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SIMULATION MODEL SCHEDULING QUEUE IN TELLER BANK WITH MULTI CHANNEL – MULTI PHASE

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Abstract

Progress in improving communication and information, as well as the increasingly rapid development of the banking world, requires a customer service system capable of providing satisfying services to customers. One of the problems that often arise in banking customer service systems is customer queuing services which cause customers to wait too long to get service. Information alone is not enough if it cannot be managed to be the best alternative, therefore a simulation system for scheduling bank customer queues is used. The design of the queue simulation model is expected to provide Mega Padang bank management information and better service to customers, so that every input, process and output that occurs during model development and simulation can be seen. Therefore, the simulation is carried out using the discrete event method. The customer service system of Bank Mega Padang which produces services explains the effect and behavior of the observed system, in this case it provides information about the average customer waiting time, the average customer waiting time and the length of time that tellers are unemployed for a certain period. time. The results of the system design process from time to time can increase teller unemployment by as many as 65 Bank Mega Padang customers. This study maximizes service time to customers based on the duration of service provided by the teller so that there are no unemployed or unserved terllers. The research that was achieved for the management of Bank Mega Padang was that management did not need a teller due to a lot of time. idle cashier.

Keywords: Simulation, Model, Queue

INTRODUCTION

Along with the advancement of communication and information that is increasing, many people collect as much information as possible through the various media they have. But not everyone is able to manage this information properly so that it can be used at the right time efficiently and effectively.

The simulation concept is a tool to understand the problem to be solved. Designed to help solve problems related to systems that are operated naturally. Simulation begins with an understanding of the system and the development of the model. Modeling is the process of designing before coding. Modelers need sufficient knowledge of the system to be studied. Modeling a complex system is very important because we cannot understand such a system as a whole. In banking activities, this system can also be used. At certain hours, tellers who serve customers are unemployed (Idle), because there are no customers being served. But other times, many customers queue because almost all tellers are used by customers (in busy conditions). The emergence of time efficiency demands in completing transactions at banks is closely related to the queuing system, which includes the number of services the bank has. because customers are forced to wait

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in long queues, but if there are too many tellers unemployed (not busy) it will increase costs for management. Likewise, if too many customers queue, it will reduce excellent service. Customers who wait too long, of course, will look for other bank alternatives or cancel the transaction. Banks must provide tellers in the right number so that the bank's performance is more optimal. In other words, all tellers are used and the level of customer satisfaction is good. Based on the research background described, the authors identified 2 (two) problems faced based on the cases studied are how to design a model for scheduling simulation of Bank customer queues specifically for the value of teller service time to customer? and how the simulation results are useful to meet management needs in the form of accurate information in order to determine whether or not to add a teller to Bank Mega Padang.

Definition of Customer Queuing according to Gross and Haris (Gross, 2001) says that the queuing system is the arrival of customers to get service, waiting to be served if the service facility (server) is still busy, getting service and then leaving the system after being served. The queuing system is an important factor in the business world because it is a measure of whether or not the performance of business services is efficient. In this study, two types of queuing systems were analyzed: single-channel queues and multiplechannels, which are widely used in banks. The research was conducted by developing computer programs to simulate queuing systems and to predict queue lengths, waiting times, and queuing probabilities. The discrete-event method approach is used to model the queuing system, and to analyze the effects that will occur if a change in queuing system type is to be made. The simulation results show that a single-channel queuing system is more efficient than a multiple-channel system. Queue characteristics The basic component of the queuing process is A. Arrival, any queuing problem involves arrivals, for example people, cars, phone calls to be served, and others. This element is often called the input process. The input process includes the source of the arrival or what is usually called the calling population, and the way in which the arrivals occur, which is generally a random variable. According to Levin, et al (2002), a random variable is a variable whose value can be anything as a result of a randomized experiment. Random variables can be either discrete or continuous. If it is possible for a random variable to have only a few values, then it is a discrete random variable. Conversely, if the value is possible to vary over a certain range, it is known as a continuous random variable. A waiter, servant or service mechanism can consist of one or more servants, or one or more service facilities. Each service facility is sometimes referred to as a channel (Schroeder, 1997). For example, a toll road can have several toll booths. The service mechanism can only consist of one waiter in one service facility found at a counter such as ticket sales at the cinema building. C. Queue, the essence of queuing analysis is the queue itself.

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RESEARCH METHODS

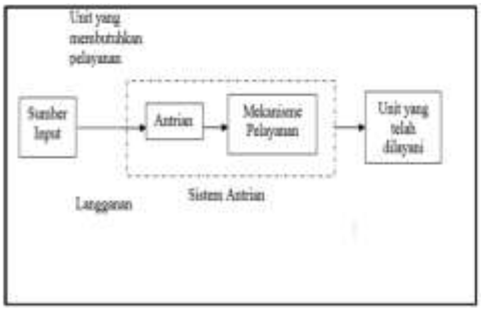

Figure 1. Standard Structure of the Antria Model

Queue Structure

There are 4 basic queuing structure models that are common but in all queuing systems:

1. Single Channel - Single Phase
Single Channel means that there is only one line entering the service system or there is one service facility. Single Phase means there is only one service.

Figure 2. Single Channel Model - Single Phase

2. Single Channel – Multi Phase
The term Multi Phase indicates that there are two or more services carried out sequentially (in phases). For example: car washes.

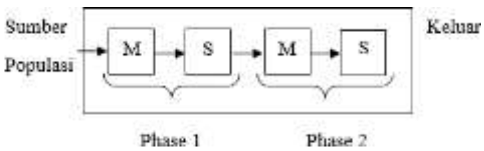

Figure 3. Single Channel – Multi Phase

3. Multi Channel – Single Phase
Multi Channel System - Single Phase occurs whenever there are two or more service facilities supplied by a single intermediary, for example this model is a queue at a bank teller.

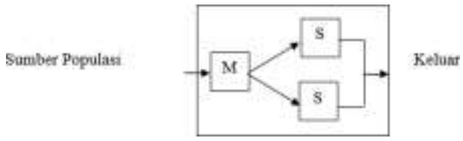

Figure 4. Multi Channel – Single Phase

4. Multi Channel – Multi Phase
For example, the registration of students at the university, services to patients in the hospital from registration, diagnosis, treatment to payment. Each of these systems has several service facilities at each stage.

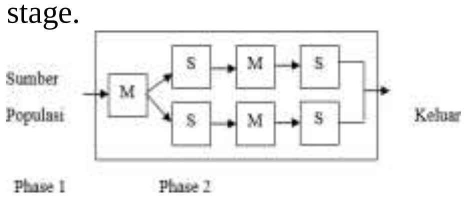

Figure 5. Multi Channel – Multi Phase

In an activity, various experiments or experiments are often carried out. According to Djauhari (1990), the experimental results will provide information about the problems being faced in these activities. These experiments have the following characteristics, Experimental results cannot be predicted in advance with a certain level of confidence. All possible results can be given. Experiments can be carried out repeatedly under the same conditions

Experiments that have these characteristics are called random experiments. Then, the

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set of all possible outcomes from a random experiment is called the sample space (Djauhari, 1990). Whereas events are subsets of the sample space (Djauhari, 1990: 4).

Probability theory studies the probability of a thing or event happening. Probability is expressed as a decimal fraction between 0 and 1. If the probability of an event is 0, it will not occur. Meanwhile, if an event has a probability of 1, then the event must occur. The probability of an event or event is one or more possible outcomes of an action. (Dimyati, et al, 1999)

A quick way to check if a data set is raw according to a particular theoretical distribution is to graphically compare the cumulative empirical distribution with the corresponding cumulative density function of the corresponding theoretical distribution. If the two functions do not show excessive deviation, there is a fairly high probability that the theoretical distribution fits the raw data. The Goodness of Fit test is a test conducted to determine the probability distribution of the data obtained by comparing frequencies theoretical or expected frequency (Guttman, 1982)

To use a simulation, the things that need to be done are, Determine the problem, Propose variables related to the problem, . Build a numerical model, Determine the sequence of possible actions for the experiment, Running the experiment considering the experimental results (modifying the model or changing the input).

RESULTS AND DISCUSSION

In grouping different queuing models a notation called Kendall notation will be used. This notation is often used for several reasons including, because it is an efficient tool to identify not only queuing models, but also assumptions that must be met (Subagyo, 2000). http://www.ekonomi.wima.ac.id/files/OR.doc General model equation:

(a / b / c); (d / e / f) (1).

some of the characteristics of the queuing system for the (M / M1) model; (FIFO / ∞ / ∞):

1. Traffic Intensity

$$\rho = \frac{\lambda}{\mu} \text{.....................................} (2)$$

referred to as traffic intensity, namely the quotient between the order rate and the rate of service. The higher the price, the longer the queue and vice versa.

The probability of a busy period from a queuing system with a single service is equal to the traffic intensity. Therefore, if f (b) is a function of the chance of the busy period.

Distribution of Opportunities from Subscriptions in the system

If there is a chance that the queue system is busy, then of course 1 - is the chance that the system is not busy at all times. This means that 1- is the opportunity for n subscriptions. For example Pn is an opportunity

there are n subscriptions in the queue, then for n = 0: Pn = 1 - …… (4) Because Pn = n. Pn, then:

Pn = n (1-) (5)

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is known :

P*n* = Opportunity in n subscriptions

n = Chance that the queue system is busy in *n* customer

Average number in the System

Let Ls be the average number of subscriptions in the queuing system, including both waiting and being served subscriptions.

$$Ls = \frac{\lambda^2}{\mu - \lambda} \quad Lq = \frac{\lambda^2}{\mu(\mu - \lambda)}$$

$$\frac{\rho}{1-\rho} - \frac{\rho^2}{1-\rho} = \rho$$

Average time a customer spends waiting in a queue to be served

$$Wq = \frac{\lambda^2}{\mu(\mu - \lambda)}$$

Tabel 1. Laporan penjadwalan antrian nasabah

Customer	Arrival Time In Teller
1	8:00:00
2	8:01:00
3	8:01:02
4	8:04:10
5	8:06:25
6	8:08:13
7	8:10:23
8	8:12:14
9	8:14:30

From the form of the report above, it is difficult to obtain precise scheduling of customer queues, due to the incomplete form of the reports provided, and there are no supporting variables in modeling and simulation. For example, in the time served column, customers are only stated time of arrival, without clearly specifying how many start to be served, waiting time, length of service and time at the bank, so it is not known when tellers are unemployed it is difficult to determine.

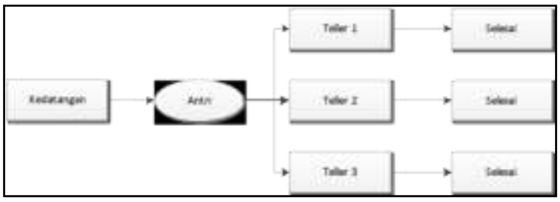

Figure 6. Queuing System at Bank Mega Padang

In general, the queuing system for teller transactions at Bank Mega Padang can be explained as follows.

1. Has 3 tellers, because there are 3 counters that serve customer transactions.

2. Unlimited queue capacity.

3. The queuing system uses FIFO queuing discipline (first in first out).

4. When customers arrive, the time of arrival of customers is calculated (customers enter the queuing system).

5. After the customer enters the queue room, the customer forms a queue or waiting line. The customer waits until the teller calls to make a transaction at the teller

6. The next stage is the transaction process. At this stage, it is noted the time it takes for a teller to serve each customer.

7. After the transaction process is complete, the customer leaves the bank. Based on observations made by the

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queuing system on teller transactions at Bank Mega Padang.

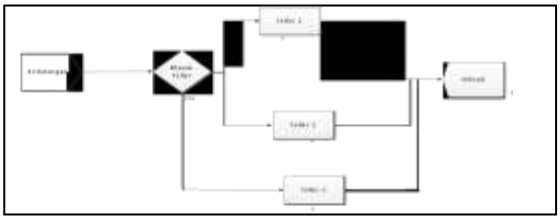

Figure 7. Simulation Model Flowchart

Based on the flow diagram of the teller queue simulation model, it is obtained:

1. Queue simulation model procedure

a. The first step in making a queue model simulation is using the create module. This module is used as a starting point for the entry of entities in the simulation model. The entity in this simulation model is the customer who will make transactions. The attributes in this create module are as follows: Name: Arrival, Entity Type:

Customer

b. The second step is to use the decide module, this module considers the decisions that will be taken in the system

c. The third step is the process module, where the main process in the simulation occurs. There are 3 processes in this simulation model, because the number of servants in the system consists of 3 counters.

d. The final step is to use the Dispose module, this module is used as the end point of the entity in the simulation model. Attributes in this dispose module are as follows: Name: Done, Record Entity Statistics: Yes

Data on the number of customers and time of arrival can be seen in Table 2 as follows:

Nasabah	Waktu Kedatangan		Waktu Mulai Dilayani	
Ke	di Teller	Teller 1	Teller 2	Teller 3
1	8:00:00	8:00:00	0:00:00	0:00:00
2	8:01:00	0:00:00	0:00:00	8:01:00
3	8:01:02	0:00:00	8:01:02	0:00:00
4	8:04:10	0:00:00	8:04:10	0:00:00
5	8:06:25	8:08:10	0:00:00	0:00:00
6	8:08:13	0:00:00	0:00:00	8:09:17
7	8:10:23	8:11:00	0:00:00	0:00:00
8	8:12:14	0:00:00	8:13:53	0:00:00
9	8:14:30	8:15:29	0:00:00	0:00:00
10	8:16:26	0:00:00	0:00:00	8:17:30
11	8:18:20	8:19:28	0:00:00	0:00:00
12	8:20:18	0:00:00	8:21:37	0:00:00
13	8:22:29	8:23:09	0:00:00	0:00:00
14	8:24:13	0:00:00	0:00:00	8:25:56
15	8:25:57	0:00:00	8:26:34	0:00:00
16	8:27:41	0:00:00	0:00:00	8:28:21
17	8:29:25	0:00:00	8:30:01	0:00:00
18	8:31:09	8:32:46	0:00:00	0:00:00
19	8:33:03	0:00:00	0:00:00	8:34:35
20	8:35:57	8:36:40	0:00:00	0:00:00
21	8:37:51	0:00:00	8:38:02	0:00:00
22	8:39:45	0:00:00	0:00:00	8:40:33
23	8:41:39	0:00:00	8:42:04	0:00:00
24	8:43:33	0:00:00	0:00:00	8:44:42
25	8:45:00	8:46:45	0:00:00	0:00:00
26	8:46:27	0:00:00	8:47:24	0:00:00
27	8:47:54	8:48:09	0:00:00	0:00:00
28	8:49:21	0:00:00	8:50:32	0:00:00
29	8:51:48	0:00:00	0:00:00	8:52:07
30	8:53:15	0:00:00	8:54:09	0:00:00

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31	8:55:42	8:56:37	0:00:00	0:00:00
32	8:57:09	0:00:00	0:00:00	8:58:11
33	8:59:36	0:00:00	9:00:43	0:00:00
34	9:01:03	0:00:00	0:00:00	9:02:04
35	9:03:30	9:04:43	0:00:00	0:00:00
36	9:05:57	0:00:00	0:00:00	9:06:55
37	9:07:24	0:00:00	9:09:43	0:00:00
38	9:09:51	0:00:00	0:00:00	9:10:13
39	9:11:18	9:12:53	0:00:00	0:00:00
40	9:13:45	0:00:00	0:00:00	9:14:22
41	9:15:12	0:00:00	9:16:55	0:00:00
42	9:17:39	9:18:03	0:00:00	0:00:00
43	9:19:06	0:00:00	9:20:33	0:00:00
44	9:21:15	9:22:40	0:00:00	0:00:00
45	9:23:42	0:00:00	0:00:00	9:24:06
46	9:25:09	9:26:41	0:00:00	0:00:00
47	9:27:36	0:00:00	0:00:00	9:27:45
48	9:29:03	9:30:23	0:00:00	0:00:00
49	9:31:30	0:00:00	9:32:05	0:00:00
50	9:33:57	0:00:00	0:00:00	9:34:23
51	9:35:24	0:00:00	9:37:44	0:00:00
52	9:37:51	9:38:22	0:00:00	0:00:00
53	9:39:18	0:00:00	0:00:00	9:40:53
54	9:40:45	0:00:00	9:42:25	0:00:00
55	9:42:12	0:00:00	0:00:00	9:44:20
56	9:43:39	9:45:05	0:00:00	0:00:00
57	9:45:06	0:00:00	0:00:00	9:46:00
58	9:46:33	0:00:00	9:48:43	0:00:00
59	9:48:00	0:00:00	0:00:00	9:50:31
60	9:49:27	9:50:30	0:00:00	0:00:00
61	9:50:54	0:00:00	9:51:45	0:00:00
62	9:52:21	0:00:00	0:00:00	9:52:50
63	9:53:48	9:54:58	0:00:00	0:00:00
64	9:55:15	0:00:00	0:00:00	9:57:30
65	9:56:42	0:00:00	9:58:36	0:00:00

Table 2. Customer Arrival at the Bank

Table 2 shows the customer data and the time of arrival of the customer at the bank, in the table the time of arrival of this customer only consists of two parts, namely: the presence of a customer to (Arrival no) of the customer who came and the time of arrival (t) which is different.

It is known in a simulation experiment of a queuing process the arrival distribution is an exponential distribution with an average time between arrivals (IAT) = 60 seconds. By means of simulation through this distribution data has been obtained from 65 arrival units / person (arrival number).

Customer Service Time (t)

He also explained the time of teller service to customers of Bank Mega Padang, which consists of 3 existing counters.

(t) is the result of the simulation for arrival taken from Bank Mega Padang:

t1 = 08:00:00, t2 = 08:01:00, t3 =

08:01:02…. And so on until t65 = 09:55:42.

Data retrieval is carried out at each counter, so the time recorded is the time it takes for a teller to serve a customer at each existing counter. Customer service time is categorized as follows:

a. Service time (ST) at the teller 1

b. Service time (ST) at the teller 2

c. Service time (ST) at the teller 3

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Bank Mega Padang Queuing System

In serving transactions at the teller section, Bank Mega uses a multi-channel queuing model structure - single phase, meaning that there is more than one teller (service) provided to serve customers and only one phase of service must be passed by the customer to complete the transaction.

The number of service facilities provided is 3 tellers, customers who are going to make transactions must wait in the queue before they are served.

The time required by each teller to serve one customer to another is random. The length of service time depends on the type of transaction and the size of the transaction made by the customer.

Service procedures performed by each teller in serving transactions for customers are as follows:

1. Checking the correctness and completeness of filling in data on the transaction slip to avoid errors,

2. Check customer specimens, except for other bank notes,

3. Request or inform something to the customer in connection with the transactions made (especially in withdrawal transactions), such as:

- Asking customers to wait for inter-branch transactions that take a long time to process. If necessary, ask customers to wait in the guest seat to queue and then they will be called back.

4. Receiving deposits and making payments as well as checking the physical legality of the money.

5. Counting money in front of customers, seeing the calculations performed by the teller, either using a machine or manually.

6. Ratify the transaction by posting and checking the validation results or by affixing the time stam and initials

7. Confirming the nominal money for all transactions

8. Forward documents that need further processing.

Queuing System Performance

The queue system performance includes the following calculations:

(a) Customer to (Arrival no) = 1, 2, 3, 4, 5,

… And so on until 65.

(b) Inter Arrival Time

) t1 = 08:00:00, t2 = 08:01:00, t3 = 08:01:02

…. And so on until t65 = 09:55:42.

(c) Arrival time or arrival time which is the sum of the inter arrival time for the time between arrivals for each arrival, means 08:00:00 08:01:00 08:01:02 for the 65 arrivals

(d) Service time, namely service time with an exponential distribution of mean / minute.

The level of customer arrival is the number of customers who come to get service from the teller, expressed in how many customers (people) come in a certain period of time.). The teller

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service level is expressed in an exponential distribution, which is a continuous distribution which states all opportunities for failure at a certain time.

Meanwhile, the average teller service level for each time period can be seen in the following calculations:

Duration of teller service (service time) = customer exit time - service time. It is known arrival no = 65 units / person.

By using the equation used for the multiple channel exponential service time model and from the average arrival time and average rate time), the queuing system performance at Bank Mega can be calculated. Meanwhile, the average waiting time for a customer to be served by a teller for each time period can be explained as follows :

Arrival no.1 = 8:00:00 - 8:00:00 = 0:00:00

Arrival no.2 = 8:01:00 - 8:01:00 = 0:00:00

Arrival no.3 = 8:01:02 - 8:01:02 = 0:00:00

Arrival no.4 = 8:04:10 - 8:04:10 = 0:00:00

Arrival no.5 = 8:08:10 - 8:06:25 = 0:01:45

Arrival no.6 = 8:09:17 - 8:08:13 = 0:01:04

Arrival no.7 = 8:11:00 - 8:10:23 = 0:00:37

Etc…

(f) from time, this means the time to leave the service facility (proper service) of as many as n arrivals who can enter the service facility.

The amount of time you leave this service facility is obtained from:

Into time + service time = From time (time) left the queue system.

Arrival no.1 = obtained from 8:00:00 + 0:02:45

= 8:02:45

Arrival No.2 = 8:01:00 + 0:01:40 = 8:02:40

Arrival no.3 = 8:01:02 + 0:03:03 = 8:04:05

Arrival no.4 = 8:04:10 + 0:02:10 = 8:06:20

Arrival no.5 = 8:06:25 + 0:02:03 = 8:10:13

Etc.

(g) Queuing time. This is the amount of queue time, the amount of time for the unit / person arriving in the queue before entering the service facility or what has been recorded with the Into time.

(Into Time) - (Arrival Time) = Query time (time in queue)

In this data, there is a total queue time of = 1:09:08 / hour. This means the total time only in Queuing or Queuing Time

$n = 65$ is $\sum (i = 1\ Q.T) = 1:09:08$ / hour. (h) Average Queuing Time = Average time.

- Queues obtained from:

Total Queuing Time divided by 65 units / person = 0:01:04 minutes.

So that:

AQT = 1:09:08 / 65 = 0:01:04 minutes

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MULTI CHANNEL – MULTI PHASE

Nasabah	Waktu Kedatangan		Waktu Mulai Dilayani	
Ke	di Teller	Teller 1	Teller 2	Teller 3
1	8:00:00	8:00:00	0:00:00	0:00:00
2	8:01:00	0:00:00	0:00:00	8:01:00
3	8:01:02	0:00:00	8:01:02	0:00:00
4	8:04:10	0:00:00	8:04:10	0:00:00
5	8:06:25	8:08:10	0:00:00	0:00:00
6	8:08:13	0:00:00	0:00:00	8:09:17
7	8:10:23	8:11:00	0:00:00	0:00:00
8	8:12:14	0:00:00	8:13:53	0:00:00
9	8:14:30	8:15:29	0:00:00	0:00:00
10	8:16:26	0:00:00	0:00:00	8:17:30

Table 3. Teller service frequency

Teller	starting Time	Finished	Duration
1	8:00:00	8:15:29	0:15:29
2	8:01:02	8:13:53	0:12:51
3	8:01:00	8:17:30	0:16:30

Table 4. Duration Teller Service

CONCLUSION

From the sample data in the table value of customer queues and queue status of Mega Padang bank tellers, it can be seen that what will be calculated is the average waiting time is the average waiting time per customer. and furthermore by providing job recommendations that will be given to the Teller based on the Service Duration Ratio from the Teller. Tellers who have a little duration will get a queued job from the queuing system.

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