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QUEUE MODEL ANALYSIS AT LAWSON MINIMARKET JATINANGOR

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ABSTRACT

Lawson is a popular minimarket offering ready-to-eat food and beverages, making it a frequent destination for customers in the Jatinangor area. Due to the high volume of visits, the efficiency of its service system plays a vital role in ensuring customer satisfaction. This study aims to analyze the performance of the queueing system at Lawson Jatinangor using a descriptive quantitative approach based on direct observation of customer arrival and service times. The collected data were processed using the POM-QM software through the waiting line module. The results show that the queueing system operates with high efficiency, characterized by a short average waiting time, a low number of customers in the queue, and a low cashier utilization rate. The high probability of the system being idle indicates underutilized service capacity. The study concludes that while Lawson's current service system is responsive, there is still potential to improve operational efficiency by adjusting the number of active cashiers during peak hours

1. INTRODUCTION

Jatinangor is one of the most densely populated educational areas in West Java, home to several major universities. The high level of academic activity and student mobility makes this area highly dynamic, with an increasing demand for various services that support daily life. In this context, minimarkets play an important role as providers of fast, practical, and easily accessible daily necessities. The presence of minimarkets not only serves as a place for shopping but has also become part of the lifestyle of students and the surrounding community, particularly in meeting instant needs for food, beverages, and personal items.

In order to understand the dynamics of service operations at Lawson Minimarket Jatinangor, queueing model analysis becomes crucial. This minimarket functions as one of the distribution points for daily necessities, so efficient queue management not only affects customer satisfaction but also contributes to optimal operations. According to a study by Al-Kholis et al. (2018), the efficiency of service systems in minimarkets located near campuses can influence student satisfaction levels. Their research also shows that fast service times and good queue management have a significant impact on the student shopping experience. Other studies have found that well-managed queueing systems contribute to service efficiency improvements in various types of businesses, including retail and restaurants (Rosyadi et al., 2024). Moreover, queueing problems are also found in more technical environments such as manufacturing, computer networks, and telecommunications (Shanmugasundaram & Umarani, 2015).

The application of queueing theory can help design systems that reduce waiting times and improve customer shopping experiences. The M/M/1 queue model, one of the classic models in queueing theory, can be applied to analyze queue patterns and performance at Lawson Jatinangor (Dhaifullah et al., 2023). This model allows us to measure variables such as average waiting time, service duration, and customer arrival rates, all of which provide a clear picture of the efficiency of the existing queue system (Wijaya & Astuti, 2021).

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With increasing competition in the retail sector, it is important for minimarkets to focus not only on the products they offer but also on how they manage the customer experience, including service time. Previous research has shown that poor queue management can negatively affect the shopping experience and even reduce customer return rates (Ramadhan et al., 2021). Studies conducted in other sectors, such as restaurants and shopping centers, also indicate that systematic approaches to queue management can result in significant improvements in customer satisfaction and loyalty (Ghaisani et al., 2023). Furthermore, proven queueing techniques from other industries can be adapted to the minimarket setting. For example, the single-channel single-phase technique, which has been shown to effectively reduce waiting times in service systems, can also be applied to Lawson (Ramdani et al., 2021).

This study aims to analyze the queueing model at Lawson Minimarket Jatinangor, assess the current system's efficiency, and identify potential areas for improvement. Through a quantitative analysis approach to queue parameters, this research seeks to provide practical and applicable solutions to enhance the customer shopping experience. Therefore, the findings of this study can serve as a basis for managerial decision-making in improving service performance on an ongoing basis.

2. METHODS

In research on queueing models in minimarkets, several research methods can be applied to analyze and understand the dynamics of queues occurring at the location. A commonly used approach is quantitative descriptive, in which researchers collect numerical data related to service flow, waiting times, and the number of customers making transactions within a certain period. For example, a study by Fuanasari et al. (2014) used a descriptive method to analyze the queueing system at a registration counter, which can be adapted to a minimarket setting by collecting data on customer arrival times and service durations. In this queueing model study, the researcher analyzes the performance of the queueing system at the Lawson Jatinangor store. This study focuses on analyzing customer arrival times, service durations, and waiting times, which are useful for evaluating cashier service efficiency. The researcher also uses primary data obtained through direct observation.

Research Stages

The research was conducted through several systematic stages to analyze the queueing model at Lawson Minimarket Jatinangor. First, a direct observation was carried out at the Lawson Jatinangor store on June 13, 2025, from 2:00 PM to 4:00 PM, to observe customer flow and queue conditions during peak hours. Second, the data required for analysis—such as arrival time, service time, and waiting time—were recorded and summarized into a structured data table for further processing. The third stage involved collecting this primary data with the specific aim of capturing real queue dynamics that occurred in the field. This approach was intended to ensure the accuracy and relevance of the dataset used in the analysis. Finally, the collected data were processed using the POM-QM software, specifically utilizing the "Waiting Lines" module, which allows for simulation and calculation of queue performance metrics, such as average waiting time, system utilization, and service efficiency.

Data Analysis Stages

a) Calculate the customer arrival rate and service level

b) Level of Customer Arrival (λ)

$$\lambda = \frac{\text{Number of Customer}}{\text{Total Arrival Time}}$$

c) Level of Customer Service (μ)

$$\mu = \frac{\text{Total Service Time}}{\text{Number of Customer}}$$

Description:
λ = average arrival rate (number of customer arrivals per unit of time)
μ = average service rate (number of customers served per unit of time)

1. Calculating the characteristics of a queuing system

   a) The probability that there are 0 people in the system

$$P_0 = \frac{1}{\left[\sum_{n=0}^{M-1} \frac{1}{n!}\left(\frac{\lambda}{\mu}\right)^n\right] + \frac{1}{M!}\left(\frac{\lambda}{\mu}\right)^M \frac{M\mu}{M\lambda - \mu}}$$

Description:
M = number of open lines
λ = average number of arrivals per unit time
μ = average number of customers served per unit time on each line
n = number of customers

b) Average number of requests in the system (Ls)

$$Ls = \frac{\lambda\mu\left(\lambda/\mu\right)^M}{(M-1)!\,(M\mu-\lambda)^2} Po + \frac{\lambda}{\mu}$$

Description:
M = number of open routes
λ = average number of arrivals per unit time
μ = average number of people served per unit time on each route
P0 = probability that there are 0 people in the system

c) Average time spent by a customer in line or being served in the system (Ws)

$$Ws = \frac{Ls}{\lambda}$$

Description:
Ls = average number of customers in the system
λ = average number of arrivals per unit time

d) Average number of people or units waiting in line (Lq)

$$Lq = Ls - \frac{\lambda}{\mu}$$

Description:
Ls = average number of customers in the system
λ = average number of arrivals per unit time
μ = average number served per unit time on each route

e) Average time spent by a customer/unit waiting in line (Wq)

$$Wq = \frac{Lq}{\lambda}$$

Description:
Lq = average number of customers in the system
λ = average number of arrivals per unit time

f) System utilization factor (ρ)

$$\rho = \frac{\lambda}{M\mu}$$

Description:
λ = average number of arrivals per unit time
M = number of open routes
μ = average number of passengers served per unit time on each route

1. Simulation Process

The collected queue data will be analyzed using POM-QM software. This process will utilize the software's existing modules, namely the waiting lines module, by entering the average number of arrivals per unit of time, the average number of customers served per unit of time on each line, and the number of cashiers. In the second stage of data analysis, this data will appear when using the POM-QM software, eliminating manual calculations.

2. Analysis of Calculation Results

After conducting the simulation calculations using the POM-QM software, the results will be analyzed to evaluate the existing queue model at Lawson Jatinangor.

3. RESULTS AND DISCUSSIONS

Results

Queue Characteristics at Lawson Jatinangor

At present, Lawson Jatinangor has implemented a queueing system, which consists of a single queue phase located at the cashier service area. The queueing characteristics observed at this minimarket can be described through three main aspects: arrival, queue discipline, and service process.

a. Arrival Characteristics
Customer arrivals at Lawson are random and independent, meaning that the arrival of one customer is not influenced by the arrival time of others. This type of arrival behavior follows an exponential distribution pattern, which is commonly found in service systems where customers arrive unpredictably.
b. Queue Characteristics
Lawson Jatinangor operates with two service counters. The first cashier serves customers purchasing general retail items, while the second cashier is dedicated to handling orders of ready-to-eat meals, which are served directly at the counter. The queue discipline implemented is First Come, First Served (FCFS), where customers are served in the order of their arrival.
c. Service Characteristics
The service system at Lawson Jatinangor falls under the Multi-Channel Single-Phase category, where a single queue is served by multiple service facilities. In this case, there are two cashiers operating simultaneously, allowing for parallel processing of customer transactions. As such, the queue model applied in this study corresponds to the (M/M/2) queue model, which is characterized by Poisson arrivals, exponential service times, and two servers operating in parallel within a single-phase system.

Analysis of Arrival and Service Patterns at Lawson Jatinangor

The analysis of customer arrival and service patterns in this queueing system study was conducted at Lawson Jatinangor. Data collection was carried out through direct observation over a 2-hour period, specifically from 2:00 PM to 4:00 PM (WIB). The total observation duration amounted to 120 minutes, during which data were recorded regarding the arrival time of each customer and the duration of service provided by the cashier. This data serves as the basis for understanding the characteristics of customer flow and the responsiveness of service staff in handling transactions. Both inter-arrival times (the time interval between the arrival of one customer and the next) and service times (the time taken to serve each customer) were recorded meticulously during the observation period. These variables are essential for determining the performance of the queueing system and are presented in the following table.

Table 1. Arrival Data (λ) dan Service Data (μ)

No	Arrival Time	Interarrival Time	Starting to be Served	Finished Serving	Service Time
1	13:53:28		13:53:30	13:55:45	0:02:15
2	13:55:50	0:02:22	13:55:51	13:57:19	0:01:28
3	13:58:52	0:03:02	13:59:05	13:59:35	0:00:30
4	14:05:40	0:06:48	14:05:59	14:09:51	0:03:52
5	14:05:57	0:00:17	14:06:20	14:08:13	0:01:53
6	14:08:14	0:02:17	14:08:28	14:09:05	0:00:37
7	14:11:57	0:03:43	14:12:08	14:12:50	0:00:42

8	14:12:33	0:00:36	14:12:52	14:14:12	0:01:20
9	14:33:40	0:21:07	14:33:42	14:36:15	0:02:33
10	14:36:06	0:02:26	14:36:19	14:37:29	0:01:10
11	14:40:21	0:04:15	14:40:24	14:43:09	0:02:45
12	14:52:32	0:12:11	14:52:34	14:53:26	0:00:52
13	15:00:16	0:07:44	15:00:17	15:01:37	0:01:20
14	15:05:24	0:05:08	15:05:27	15:07:00	0:01:33
15	15:10:17	0:04:53	15:10:19	15:12:06	0:01:47
16	15:14:06	0:03:49	15:14:10	15:14:33	0:00:23
17	15:16:15	0:02:09	15:16:17	15:19:43	0:03:26
18	15:25:32	0:09:17	15:25:33	15:26:16	0:00:43
19	15:27:47	0:02:15	15:27:49	15:29:04	0:01:15
20	15:37:13	0:09:26	15:37:20	15:38:08	0:00:48
21	15:40:12	0:02:59	15:40:14	15:41:30	0:01:16
22	15:54:28	0:14:16	15:54:29	15:58:16	0:03:47
	Total	0:05:46		Total	0:36:15

During the observation that day, 22 customers arrived within 120 minutes. Based on the calculation, the total time between customer arrivals was 2 hours, so the customer arrival rate (λ) is:

$$\lambda = \frac{22}{2} \approx 11\,/hours$$

For service time, data was obtained on the waiting time of each customer before being served, which when added together represents the total service time for all customers. The data shows that the total service time is 36 minutes, so the customer service level (μ) is:

$$\mu = \frac{36{,}25}{22} \approx 0{,}607$$

This means that the officer is able to serve an average of around 1 customer every 1.65 minutes or on average each customer that the officer can serve in 1 hour is around 36 customers.

Waiting Line Simulation Using POM QM

Before calculating system performance variables, the arrival rate, service rate, and system utilization rate for each service facility must be known to allow for decision-making. Data on arrival rates and cashier service rates are presented in Table 3.

Table 2. Observation Result M/M/2

	Parameter	Observation Result
		M/M/2
λ	Customer arrival rate (persons/hour)	11
μ	Cashier service rate per customer (persons/hour)	36
	Intensity Level	22

Source: Processed data (2025)

After the necessary data was collected, the researcher entered the data into the POM QM software using the waiting lines method, which would then produce the following figure:

Figure 1. Simulation Result Using POM-QM

4. Discussion

Based on the analysis, the queueing system at Lawson Jatinangor, modeled using the M/M/2 queueing model, indicates a highly efficient service system. The server utilization rate is only 15%, meaning that each server (cashier) is active for only a small portion of the total operational time. This low utilization rate suggests that the system operates under light load conditions and is rarely busy. The average number of customers waiting in the queue (Lq) is 0.13, while the average number of customers in the system (Ls) is 0.44. These figures reflect that the queue length and overall system burden are minimal, indicating an almost non-existent queue and a service system with very low congestion. Furthermore, the average waiting time in the queue (Wq) is only 44 seconds, and the average total time spent in the system (Ws) is approximately 2 minutes and 24 seconds. With such a short waiting time, it can be concluded that the service process at Lawson Jatinangor is very fast and responsive.

The probability of an empty system (P_0) reaches 85%, implying that for the majority of the time, the system has no customers being served or waiting. This reinforces the observation that the system operates under very light load conditions. In conclusion, the service system at Lawson Jatinangor can be categorized as underutilized and highly efficient. However, the very low server utilization may warrant further evaluation from an operational efficiency perspective. For example, management may consider reviewing the number of active servers (cashiers) to optimize resource allocation while maintaining service quality.

5. CONCLUSION

The queueing system at Lawson Jatinangor demonstrates very efficient performance, based on the analysis using the M/M/2 queueing model. The system operates at a low utilization rate of only 15%, with an average customer arrival rate of 11 customers per hour and service rate of 36 customers per hour. This indicates that the two available cashiers are not fully utilized during the observation period. The average number of customers in the system (Ls) is recorded at only 0.44, while the average number of customers waiting in the queue (Lq) is just 0.13. Additionally, the average waiting time in the queue (Wq) is approximately 44 seconds, and the total time in the system (Ws) is only 2 minutes and 24 seconds. The probability that the system is empty (P_0) reaches 85%, suggesting that most of the time, the system is not busy. Overall, the service system at Lawson Jatinangor is highly responsive to customer needs and operates under light load conditions. However, the low server utilization may be taken into consideration by management to further improve operational efficiency. For instance, adjusting the number of active cashiers during specific hours could help allocate resources more effectively without compromising service quality.

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