Journal of Engineering Science and Technology
Vol. 19, No. 3 (2024) 774 - 781

QUEUE SYSTEM ANALYSIS USING ARRIVAL PATTERNS AND CUSTOMER SERVICE PATTERNS FOR FAST FOOD RESTAURANTS AT SIMPANG DAGO BANDUNG

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Abstract

Queues are one of the problems that have a large enough influence for a fast-food restaurant, especially in the world of food and beverage. Queues occur because the high arrival rate is not matched by the maximum level of service. This study aims to determine the queuing model that occurs at the McDonald's cashier and find out whether the queue model applied is efficient by comparing the results of observations and simulation results. The research method used is descriptive analysis with a quantitative approach to customers at McDonald's restaurants with arrival times and service times every 20 minutes on both servers. The results showed that there are several things that affect the queuing system, namely arrival time, service time, number of servers and McDonald's consumer eating hours. From this, we can simulate the addition of servers to reduce queues during peak hours, namely at lunch time. Of course, the optimal performance of the queuing system will provide satisfaction for consumers or buyers because it can reduce waiting time during the purchasing process.

Keywords: Fast-food restaurant, McDonald's cashier, Queues, Queuing model, Simulation results.

1. Introduction

McDonald's restaurant is a restaurant from California, United States. This restaurant is the second largest fast-food restaurant in the world when viewed from the number of restaurants worldwide. Currently, McDonald's restaurants can be found in 119 countries in the world [1]. One of the McDonald's restaurant franchises in Indonesia is McDonald's Simpang Dago Bandung. There are several ways to order food at this restaurant, namely by ordering directly at the restaurant and by ordering through the delivery system by contacting McDonald's by telephone. As a worldwide franchise, McDonald's is well known as a company that pays great attention to its service sector, namely cleanliness, friendliness and speed of service [2].

The process for ordering food at a McDonald's restaurant is to queue according to the order in the queue, then when it arrives in front of the cashier, the buyer will order the desired food [3]. After completing the order, the cashier will repeat the buyer's order and if the order has been confirmed, the cashier will tell you how much the food is ordered. After the payment process is complete, the buyer must wait for the food to be prepared and then it can be brought to the table to be eaten. The problem that occurs is that there is a long queue at the McDonald's cashier [4]. Queues are a common problem in society or in the production process of goods and services [5]. The queue can occur because the level of service demand is greater than the level of the facility's ability to provide services [6]. In fast food restaurants such as McDonald's, queues usually occur at lunch or dinner hours [7]. The queuing system will be simulated to find out how to reduce consumer waiting time.

This study aims to determine the queuing model that occurs at the McDonald's Simpang Dago Bandung cashier and find out whether the queuing model applied is efficient by comparing the observations with the simulation results.

2. Research Method

This research was conducted at the fast-food restaurant McDonald's Simpang Dago Bandung. The research was conducted on Saturday, January 15, 2022, at 11.10 – 13.10 WIB. The data used in this study is primary data, namely data taken directly through the process of observation (observation). The primary data are in the form of arrival time data and customer service time data [8, 9]. Then the data processing is carried out using Microsoft Excel software to perform data processing. The flow chart of this research can be seen in Fig. 1.

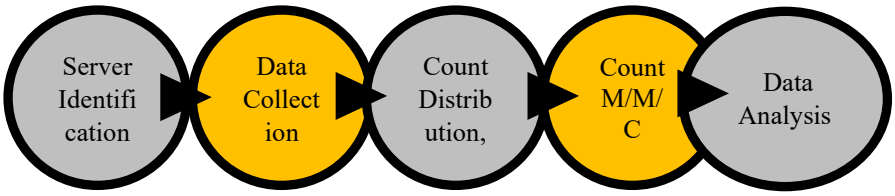

Fig. 1. Research flowchart.

Server identification is done as the first step of the data processing system. At this stage, direct observation is carried out to obtain information about the things that will be included in data processing. After that, the observer will collect the

arrival time data and customer service time data at the fast-food restaurant. After the data is collected, the distribution calculation, lamda and Mu will be carried out. After obtaining this value, the M/M/C calculation is carried out to determine the performance of the queuing system. Then, the data analysis is carried out whether the addition of the number of servers can affect the performance of the queuing system [10, 11].

The limitations contained in this study include:

- The data taken is the service queue data at the cashier (not including drive-thru, waiting list).
- Observation of queues occurs at busy times, namely at lunch time.
- The assumptions used include:
- There is no change in the number of servers and there is no disruption to the server.
- The arrival of customers in groups in the queuing system is counted as one customer.

3. Results and Discussion

3.1. Data collection and processing

In this section, processing and data collection are carried out. First, data processing is carried out using Microsoft Excel software to get the average value of arrival time and service time and the value of the utility factor [12].

3.1.1. Time of arrival

Arrival time shows the interval between customer arrivals at the McDonald's Simpang Dago restaurant. The arrival time of consumers every 20 minutes is shown in Table 1.

Table 1 shows the distribution of consumer arrival times every 20 minutes of observation. At 11.10 – 11.30 there were 4 consumers who made purchase transactions with the time difference between server 1 and server 2 consumers. On the second consumer server 1 made transactions for 1 minute 43 seconds and the second consumer server 2 made transactions for 52 seconds and so on. After that, the average value of the arrival time of consumers is obtained which is shown in Table 2.

Table 1. Customer arrival time every 20 minutes.

Hours	Time (minutes)	
	Servers 1	Servers 2
11.10 – 11.30	0.00	0.00
	1.43	0.52
	2.51	2.33
	2.39	1.47
11.30 – 11.50	0.00	0.00
	1.08	0.43
	0.00	2.11
	0.44	0.44
	0.00	0.00
	0.00	1.22
11.50 – 12.10	0.00	0.00
	0.00	1.22
	0.00	0.00

	1.05	1.34
	0.00	0.00
	0.49	1.20
12.10 – 12.30	0.00	0.00
	1.42	0.44
	3.28	1.32
	0.00	0.00
12.30 – 12.50	0.00	0.00
	0.00	1.22
	0.00	0.00
	0.40	1.22
12.50 – 13.10	0.00	0.00
	0.20	0.32
	1.48	1.11
	2.19	1.33
	0.00	1.42
	0.00	0.00

Table 2. Average customer arrival time on server 1 and server 2

Hours	**Time (minutes)**	
	λ**1**	λ **2**
11.10 – 11.30	1.58	1.38
11.30 – 11.50	0.25	1.10
11.50 – 12.10	0.26	1.03
12.10 – 12.30	1.08	0.44
12.30 – 12.50	0.10	1.01
12.50 – 13.10	0.65	1.10

Table 2 shows the distribution of the average arrival time of consumers on servers 1 and 2. At 11.10 – 11.30 on server 1, the average arrival time is 1 minute 58 seconds and on server 2, the average arrival time is 1 minutes 38 seconds and so on.

The following is an example of processing the average arrival time data on server 1 and server 2 contained in Table 2.

$$\lambda 1 = \frac{0 + 1.43 + 2.51 + 2.39}{4} = 1.58$$

$$\lambda 2 = \frac{0 + 0.52 + 2.33 + 1.47}{4} = 1.38$$

3.1.2. Service time

Service time is the length of time from the time the customer can start ordering food on the server until the customer gets the food or drink ordered. The customer service time is shown in Table 3.

Table 3 shows the distribution of customer service time every 20 minutes. At 11.10 – 11.30 there were 4 consumers who made purchase transactions with the time difference between server 1 and server 2 consumers. On the second consumer server 1 made transactions for 2 minutes 15 seconds and the second consumer server 2 made transactions for 3 minutes 39 seconds and so on. After that, the average value of customer service time is shown in Table 4.

Table 3. Customer service time every 20 minutes.

Hours	Time (minutes)	
	Servers 1	Servers 2
11.10 – 11.30	2.18	3.20
	2.15	3.39
	2.44	3.44
	1.54	2.29
11.30 – 11.50	1.19	2.12
	3.34	3.34
	1.24	1.24
	2.30	2.30
	2.58	2.58
	2.57	2.57
11.50 – 12.10	2.01	2.22
	2.49	1.54
	2.59	2.22
	3.42	1.43
	4.18	3.22
	2.50	2.49
12.10 – 12.30	1.02	2.33
	9.18	7.22
	2.16	2.16
	3.25	3.29
12.30 – 12.50	5.35	4.44
	5.17	3.43
	2.42	4.11
	1.57	2.32
12.50 – 13.10	3.48	4.44
	3.28	2.21
	1.14	2.29
	4.37	3.17
	4.34	2.11
	0.56	1.66

Table 4. Average service time on server 1 and server 2.

Hours	Time (minutes)	
	μ1	μ2
11.10 – 11.30	2.08	3.08
11.30 – 11.50	2.20	2.36
11.50 – 12.10	3.27	2.19
12.10 – 12.30	4.30	4.15
12.30 – 12.50	4.03	3.58
12.50 – 13.10	3.26	3.05

Table 4 shows the distribution of the average customer service time on servers 1 and 2. At 11.10 – 11.30 on server 1, the average value of service time is 2 minutes 8 seconds and on server 2 the average value of service time is 3 minutes. 38 seconds and so on.

Table 4 shows the distribution of the average customer service time on servers 1 and 2. At 11.10 – 11.30 on server 1, the average value of service time is 2 minutes 8 seconds and on server 2 the average value of service time is 3 minutes. 38 seconds and so on.

The following is an example of data processing the average service time on the server 1 and server 2 are listed in Table 4.

$$\mu 1 = \frac{2.18 + 2.15 + 2.44 + 1.54}{4} = 2.08$$

$$\mu 2 = \frac{3.20 + 3.39 + 3.44 + 2.29}{4} = 3.08$$

3.2. Queue system plan

This section describes the queuing system for the McDonalds Simpang Dago fast food restaurant by describing the layout of the queuing system which is shown in Fig. 2.

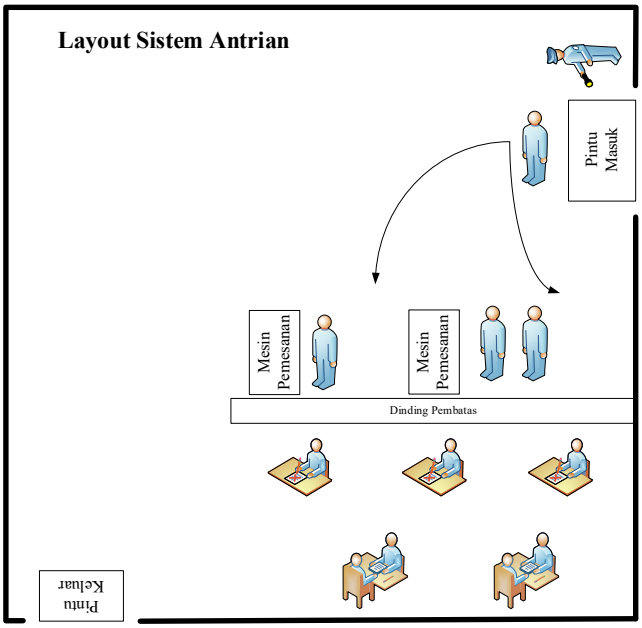

Fig. 2. Queue system plan.

Figure 2 shows the layout pattern of the queuing system that occurs in a fast-food restaurant. In addition, on the floor plan there are 2 servers for consumers to make food and beverage purchases. Then, queues often occur during peak hours, namely at lunch time.

The following is an analysis of the performance of the queuing system at McDonald's Simpang Dago.

$$\rho = \frac{Capacity\ Demand}{Avilable\ Capacity} = \frac{\lambda}{c\mu}$$

$$\rho = \frac{1.48}{2 \times 2.58} = 0.29$$

Based on the results of the utilization factor above, it can be concluded that on servers 1 and 2 the queuing system pattern does not experience a long (busy) queue

with a value of $\rho < 1$ [13-15]. This study gives additional information regarding customer and industry, which has been well reported in previous studies [16-21].

4. Conclusion

The fast-food restaurant at Simpang Dago Bandung operates 2 servers (cashiers) with a FIFO (First in First Out) queue model with an average customer arrival parameter of 1.48 minutes and an average service time of 2.58 minutes. Based on the simulation results, the improvement model, namely the model with the addition of one cashier, can reduce the parameters of the average length of arrival of consumers. In addition, the addition of cashiers to 3 units is needed during peak hours, namely lunch or dinner hours to increase customer satisfaction. Then, the results of factor utilization can be concluded that on servers 1 and 2 the queuing system pattern does not experience long (busy) queues with a value of $\rho < 1$.

Acknowledgment

We would like to thank Universitas Komputer Indonesia to help us in writing this paper.

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