results are given in the followings table:

TABLE III. DATA II

Service time	Number of observed services: s_n
< 1 min	58
From 1 to 2min	24
From 2 to 3 min	11
From 3 to 4 min	5
From 4 to 5 min	2

The average is 1, 19 minutes.

Therefore, the number of customers served per minute is: μ ≈ 0, 84

We take as a hypothesis that the law of services is an exponential law of density $0{,}84e^{-0{,}84t}$ and rate μ = 0,84.

We use once again the Pearson's χ^2 test.

TABLE IV. PEARSON χ^2 TEST WITH EXPONENTIAL LAW

n	Number of observed services (s_n)	Theoretical number of services (s_{th})	| Δ|	Δ^2	$\frac{\Delta^2}{s_{th}}$
0,5	58	55,1	2,9	8,41	0,152
1,5	24	23,8	0,2	0,04	0,001
2,5	11	10,2	0,8	0,64	0,062
3,5	5	4,4	0,6	0,36	0,081
4,5	2	1,9	0,1	0,01	0,005
					∑=0,301 = χ^2 calculated

The number of degrees of freedom is 3.

Referring [10] to a table of χ^2, we find for 3 degrees of freedom:

${\chi^2}_{0,95}$ = 0,352. As the calculated χ^2 is less than this value, the analyst decide to admit that he has an exponential law with rate μ = 0, 84.

VI. RESULTS AND DISCUSSION

The average number of customers in the system is L_s=0,161.

The average waiting time of a customer in the queue is $W_q = 0{,}191$ min. The waiting time of the customers during a day's work is W_s=10,726 min. The average waiting time of the tellers is $W_t = 1\text{h } 6{,}83$ min.

VII. CONCLUSION

In this paper, the study of our problem has shown us that the laws of arrivals and service are respectively, Poisson process and exponential distribution. In this branch of the ECOBANK Bank, the time lost by customers is negligible: the head of the Agency and its staff deserve our congratulations.

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