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M/G/1 QUEUE WITH SINGLE WORKING VACATION AND VACATION INTERRUPTION TO THE EXPECTED VALUE OF MANY CUSTOMERSAT BANK MUAMALAT SUKARAMAI SUB-BRANCH OFFICE

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ABSTRACT

Queuing occurs because the number of customers who arrive exceeds the service capacity, so customers have to queue to be served. A working vacation is a server serving at a slower speed. The server can return to a busy period with a p (vacation interruption) opportunity or continue a vacation with a $1-p$ opportunity, with the single working vacation and vacation interruption method. The objective of this study is to obtain the effect of service rate and the expected value of the number of customers in the system after the departure of one customer and minimize operating costs during the vacation period (pause). The M / G / 1 queue study with Single Working Vacation and Vacation Interruption found that the average arrival rate (λ) was 0.069 and the average service rate (μ_b) was 1.5 with the average vacation time (θ) was 0, 41 and the average value of the expected number of customers in the system $(E(L))$ is 0,19 and for operating costs it can also be drunk to -16,38. This means that the queuing system is not efficient, due to the low level of server activity and the expected value of the number of customers in the system is 0 or there are no customers waiting in the system.

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1. INTRODUCTION

Queues are often encountered around us, such as when someone will queue to buy or pay for something, but there are still many queues that occur in the community other than in the bank, such as queues to buy train tickets, buying tickets at theme park recreation rides, queues of goods in the post office and many more queues that occur in daily life (Andika et al. , 2018).

Queues that are in English called queueing or waiting line often occur in everyday life. Generally, everyone has been waiting in a waiting line at a service facility before getting the service they need. Queues occur because the number of customers who come exceeds the number of service facilities provided, so customers who come can not be served immediately because of the busyness of the waiter (Nia et al, 2016).

One place that can not be separated from the problem of queues is the bank. Today the bank is one of the most important actors in a country's economy. The general public and industry are in desperate need of bank services to facilitate their activities. To increase the number of customers in addition to promoting by creating new products that are more attractive, the bank must also perform a fast and easy service in order for transactions to run well. Banks should be able to think about how to provide efficient service in order to satisfy their customers.

This study uses the method of queue system M/G/1/SWV-BI with M means the arrival of customers to the system following the Poisson process, G means general, server service time has a certain spread and is general, 1 means the number of servers as much as 1 with single working vacation and vacation interruption spread Bernoulli, namely the server starts vacation (pause) during the empty period and vacation time follows the exponential distribution with θ parameters. In the working vacation period, if the customer comes will be served at a lower speed, if there are customers in the queue during this period, then in the vacation period, the server can stop or continue the vacation with the policy if there are customers in the queue, that means vacation interruption has occurred so that the server can return to normal working period and busy period with p (vacation interruption) opportunity or continue vacation with 1-p chance (Shan Gao and Zaiming Liu, 2013).

2. RESEARCH METHODE

2.1. Place and Time

This research was conducted at Bank Muamalat sukaramai branch office located at Jl. Sukaramai, Kec. Medan Denai Kota medan. This research starts from February to October 2020.

2. 2. Types and Data Sources

The type of data used by its nature in this study is quantitative data, and the data based on the source is primary data. Quantitative data is data that has the form of numbers or numbers that can be analyzed and calculated statistically or mathematically, and primary data is a type of data taken or collected directly from research objects by a researcher who needed to analyze a queue that occurred at the bank using a single working vacation and vacation interruption that spread Bernoulli, which was obtained by conducting his own research at Bank Muamalat sukaramai branch office.

2. 3. Research Variables

The research variables studied are the expected value of the number of customers in the system after the departure of one customer (Y), arrival time (X_1), wakru service (X_2). working vacation time (X_3).

2. 4. Research Procedure

The research procedures in this study are:

a. Research design

At this stage starts from determining the problem to be studied, preliminary study, making problem formulation, research objectives, research benefits, looking for library reviews, determining methodologies, and finding sources that can support the course of this research.

b. Implementation of research

The stage of implementation of research is the collection of data needed to answer existing problems. Analyzing data obtained through observations at Bank Muamalat KCP Sukaramai.

c. Creation of research reports

The research report is the last step that determines whether the research has been done well. The stage of making this research report researchers report the results of the study in accordance with what has been obtained in the form of thesis.

2. 5. data analysis

a. Data collection in the form of references

This research was conducted with literature study that collects material material as reference from various sources such as articles, books, journals, papers and other literature related to M/G/1 queue with Single Working Vacation and Vacation Interruption.

b. Data collection

Research data is the primary data, where the data is taken directly from the research site at Bank Muamalat Sukaramai sub-branch office.

c. Data Processing

Processing is done by two methods, the method in question researchers are manual and use spss program application.

- Calculate the expected value of the number of customers in the system

$$E(L) = L'(1) = \lim_{z\to 1} \mathcal{K} \times \frac{\mathcal{D}'(z)\mathcal{N}''(z) - \mathcal{N}'(z)\mathcal{D}''(z)}{(\mathcal{D}'(z))^2} = \frac{\mathcal{N}''(1)}{\mathcal{N}'(1)} - \frac{\mathcal{D}''(1)}{\mathcal{D}'(1)}$$

With:

$$\mathcal{K} = \frac{\theta(1-\rho)(1-\bar{p}G_v(\theta))}{(\theta(\lambda+\theta)+\lambda^2(1-\gamma))(1-\bar{p}G_v(\theta))-\lambda(1-\gamma)(\rho\theta+p\lambda)G_v(\theta)}$$

$$\mathcal{D}'(1) = (1-\rho)(1-\bar{p}G_v(\theta)$$

$$\mathcal{D}''(1) = 2(1-\rho)(1-\bar{p}\alpha)-\lambda^2\beta^{(2)}(1-\bar{p}\tilde{G}_v(\theta))$$

$$\mathcal{N}'(1) = \frac{(\theta(\lambda+\theta)+\lambda^2(1-\gamma))(1-\bar{p}G_v(\theta))-\lambda(1-\gamma)(\rho\theta+p\lambda)G_v(\theta)}{\theta}$$

$$\mathcal{N}''(1) = 2(\lambda+\theta)\left[(1-\bar{p}\alpha)+\rho(1-\bar{p}G_v(\theta))\right]-2\lambda(2-\gamma)\left[\rho G_v(\theta)-\frac{\lambda}{\theta}(1-G_v(\theta))\right]$$
$$+\lambda(\gamma-1)\left[\lambda^2\beta^2\tilde{G}_v(\theta)-\frac{2\lambda^2}{\theta^2}+\frac{2\rho\lambda}{\theta}(1-\tilde{G}_v(\theta))+2\alpha(\rho+\frac{\lambda}{\theta})\right]$$

- service rate in the system
  if the μ_v increases means the greater the rate of customer service when working vacation then the fewer customers are in the system.
- Calculates minimize operating costs

$$Z_c = c_w E(L) + c_0\mu_v P(J=0) + c_1\mu_b P(J=1)$$

d. Interachievement of analysis results.

After getting the results of the queue system analysis, the next step is to explain the analysis of the queue system

e. Draw conclusions.

3. RESULT AND ANALYSIS

3. 1. The expectation value of the number of customers in the system

Day	Number of customers	λ	θ	ρ	$E(L)$
Monday	43	0,078	0,4	0,0023	0,15
Tuesday	71	0,063	0,49	0,0019	0,5
Wednesday	63	0,066	0,34	0,0021	-0,09

From the analysis it is known that on Monday λ = 0.078 Tuesday λ = 0.063 and on Wednesday λ = 0.066 then on Monday ρ = 0.0023 Tuesday ρ = 0.0019 and ρ = 0.0021. It appears that the server is not too busy, with vacation time on Monday θ = 0.4 hours on Tuesday θ = 0.49 hours and on Wednesday θ = 0.34 hours. The expected value of the number of customers on Monday $E(L)$ = 0.15 on Tuesday increased by $E(L)$ = 0.5 and on Wednesday decreased $E(L)$ = -0.09. This means that the queue system at Bank Muamalat KCP Sukaramai has not been efficient, due to the low level of server busyness and the expectation value of the number of customers in the system is 0 or no customers waiting in the system.

3. 2.Service rate in the system

If the μ_v increases means the greater the rate of customer service when working vacation then the fewer customers are in the system. On Monday μ_v = 13.4, Tuesday μ_v = 36.04, and on Wednesday μ_v = 30.91. On Tuesday μ_v increased so that customers who are in the system are getting less and less. On Monday μ_v decreased because the server was not too busy.

3. 3. Minimize operating costs

Can be formulated the expected operating cost function as follows:

$$Z_c = c_w E(L) + c_0\mu_v P(J=0) + c_1\mu_b P(J=1)$$

Then calculate the minimum operating cost is as follows:

Suppose $c_w = 4,\ c_0 = 10,\ c_1 = 15$

$$Z_c = c_w E(L) + c_0\mu_v P(J=0) + c_1\mu_b P(J=1)$$
$$= 4(0,19)+10(0,44)(-1,446)+15(1,5)(-0,479)$$
$$= 0,76-6,3624-10,7775$$

$$Z_c = -16,38$$

So the cost of operation can be drunk up to -16.38. This means that the smaller the p, the smaller the minimum operating cost and the greater the optimal μ_v value.

4. CONCLUSIOON

The conclusion of this article, obtained that the average arrival rate (λ) is 0.069 and the average service rate (μ_b) is 1.5 with the average vacation time (θ) is 0.41 and the average expectation value of the number of customers in the system is 0.19. This means that the queue system at Muamalat KCP Sukaramai bank has not been efficient, due to the low level of server busyness and the expectation value of the number of customers in the system is 0 or no customers waiting in the system. The high rate of service μ_v is also the cause of the absence of customers waiting in the system. Even for the cost of operation can also be drunk to -16.38. So bank Muamalat KCP Sukaramai do not need to add tellers because the existing server is not too busy and customers who come can still be served with one teller. Based on the calculation of operating costs, the less chance of vacation interruption occurring, the smaller the operating cost.

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