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Email : editorijhess@gmail.com

Simulation Of The Trans Binjai Bus Quue Service System Using Poisson And Exponential Distribution Test Results (Case Study: Binjai City Transportation Office)

Asrofi Liza Nasution[1)], Akim MH Pardede[2)], Fuzy Yustika Manik[3)]
[1,2,3)] Information System, STMIK Kaputama Binjai

*Corresponden Author :
Email: asrofiliza@gmail.com

Abstract

The Trans Binjai Bus or Bus Rapid Transit (BRT) which is managed by the Binjai City Transportation Service is a bus system that is fast, comfortable, safe and on time. Each BRT system must use a different improvised system, although the improvements are shared with other BRT systems. The queue system in operations carried out by the Trans Binjai Bus often occurs overcrowding and even builds up at one point which results in Trans Binjai Bus users having to wait and not know the departure schedule. Therefore, the queuing system in the operation of the Trans Binjai bus must be carried out in a systematic and scheduled manner so that accumulation at one point and delays can be avoided. Queue is a waiting line situation where a number of physical units (entrants) are trying to receive service,

Keywords: Simulation, Queue, Trans Binjai Bus, Poisson Distribution, Exponential Distribution.

INTRODUCTION

In everyday life, of course, you have seen queues such as waiting to be served at the bank, queues to buy food at restaurants, queues to enter elevators, queues to get prescription drugs at hospitals and others. The queuing system is useful to help manage queues more effectively and efficiently so as to enable every arrival to be served their needs easily.

The Trans Binjai Bus or Bus Rapid Transit (BRT) managed by the Binjai City Transportation Service is a bus system that is fast, comfortable, safe and on time. Each BRT system must use a different improvised system, although the improvements are shared with other BRT systems.
However, in the operational queuing system carried out by the Trans Binjai Bus, there is often congestion and even buildup at one point which results in Trans Binjai Bus users having to wait and not know the departure schedule. Therefore, the queuing system in the operation of the Trans Binjai bus must be carried out in a systematic and scheduled manner so that accumulation at one point and delays can be avoided.

RESEARCH METHODS

Definition of Queue

Queue is the science of the shape of the queue and is the people or goods in line waiting to be served or covers how companies can determine the best time and facilities in order to serve customers efficiently(Heizer, 2006).

While the queue is a waiting line situation where the number of physical units (entrants) are trying to receive services from limited facilities (service providers), so that newcomers have to wait some time in line to get their turn to be served. Based on the above definitions, it can be concluded that queuing is a process associated with the arrival of a customer at a service facility, then waiting in a queue and finally leaving the facility(Ma'arif, 2003).

The average length of waiting time (waiting time) is very dependent on the average level of service speed (rate of services). The theory of queuing was discovered and developed by AK Erlang. Erlang conducted experiments on fluctuating demand for telephone facilities related to automatic

dialing equipment, namely automatic telephone dialing equipment. The real purpose of queuing theory is to examine the activities of service facilities in a series of random conditions of a queuing system that occurs(Tamrin, 2018).

Queue System Characteristics

In the queuing system there are three characteristic components, namely: (a) the characteristics of the arrival or system input; (b) queue characteristics; (c) service characteristics. The following is a description of the three characteristics of the queuing system. The first characteristic is the arrival characteristic or system input, i.e. the input source that brings customers for a service system has the following main characteristics (Heizer, 2006) :

Queue Structure

There are four basic queuing structure models that are common in all queuing systems((Heizer, 2006) :

1. *Single Channel – Single Phase*

*Single Channel*means that there is only one path to enter the service system or there is only one service. Single Phase indicates that there is only one service station so that those who have received service can immediately exit the queuing system. An example is the purchase of cinema tickets served by a counter, a shop assistant and others. Look at the following picture:

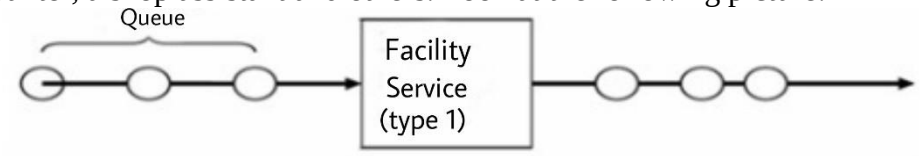

Figure 1 Model Single Channel Single Phase

*Single channel*means that there is only one path that enters the service system or there is one service facility. Single phase means there is only one service.

2. *Single Channel Multi Phase*

This structure has one service line so it is called Single Channel. The term Multi Phase indicates that there are two or more services that are carried out sequentially. After receiving service because there are still other services that must be done to make it perfect. After the service provided is perfect, you can leave the service area. Example: automatic car wash. Look at the following picture.

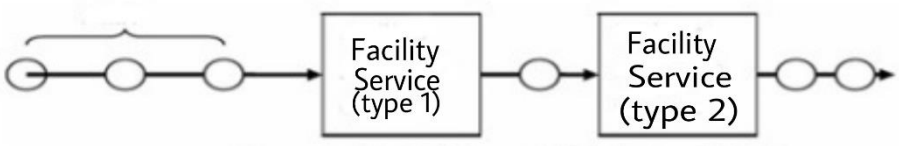

Figure 2 Single Channel Multi Phase Model

*Multi-phase*are two or more services performed sequentially (phase).

3. *Multi-Channel Single Phase*

Multi Channel Single Phase system occurs when two or more facilities are fed by a single queue. This system has more than one service line or service facility while the service system has only one phase. Example: service at a bank served by several tellers. Look at the following picture.

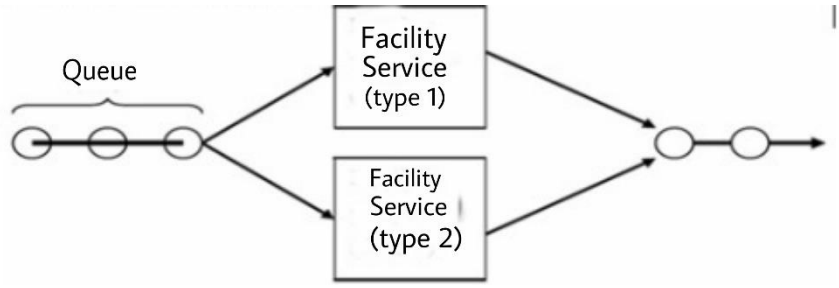

Figure 3 Single Phase Multi Channel Model

*single phase*occurs anytime where two or more service facilities are fed by a single queue.

4. Multi-Channel Multi-Phase

Each of these systems has several service facilities at each stage, so that more than one individual can be served at a time. In general, these networks are too complex to be analyzed by queuing theory. Example: service to patients in a hospital, some nurses will visit patients regularly and provide services continuously, starting from registration, diagnosis, healing to payment.

Look at the following picture.

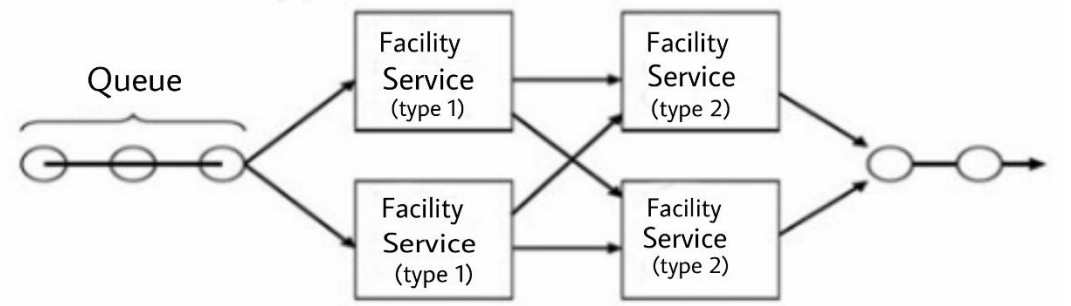

Figure 4 Multi-Channel Multi-Phase Model

*Multi-phase*Each of these systems has several service facilities at each stage.

Definition of Poisson Distribution

This distribution was first introduced by Siméon-Denis Poisson (1781–1840) and published with his theory of probability, in 1838. The work focuses on the random artist N calculating among other things the number of discrete events (sometimes also called "arrivals") that occur during a time interval certain(Bain et al., 1992). If the expected value of events in an interval is , then the probability of the event occurring x times is:

$$f(x) = \frac{e^{-\mu}\mu^{x}}{x!} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \quad (7)$$

When written in the parameter , it can be written:

$$f(x;\lambda) = \frac{e^{-\lambda}\lambda^{x}}{x!} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \quad (8)$$

With :

e = constant = 2.71828

= average success = n . p

x = Number of successful elements in the sample or discrete random variable (1,2,3, . . , x)

n = Number / size of population

P = probability of success class

Exponential Distribution

Continuous random variable X has an exponential distribution with parameter > 0 , if it has a distribution function of the form [2]

$$f(x;\theta) = \begin{cases} \frac{1}{\theta} e^{x/0} & , x > 0 \\ 0 & , x \end{cases} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \quad (8)$$

Where is a scale parameter. While the cumulative distribution function is:

$$f(X, \theta) = 1 - e^{-x/\theta} \quad , x > 0 \text{..... ..... (9)}$$

Trans Bus

Bus trans or often called Bus Rapid Transit (BRT) is a bus system that is fast, comfortable, safe and on time from infrastructure, vehicles and schedules using buses to serve services of better quality than other bus services. Each BRT system must use a different improvised system, although the improvements are shared with other BRT systems. The result of this system is to approach the transit rally if you still enjoy the security and bus fares. Countries that use BRT are in North America, in Europe and Australia it is called busway and this name is also used in Indonesia, while other countries call it quality bus or easy bus service when it reaches high quality (Dwiryanti, 2013).

RESULTS AND DISCUSSION

The results of the calculation of the Trans Binjai bus queue simulation with poisson distribution and exponential distribution, the results are:

Table 1. Calculation Results of Poisson & Exponential Distribution

Corridor	Claim Frequency	Number of Stops	Poisson distribution	Exponential Distribution
1	2	7	0.0223	0.0079
1	2	9	0.005	0.0037
2	2	6	0.0446	0.0126
2	2	5	0.0842	0.0218
3	2	12	0.0004	0.0016
3	2	12	0.0004	0.0016
4	3	9	0.005	0.0037
4	3	4	0.1465	0.0425
5a	2	10	0.0023	0.0027
5a	2	10	0.0023	0.0027
5b	2	10	0.0023	0.0027
5b	2	10	0.0023	0.0027
Amount		104	0.3176	0.1063

And the calculation above becomes the value of the graph, namely:

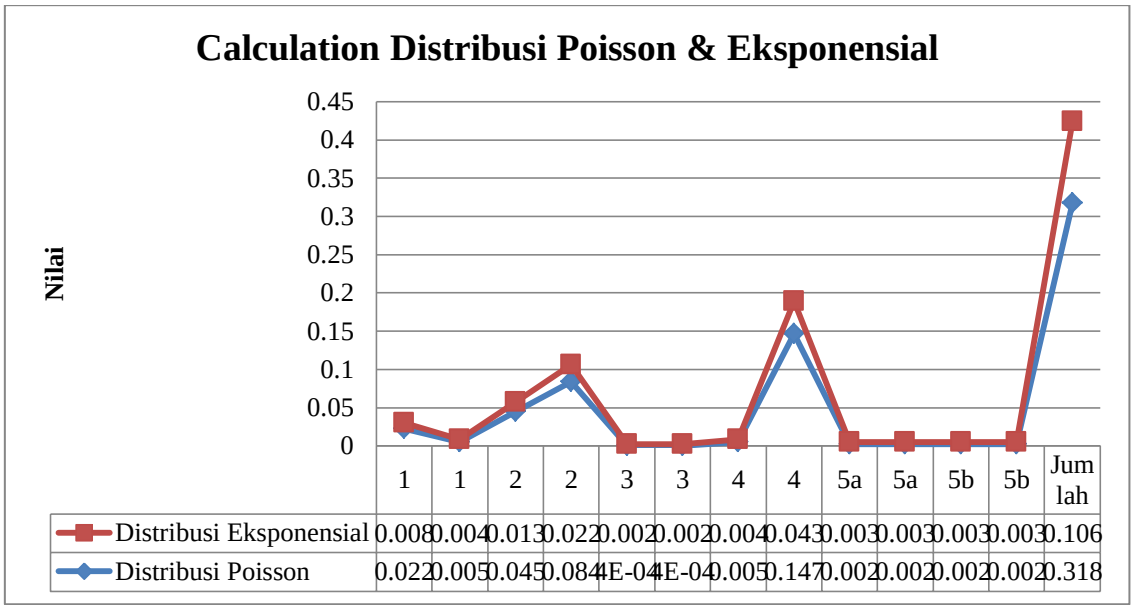

Figure 5 Results GraphPoisson & Exponential Distribution

From the calculation above, it can be seen that the difference in values using the results of the Poisson distribution and exponential distribution test results. From the value above, it is concluded that the Poisson distribution test value gets a high value of 0.3176 while the smallest value of the exponential distribution is 0.1063.

CONCLUSION

From the calculations above, it can be seen that the difference in values using the results of the Poisson distribution and exponential distribution test results. From the value above, it is concluded that the Poisson distribution test value gets a high value of 0.3176 while the smallest value of the exponential distribution is 0.1063. and it is hoped that this value can help the queue rate which can help the system discipline the queue for the Trans Binjai Bus route.

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