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Simulation Model in Reducing Customer Waiting Time in Fast Food Drive-Thru System: A Case Study in Bangi

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Abstract: The demand of fast food supply is on the increasing trend especially in a society where consumers are busy working. Past researches have shown that most of the working populations are having too little time at home. Therefore, they are demanding a suitable product such as fast food that suits to their lifestyle. Waiting time theory or in other word queuing theory is originated from the mathematical theory that focuses in the waiting lines. This theory usually used and applied in service industry in customer waiting time in waiting lines. The purposes of study is to determine the optimum waiting line model in reducing customer-waiting time and identify the factors for a customer to be in waiting line for a long time period. There are two types of queuing theory that are single queue theory and multiple queue theory. In this research, multiple queue theory will be used to conduct the data collection with the quantitative method, where descriptive analysis is the main instrument used in data collection. The research conducted only in peak hour, which is at the lunch hour time period, from 12pm till 2pm. The data collected through questionnaire that will be analyzed by using Statistical Package for Social Science (SPSS) in order to get the mean score and the frequency of data. Furthermore, the observation and simulation model approach will be used in reducing the customer waiting time in McDonald's restaurant.

Keywords: Waiting time, Waiting line, Simulation model

1. Introduction

Waiting line or queuing theory is the mathematical application of a statistical model to customers flow management. It is helpful to the general public in the event that it very well may be overseen with the goal that both the unit that pauses and the one that serves get the most advantage (Bhat, 2015). The queuing system is a day- today experience of human endeavor. It is a common experience in factually every economic life. There is hardly any economic activity that waiting time is not essential. Customers

wait on line to get attention of the cashiers in the banks and attendants at the filling stations, fast food, barber shops, salon shops, bus-stops, supermarkets, telephone booths, toll gates and food canteen.

Waiting is a non-value added activity. No customer likes a waiting situation. Therefore, it is always a desire of every customer to obtain an efficient and prompt service delivery from a service system. To provide positive waiting experiences, service companies improve the waiting environment by providing music, beverages and complementary snacks (Hsu, 2011; Hul *et al.*, 1997); they control the shape of the waiting line and the number of queuing customers to reduce those customers' negative concerns about queuing time (Baker and Cameron, 1996; Usunier and Valette-Florence, 2007).

1.1 Research Background

In the drive thru operation, customers (cars) arrive at the station, pull up to the drive thru sign, place an order, form a queue once placing an order, pay and receive the order and leave the system. With today fast pace, global and highly competitive environment, management of an organization is frequently looking for new methods to improve their company's operation activities at the same time to increase their profit. Nowadays, too many competitive business fast foods in Malaysia that provide variety of menu and give the excellent service to make customers satisfied. Companies must provide excellent service because it will attract customers and increase the profit. Excellent service is the provision of a level of operational service quality that result in delight (perceived service quality). It has strong emotional impact upon us as customers, creating intense feeling about organization, staff and services, and influencing our loyalty to it. In the globalization era, all companies want to become world class-organization in their business. So, the top management must take opportunity for focusing on their excellent service of the fast-food organization in queuing system by using the simulation model in reducing customers waiting time as the method to improve the company's profit.

With today's advancement technology, by simulation applications becomes a powerful method for analyzing call centers (Saltzman and Mehrotra, 2011). Simulation is the systems have been used to make improvements in operational efficiencies and reduce wait times. Today's restaurants exhibit complex interactions between restaurant equipment, staffing levels, menu selections and customer order mix. Evaluation of how changes will integrate into this complex system often proves to be a challenging task.

1.2 Problem Statements

The demand of fast food supply is on the increasing trend especially in a society where consumers are busy working. Past researches have shown that most of the working populations are having too little time at home. Therefore, they are demanding a suitable product such as fast food that suits to their lifestyle. People have become a popular choice with the fast food especially during the lunch break period. From the reviewed have shown, it will make the fast food restaurant crowded with people in the area of waiting line at the ordering-service counter.

Most waiting line problems are centered on the question of finding the ideal level of services that a firm should provide. Long waiting lines of customers will give the negative emotions or response during customer are queuing and waiting to buy food through the service counter. The management of McDonald's drive-thru can institute operational techniques such as providing more equipment and using simulation model to reduce customer's waiting time in line. This phenomena occur on the peak hour which is when the customers having their lunch at 12pm until 2pm. When a new customer arrives at the service lane, the customer waits until the preceding customer's order is complete and then drives for service. In McDonald's Bangi, they haven't achieved their performance since a few months ago.

These are due to when some products are not available and managers have to void for the cancelled order by customers.

A fast-food restaurant experience variable demand and variable service times. The management may face problem how to reduce customer waiting time, due to the restaurant can't be sure that how much customer demand there order can be unique and require a different service time. As management, it is important to an organization know and understand the kind of waiting line system that consists of characteristics of queuing process, which are the customer population source, the arrival pattern of customers, service pattern of serves, number of service channels, system capacity and queue discipline.

1.3 Research Questions

   (i) What is the optimum waiting line model in reducing customer-waiting time?
   (ii) What is the factor for a customer to be in waiting line for a long time period?

1.4 Research Objectives

   (i) To determine the optimum waiting line model in reducing customer waiting time.
   (ii) To identify the dominant factor for a customer to be in waiting line for a long time period.

1.5 Significance of the Study

The significance of research is to the regular customer that having lunch in the peak hours' time at McDonald's restaurant. People, who are busy working and lack of time to have their lunch at home, prefer to eat at the food outlet especially in fast-food restaurant. This will help them to have a quick lunch just in one hour. This research will give benefits to the fast-food restaurant management to improve their services level and business' operations by reducing customers waiting time at the ordering drive-thrus

1.6 Scope of the Study

The scope of the research is to the regular customers that spend their time at McDonald's Restaurant when peak hour at lunch starts from 12pm until 2pm. This research is being conducted at the selected fast-food drive-thru restaurant, which is McDonald's Restaurant in Bangi, Selangor.

2. Literature Review

Researcher will collect all the information or method, which related with waiting time queuing theory and also the simulation model approaches. Researcher refers some Management Science books in order to solve the problem solving related to the mathematical theory of waiting line in service organization.

2.1 McDonald's Restaurant in Malaysia

McDonald's has started their operation in Malaysia more than 35 years ago. The first restaurant was opened on 29 April 1982 in Jalan Bukit Bintang, Kuala Lumpur. McDonald's have more than 400 business relation with local supliiers. It have 12,000 workers around Malaysiaand 95% are Malaysian. For now, McDonald's have around 260 outlets in Malaysia and will increase to 450 outlets in 2025. McDonals vission is "Make customer enjoy our fast food for every visit" and the mission is "A favourite place for customer to eat". On December 1988, McDonald's have opened it's first Drive-Thru Restaurant in Jalan Pahang, Titiwangsa. In 2008, recognition by the Malaysia Book of Records for the Largest Participation for a Drive-Thru Challege.

2.2 Waiting Line Model

Waiting-line models are useful in both manufacturing and service areas (Heizer & Render, 2011). Analysis of queues in terms of waiting-line length, average waiting time, and other factors helps us to understand service systems such as bank teller stations. Waiting is very appropriate when it is associated in serves under the category of "fast-food industry" and being fast and fresh is the most common trend that McDonald's restaurant even the service organization should emphasize. According to Berry (2006), queue in long time and congestion are not good indication in providing quality services.

According to Cooper (2000), the waiting line model have their characteristics which are applied system in service industry is under the physical configuration through specifying the number and arrangement of serves that focuses in providing the quality of the services in the customers. There are two types of waiting line or queuing model systems, which are single-channel queuing system and multiple channel queuing systems.

Service systems are generally classified in terms of their number of channels (for example, number of servers) and number of stages (for example, number of service stops that must be made). A single-channel queuing system, with one server, is exemplified by the drive-in bank with just one open teller. On the other hand, the bank has several tellers on duty, with every customer waiting in one common line for the most readily accessible teller, at that point we would have a multiple-channel queuing system. Most banks today are multichannel service systems, as are most substantial barbershops, airline ticket counters and post offices. In a single-phase system, the customer gets the service from only one station and then leaves the system.

A fast-food restaurant in which the person who takes your order also brings your food and takes your cash is a single-phase system. However, say the restaurant requires you to place your order at one station, pay at a second and pick up your food at a third. In this case, it is a multiphase system. Likewise, if the driver's license agency is large or busy, you will probably have to wait in one line to complete your application (the first service stop), queue again to have your test graded, and finally go to a third counter to pay your fee. There are two types of waiting line or queuing model systems, which are single channel queuing system and multiple-channel queuing systems.

2.2.1 Single Channel Queuing System

Single-channel system, with one server, is typified by the drive-in bank that has only one open teller, or by the type of drive-through fast-food restaurant that has become so popular in Malaysia. The single-channel queuing system can be seen such as banks and post-offices, where one single queue will diverge into a few counter. The moment of a customer leaves a service station; the customer at the head of queue will go to the server. According to Salyers *et al.* (2006), single-channel queuing system is a naïve approach which performs as an outlet system of finding its ways out in terms of shaping the services process.

2.2.2 Multiple Channel Queuing System

According to Zhang *et al.* (2006), multiple-channel queuing system promises to ensure the efficient and effectiveness in delivering the services through the use of multiple outlets. The Multiple-channel commonly observed in fast food restaurant like Burger King, McDonalds and KFC. Generally, the customers in a multiplechannel queue feel happier because queue length is shorted as they are distributed to different counters.

2.3 Simulation Model Concept

According to Goldsman (2007), a simulation is a model of the operation of a realworldsystem for the purpose of evaluating that system. Support by Law (2007), simulation model is useful when analyzing systems that are too complex to be analyzed using analytical models such as queuing theory. Like queuing theory, simulation allows the researcher to experiment quickly and efficiently (Goldsman, 2007) and maintain tighter control over experimental conditions than if experimenting with the system itself (Law,2007). The purpose of using simulation is to analyze the collected data and avoid costly design errors. Most importantly, simulation can be used to predict the performance of the existing system when the input parameters such as the arrival rate and service rate are changed

2.3.1 Simulation Model of McDonald's Waiting Line

The drive-thru is getting slower (Brad, 2014). Many organizations deliver service offering where people are an intrinsic part of the delivery process, as at McDonald's Restaurant in Bangi. They have tried to achieve process efficiencies by standardization of processes and creating an optimized instantiation of these standardized models. The average for one car is 180 seconds and in one hour their target is 100 cars. The research conducted in McDonald's Restaurant where this fast food-using single channel, multiple phase queuing system. A result of waiting line is a queue, and the queue will get heavy when they have a lot of customers especially during peak hours. So the researcher would like to determine a simulation model in reducing customer-waiting time in the queue.

2.3.2 Input of Waiting Line Simulation

In the waiting line simulation, there are inputs of McDonald's Restaurant that consists of these queuing systems of inter-arrival time, service start time, waiting time, service time, completion time and time in system. The application of simulation for solving waiting lines problems will produce some important information that will help management in decision making so as to reduce customer waiting times, hence protecting balking of customers to competitors (Hamid & Musatrya, 2003).

2.4 Factors of Customers to be in Waiting Line

According to Namin (2017), service quality, food quality and price value ratio have relationship with customer satisfaction and behavioral intentions at fast- food restaurants. Variety of food, food taste and quality, ambience and hygiene, service speed, price, and location are contributes factors for the selection of fast food restaurants.

2.4.1 Factor of Food Quality

Food quality can be an important element in the fast food restaurants but there is no consensus on the individual attributes that constitute food quality. Food quality is an indication of quality of ingredients and food offered by the fast food restaurant that includes the food's cleanness, freshness, and healthiness as well as variety of foods offered at the fast food restaurant (Namin, 2017).

2.4.2 Service Quality

Service quality is intangible, relativistic and indivisible and has a tendency to deteriorate. Service quality is more a function of attitude than technology. It consists of technical quality (hard part) and functional quality (soft part). Some of the difficulties of determining service quality would strongly let customers to make high emotional judgment about the quality of services (Sridhar, 2001).

2.4.3 Excellent Service

An excellent service and reputation provided by the service organization is exceeding the customer expectations. Excellent service is the provision of a level operational service quality that results in delight (perceived service quality). Excellent service is a good experience, the right outcome with the right products and benefits, then will satisfy, indeed delight customers.

2.4.4 Factor of Time

According to Dharmawirya, Oktadiana, & Adi (2012), waiting time is something that needs to be managed seriously, especially in fast food restaurants. Other sources have mentioned that the fast food restaurant is often categorized under quick-service restaurant, even though not all quick-service restaurants serve fast food. The main characteristics of quick-service restaurants are speedy service, inexpensive food items, simple décor, limited menu normally displayed on a wall, and convenience.

2.4.5 Factor of price

Queues through such promotional activities as creating a long queue, limiting the quantity of goods available, fixing and short promotional time, broadcasting about their products through the news media, selling well-known goods, creating a crowd through hiring volunteers, establishing events that stimulate customer curiosity and offering low prices (Friman, 2010).

3. Research Methodology

In this research study, quantitative method is used as the research methodology in order to achieve to research objective. The population is made up of the customers of McDonald's Restaurant who are regularly having their lunch in fast-food restaurant at lunch peak hour in 2018.The number of population of McDonald's Restaurant in Bangi has 260 customers in March 2018 for the lunch time period.

In this research study, a questionnaire is used as the data collection instrument. The questionnaire is divided into two parts, which are Part A and Part B. Part A, is the demographic information of respondents. Part B consists of the dominant factors for a customer to be in waiting line during the lunch hours. The data will analyse by Statistical Package for the Social Sciences (SPSS).

For the simulation part, the data that is collected are the customers' inter-arrival time (uniform distribution) and service time (normal distribution). Once data is collected, data will stimulate and calculate by using the formulas of selected simulation model, which related with the queuing theory system. All the calculation is done through Microsoft Excel by using the simulation model approach and normal random distribution.

4. Data Analysis and Results

4.1 Simulation Model in Reducing McDonald's Restaurant Customer Waiting Time

The simulation model data in reducing customer-waiting time is collected through the self-observation of customer inter-arrival time and employees' service time at McDonald's Restaurant in Bangi. The inter-arrival time is calculated by using uniform distribution of observation in the waiting line of ordering-services counter at McDonald's Restaurant in Bangi. From researcher observation at McDonald's Restaurant, the smallest inter- arrival time for ordering process, cashier window and pick

up window is 4.29 seconds, 11.32 seconds and 13.89 respectively. Whereas the largest value of customer arrival for ordering process, cashier window and pick up window is 17.23 seconds, 32.48 seconds and 36.6 seconds respectively. The services time is calculated by using normal distribution where the results are in term of mean and standard deviation. The mean services time for ordering process is 10.2 seconds and the standard deviation is 3.4 seconds. While, for payment window, the mean is 24.7 seconds and standard deviation is 6.6 seconds. At the pick up window, the mean is 23.5 seconds, whereas the standard deviation is 5.4 seconds.

4.2 The Factor for Customer to be in Waiting Line during Lunch Treat Hours

Table 1: Mean values for food quality

Factor of Food Quality	Mean	Stage
Food provided is in fresh condition	4.15	High
The food presentation is reasonably attractive.	3.64	High
Variety of food options on the menu.	3.75	High
The food taste achieves high-satisfying level.	3.89	High
Total Average of Mean	3.86	High

Table 1 shows, the overall element of food quality required high level that average mean is 3.86. The highest element of mean is 4.15 that describe the food freshness in the McDonald's Restaurant. The other three element being considered as high level of mean which are describe the food taste achieves high satisfied level of customer in McDonald's Restaurant, variety of food options on the menu in McDonald's Restaurant is good and the food presentation is reasonably attractive with the mean 3.89, 3.75 and 3.64 respectively.

Table 2: Mean values for service

Factor of Service	Mean	Stage
The services counter is well organized throughout lunch threat hours.	3.90	High
The staffs are being professional during busy times.	3.93	High
The staffs at the services counter are customer-friendly.	3.65	High
The services provided are very fast and responsive.	3.54	High
The customers feel convenient to place an order and make their payment.	3.73	High
Total Average of Mean	3.75	High

Table 2 shows, the overall elements factor of services required in high level satisfaction that average mean is 3.75. The highest element that is the customers said that the staffs are being professional during

busy times with 3.93 mean. The services counter at McDonald's is well organized throughout lunch threat hours with mean 3.90. Besides, the customers feel convenient to place an order and make a payment and the staff are customer- friendly with required average mean is 3.73 and 3.65 respectively. Based on the analysis, customers have agreed that the services provided at McDonald's Restaurant are very fast and responsive which average mean are 3.54 in high-satisfied level.

Table 3: Mean values for environment

Factor Environment	Mean	Stage
The customers feel convenient with the parking place.	4.21	High
The interior decoration and design of McDonald's very attractive	3.72	High
The environment at McDonald's is thoroughly clean	3.74	High
The waiting line at McDonald's service counter is arranged systematically	3.56	High
Total Average of Mean	3.81	High

Table 3 shows, the customers feel convenient with the parking place of McDonald's Restaurant that required the mean only 4.21 which in high stage. Besides, other elements factor of services in high stage level where the interior decoration and design of McDonald's very attractive, the environment at McDonald's is thoroughly clean and the waiting line at McDonald's service counter is arranged systematically that required average mean 3.72, 3.74 and 3.56 for each elements. The total mean in medium level with is 3.81.

Table 4: Mean values for time

Factor Time	Mean	Stage
The lunch treats promotion time period convenient to customers.	4.18	High
The waiting time to place an order in the drive-thru pathway is at satisfactory level.	3.49	Medium

The waiting time to place payment in the drive-thru pathway is at satisfactory level.	3.50	High
The waiting time to pick-up the order in the drive-thru pathway is at satisfactory level.	3.48	Medium
Total Average of Mean	3.66	High

Table 4 shows that the highest element factor of time which McDonald's lunch treat promotion serve convenient to all level of customer required higher level with mean 4.18. While, the waiting time to place an order, payment and pick-up order in drive-thru pathway is at satisfaction levels that are 3.49, 3.50 and 3.48 respectively. The average mean for factor of time in high level with scored 3.66.

Table 5: Mean values for price

Factor Price	Mean	Stage
The lunch treat price at McDonald's is affordable	4.32	High
The food and beverages in lunch treat promotion worth the price.	4.34	High
Total Average of Mean	4.33	High

Table 5 shows, that the mean for each element in the high satisfied level for customer McDonald's Restaurant with the total average mean is 4.33. All the two elements factor of price in high level where the lunch treat price at the McDonald's is affordable with mean scored is 4.32. However, the food and beverage in lunch treat promotion worth the price scored 4.34.

Table 6: Summary of factors

Factors	Mean	Stage
Food Quality	3.86	High
Services	3.75	High
Environment	3.81	High
Time	3.66	High
Price	4.33	High

Table 6 shows that the highest mean for factor of customer McDonald's Restaurant to be in waiting line is because of price with mean 4.33 that required high satisfied level. Besides, the second high mean is factor of food quality with 3.86. The manager McDonald's said that they would always make sure the ingredient of food that been served always fresh. Next, the customers feel convenience with the parking place at the McDonald's Restaurant in Bangi that scored 3.81. Besides, the factor of services and time are in high stage with 3.75 and 3.66 respectively.

5. Discussion and Conclusion

5.1 Research Objective 1: Summary of simulation in reducing McDonald's Restaurant customer waiting time

According to this research, the simulation model in reducing customer-waiting time is determined. The researcher was determining simulation for 2000 customers by using only an ordering, cashier window and pick up window at McDonald's Restaurant in Bangi. It is including the inter-arrival time, service start time, waiting time, service time, completion time, and time in system. The researcher was using normal distribution in calculating the simulation. Based on findings, it is about 1747 arriving customers have to wait at the ordering process. While the number of waiting at the cashier window is 1656. Whereas, the customer waiting at pick up window is 1744. The total number of customer is more than half and this show that the services is not efficient with the large waiting time. The total average waiting time in system for ordering process, cashier window and pick up window is 84.58 seconds which is less than 180 seconds of McDonald's Bangi benchmaking management. Thus, opening a second ordering and serving counter must be considered.

5.2 Research Objective 2: Summary of factor for customer to be in waiting line during lunch treat hours at McDonald's Restaurant in Bangi

Based on the research, there are five factors for customer to be in waiting line during lunch treat hours at McDonald's Restaurant in Bangi, which are food quality, services, environment, time and price. From the results, the dominant factor for customer to be in waiting line is price. This is due to it obtained the highest total average mean that is 4.33. Mostly respondents strongly agreed the food and beverages in lunch treat promotion worth the price. So, it can be concluded that the workers and their system are working effectively and there is no flaws at McDonald's in Bangi.

5.3 Limitation of study

For the limitation, the researcher was focus on an organization, which is McDonald's Restaurant in Bangi. First, the time of gathering data only one-week durations in lunch treat hours that had been given by organization of McDonald's Restaurant. The second limitation is data collected by researcher. The manager or interviewee needs to protect the organization's privacy, so that the researcher only gets the basic information of McDonald's Restaurant. Other than that, sometimes the queuing of customers at the drive-thru counter is not systematically, so that the researcher difficult to observe and record the inter-arrival times and services times of customer waiting in their waiting line.

5.4 Recommendation

5.4.1 Recommendation for McDonald's Restaurant in Bangi

From the findings, it shows that the services provided by McDonald's Restaurant are in satisfactory level towards the customer. But, there are still certain services that customer not satisfied, especially in the waiting line at drive-thru counter. Based on the results, researcher recommends that the company should applied simulation model within ordering, payment and pick up system. Simulation model will manage the services operates into a systematically ways. A systematic ordering and payment will help the pick up counter reduce the waiting time of the customers.

5.4.1 Recommendations for Future Research

After conducting a study of optimum waiting line model for reducing customer waiting time and dominant factor for a customer to be in waiting line, current researcher is suggested more research needs to be done at the other fast food restaurant in this country. First, the future researcher can improve this

study with wider scope and large number of population, so the findings will be more accurate and acceptable. The future researches also can do research by combining one fast food restaurant in one state or country. Secondly, there is an additional instrument using method such as qualitative method which conducting some interview for getting the more accurate information regarding the research study. Moreover, the other method of simulation model that related in this study such as Poisson distribution also been suggested and more challenging for the future research.

5.5 Conclusion

Based on this research, the suggestion and feedback from customer McDonald's Restaurant are important in providing services in order to give great satisfaction to the customers. It is to improve the customer's frequently of purchasing food in McDonald's Restaurant and then the company will achieve the high profits and customer loyalty.

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