

A queueing system
study for refueling
service at shell
gasoline station of
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A QUEUEING SYSTEM STUDY FOR REFUELING SERVICE AT SHELL GASOLINE STATION OF MAHAYAG, ISABEL, LEYTE Undergraduate Thesis VISAYAS STATE UNIVERSITY Visca, Baybay City, Leyte, Philippines DENNIS RODADO ARANO Second Semester S. Y. 2009-2010 A QUEUEING SYSTEM STUDY FOR REFUELING SERVICE AT SHELL GASOLINE STATION OF MAHAYAG, ISABEL, LEYTE VISAYAS STATE UNIVERSITY Visca, Baybay City, Philippines DENNIS RODADO ARANO April 2010 VISAYAS STATE UNIVERSITY Visca, Baybay, Leyte 6521-A COLLEGE OF INDUSTRIAL TECHNOLOGY Department of Engineering UNDERGRADUATE THESIS NAME OF STUDENT: DENNIS RODADO ARANO DEGREE: Bachelor of Science in Industrial Engineering THESIS TITLE: A QUEUEING SYSTEM STUDY FOR REFUELING SERVICE AT SHELL GASOLINE STATION OF MAHAYAG, ISABEL, LEYTE APPROVED: ENGR. ARTVIN B. BOLLEDO, Thesis Adviser Date: _____ REVIEWED: Student Research Committee ALBERTO S. PASANA M. Eng, Chairman Date: _____ ENGR. ANNA MARIE G. RAMIREZ, Member Date: _____ APPROVED: ENGR. JOVELINO A. AMORES, Department Head Date: _____ RECORDED: GLORIA C. GERMAN, College Registrar Date: _____

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DEPARTMENT OF ENGINEERING GENERAL EVALUATION OF THE STUDENT

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Queueing System Study for Refueling Service at Shell Gasoline Station of
Mahayag, Isabel, Leyte. Adviser: Engr. Artvin B.

Bolledo The study aimed to evaluate whether there are queues formed in the system by: (1) determining the arrival rate of the customers in the system, (2) determining the service rate of the customers in the system, and to evaluate the behavioral characteristics of waiting line by determining: (1) the average utilization of the system, (2) the average number of customers waiting in line, (3) the average number of customers in the system, (4) the average waiting time in line of customers, and (5) the average time in the system. The Isabel Shell Gasoline Station is a standard one consisting of three gasoline pumps, three diesel pumps, and one kerosene pump. The station is open from 5: 00 a. m. up to 9: 00 p. m. a day and seven days a week with straight time shift of workers.

Every week, a truck comes in to fill up the station's underground gas tanks. Three people in the gas station attend at the counter. The amount of customers wanting gasoline always depends on the part of the day, its either morning or afternoon. If all gasoline pumps are busy, a customer will wait in the one which has the shortest queue. But, if all pumps have a long waiting
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line, the arriving customer will refuse to wait and leave. The scope of this study regarding queueing system, arrival and service rate of customers has been gathered by using time and motion study. This arrival and service rate will be the basis for evaluating the waiting time of customer by using simulation process.

The simulation process is use 1000 simulated days to have close possible results generated by random numbers As the result of this study, (1) The arrival rate is 24 customers per hour, (2) The service rate is 47 customers per hour, (3) Utilization is 51 percent, (4) There are 8 customers wait in line at 36 seconds of waiting time, and (5) there are 9 customers served the system after 1. 8 minutes. The system was servicing customers about 8. 16 hours only with 7. 84 hours as the idle time of the system. Therefore, base on the overall simulation (averaging the queues on 7 days) it reflects that there is no queue formed on the system with 51 % of utilization only.

Keywords: Queuing System, Simulation, Shell Gasoline Station Mahayag, Isabel, Leyte. A QUEUEING SYSTEM STUDY FOR REFUELLING SERVICE AT SHELL GASOLINE STATION OF MAHAYAG, ISABEL, LEYTE 1/ DENNIS RODADO ARANO A thesis manuscript presented in Partial Fulfilment of the requirements for the Degree of Bachelor of Science in Industrial Engineering. Presented to the faculty of Engineering Department Visayas State University - Isabel Campus Inavs, Isabel, Leyte 1/ CHAPTER I INTRODUCTION A.

BACKGROUND OF THE STUDY Customers arrive at Shell gas station in order to get gas. The gas station is a standard one consisting of three gas pumps, three diesel pumps and one kerosene pump. The station is open from 5: 00 a. m. up to 9: 00 p. m. day and seven days a week with straight time shift of <https://assignbuster.com/a-queueing-system-study-for-refueling-service-at-shell-gasoline-station-of-mahayag/>

workers. Every week, a truck comes in to fill up the station's underground gas tanks. Three people in the gas station attend at the counter. He or she is allowed to take a fifteen minute's break every three hours. The gas station is also offering other services (like car washing, change oil, undercoating, vacuum service and so on.). The amount of customers wanting gas always depends on the part of the day, its either morning or afternoon. If all gas pumps are busy, a customer will wait in the one which has the shortest queue. But, if all pumps have a long waiting line, the arriving customer will refuse to wait and leave.

The analysis of this queueing system was directly identified the following selected statistical observation such as (probability that there are n arrivals in the system, probability of the system being empty - expected idle time of the system, probability of the system being not empty - expected busy time of the system or expected utilization, the expected number in the waiting line and/ or being serviced, the expected number in the queue, the average waiting time (in the queue) of an arrival, and lastly is to find the average time a customer spends in the system both waiting and in service). During the operation the researcher observed that the more customers come and waits in line is on the pumps 1 and 2.

Based on the Layout of the station, the pump's 1 and 2 reflects the super premium gasoline, a kind of gasoline that use for tricycle, motor single, auto, and multicab. Most of the time this pumps are the cause of queue for other pumps like diesel, regular, and kerosene pump, its because there are 3 or 4 customers arrive every minute, Therefore, the researcher conducts a study on the super premium gasoline pumps to determine the waiting time of the <https://assignbuster.com/a-queueing-system-study-for-refueling-service-at-shell-gasoline-station-of-mahayag/>

customer. Because due to this busy pumps sometimes the customer on the other pump is lost. Lost in the since, they can leave the station and go to other gasoline station (Petron Gasoline- the existing competitor of the said system).

However, shell management confused if the existing worker of three pump attendants (Gasoline Boys) and one Casher are really the best requirements of the station or the optimal number of worker of the station. The main goal of the researcher is to evaluate a result of Monday to Sunday simulation to give an overview or idea to shell management about waiting line of customer.

B. OBJECTIVE OF THE STUDY The aim of this research is to study the Queueing System for Refuelling Service at Shell Gasoline Station, Mahayag, Isabel Leyte. Specifically, this study attempts to:

- 1) Determine the arrival rate of the customers in the system.
- 2) Determine the service rate of the customers in the system.
- 3) Evaluate the behavioural characteristics of waiting line through determining the following:
 3. 1 The average utilization of the system.
 3. 2 The average number of customers waiting in line.
 3. 3 The average number of customers in the system.
 3. 4 The average waiting time in line of customers.
 3. 5 The average time in the system.

C. SIGNIFICANCE OF THE STUDY The results of this study could help the company to know and determine the characteristics of the queue such as (average number of people in line, average time that person waits, average utilization of the server system, average time that a person is in the system). This study will greatly help the company especially at Shell management to find possible solution regarding the waiting line (queues) form of the station and make ways to improve servicing rate of the customers.

This will also help the manager to know the waiting time of the customer and use it as baseline in making a decision. Through this study customers will know how much time they have to wait in the system for a service specifically on getting super premium gasoline for there vehicles like tricycle, motor single, auto and multicab. This study help the researcher to identify the systems (especially the two pumps) if line (queues) are form or not. Through this study the researcher could learn more about the waiting time of the customers. This could motivate and challenge the researcher to study and analyze the average arrival and service rate of the customers.

With that, this study contributes some important things and information which really helpful in deciding things that could help to improve the station.

D. SCOPE AND LIMITATION OF THE STUDY The scope of this study is to find out how often customers arrive for each part of the day, how long it usually takes customers to refill the gasoline into their vehicles, find out the average queue length at which the customers will choose to leave, rather than joining the queue. Another scope is to determine if the 3 gasoline boys and 1 cashier of the station is an optimal. And this study is only limited to the number of hours as to which the business operates from 5: 00 a. m. to 1: 00 p. m, for the first shift, 1: 00 p. m to 9: 00 p. m for the second shift.

Other services offer by the business like (car washing, change oil, undercoating, and etc) is not concerned of this study. It can only limit to pump 1 & 2. **E. CONCEPTUAL FRAMEWORK INPUT PROCESS OUTPUT**

Observation of ARRIVAL RATE SERVICE RATE QUEUING SYSTEM Through

SIMULATION DETERMINE QUEUES FORM Figure: 1 Conceptual Paradigm of

the Study The conceptual framework classifies the relationships between and <https://assignbuster.com/a-queueing-system-study-for-refueling-service-at-shell-gasoline-station-of-mahayag/>

among the major variables of the study. In the context of this study, the inputs include to define its paradigm are as follows: observation of arrival rate and service rate. The queueing system through simulation was the main process of the study. It was done by the researcher to determine the queues form of the pumps 1 & 2. F.

DEFINITION OF TERMS Arrival rate - the expected number of customers that arrive each period Diesoline Ultra - this diesel are used to Buses, Pajero, Damntruck, and any other heavy equipment. Forecourt area - a working place Kerosene - this is used for airplane. Line length - long lines indicate poor customer service, inefficient service, or inadequate capacity. Lubricants - a substance, as oil or grease, for lessening friction, esp. in the working parts of a mechanism. Number of customers in system - a large number causes congestion and dissatisfaction. Queue - is a line of one or more people waiting for service. Random Numbers - numbers in a table generated by computer, each of which has an equal likelihood of being selected at random. Regular - this is a kind of a gasoline that used for Pam boat, motor single ike (Yamaha brand and sometimes used for aura). Service rate - the capacity of a server measured in number of units that can be processed over a given time period. Simulation - an approach to operational problem solving in which real world problem situation is reflected within a mathematical model. Super Premium - this is a kind of a gasoline also called (extra, special) for other gasoline station. This is used for motor single, tricycle, auto, and multicab. Total time in system - may indicate problems with customers, server efficiency, or capacity. Waiting time in line - long waits are

associated with poor service CHAPTER II REVIEW OF RELATED LITERATURE AND STUDIES

RELATED LITERATURE Queuing theory first began early in this century with applications to Telephone Engineering (the founder of queuing theory, A. K. Erlang, was an employee of the Danish Telephone Company in Copenhagen), and telephone engineering still is an important application. According to Erlang there are four broad classes of queuing systems are as follows: One important class of queuing systems that we all encounter in our daily lives is commercial service systems, where outside customers receive service from commercial organizations. Many of these involve person-to-person service at a fixed location, such as a barber shop (the barbers are the servers), bank teller service, checkout stands at a grocery store, and a cafeteria line (service channels in series).

However, many others do not, such as home appliance repairs (the server travels to the customers), a vending machine (the server is a machine), and a gas station (the cars are the customers). Another important class is transportation service systems. For some of these systems the vehicles are the customers, such as cars waiting at a tollbooth or traffic light (the server), a truck or ship waiting to be loaded or unloaded by a crew (the server), and airplanes waiting to land or take off from a runway (the server). (An unusual example of this kind is a parking lot, where the cars are the customers and the parking spaces are the serves, but there is no queue because arriving customers go elsewhere to park if the lot is full). In other cases, the vehicles, such as taxicabs, fire trucks, and elevators, are the server.

In recent years, queuing theory probably has been applied most to business industrial internal service systems, where the customers receiving service are internal to the organization. Examples include materials-handling systems, where materials handling units (the server) move loads (the customers); maintenance systems, where maintenance crews (the server) repair machines (the customers); and inspection stations, where quality control inspector (the server) inspect items (the customers). Employee facilities and departments servicing employees also fit into this category. In addition, machines can be viewed as servers whose customers are the jobs being processed. A related example of great importance is a computer facility, where the computer is viewed as the server.

There is now growing recognition that queuing theory also is applicable to social service systems. For example, a judicial system is a queuing network, where the courts are service facilities, the judges (or panels of judges) are the servers, and the cases waiting to be tried are the customers. A legislative system is a similar queuing network, where the customers are the bills waiting to be processed. Various health-care systems also are queuing systems. Example a hospital emergency room, but you can also view ambulances, x-ray machines, and hospital beds as servers in their own queuing systems. Similarly, families waiting for low-and moderate-income housing, or other social services, can be viewed as customers in a queuing system.

Queuing theory is used to assess characteristics of the queue such as average number of people in line, average time that person waits, average utilisation of the server system, average time that a person is in the system, <https://assignbuster.com/a-queueing-system-study-for-refueling-service-at-shell-gasoline-station-of-mahayag/>

etc. with this information, managerial decisions can be made regarding how many servers to schedule, when to schedule servers based on arrival rates, how to layout the queue system (one line or multiple line), process improvements and training to reduce service time (increase service rate), etc. When a series of services is performed in sequence where the output rate of one becomes the input rate of the next, they can no longer use the simple formulas. Queuing problems that seem simple on first impression turn out to be extremely difficult or impossible to solve.

The technique best suited to solving this type of problem is computer simulation. Simulation originated during the Chinese war games called weich'i, way back 5, 000 years ago and continues through 1780, when the Prussians used the games to help train their army. Since then, all major military powers have used war games to test out military strategies under simulated environments (Jay Heizer 2003). From military to operational gaming, a new concept, Monte Carlo simulation, was developed as a quantitative technique by the great mathematician John von Neumann during World War II. Monte Carlo simulation is experimentation on chance or probabilistic elements by means of random sampling (Roberta S. Russel 2003).

Today, thousand of business, government and service organizations develop simulation models to assist in making decisions concerning inventory control, maintenance scheduling, plant lay-out, investments, sales forecasting and even labor hiring decisions. A simulation is an imitation of some real thing, state of affairs, or process. The act of simulating something generally entails representing certain key characteristics or behaviors of a selected physical <https://assignbuster.com/a-queueing-system-study-for-refueling-service-at-shell-gasoline-station-of-mahayag/>

or abstract system. Simulation has become an increasingly important quantitative technique for solving problems in operation. Surveys have shown simulation to be one of the techniques most widely applied to real world problems. Evidence of this popularity is the number of specialized simulation languages that have been developed by computer industry and academia to deal with complex problems areas.

The popularity of simulation is due in large part of the flexibility it allows in analyzing systems, compared with more confining analytical techniques. In other words, the problem does not have to fit the model (or technique); the simulation model can be constructed to fit the problem. Simulation is popular also because it is an excellent experimental technique, enabling systems and problems to be tested within a laboratory setting (Bernard W. Taylor III 2003). However, in spite of its versatility, simulation has limitations and must be used with caution. One limitation is that simulation models are typically unstructured and must be developed for a system or problem that is also unstructured.

As a result, developing simulation models often requires a certain amount of imagination and intuitiveness that is not required by some of the straight forward solution techniques. RELATED STUDY: There are several study of the problem about queueing or waiting line of customers. Like the China Bank. A bank wants to know how many customers are waiting for a drive-in teller, how long they have to wait, the utilization of the teller, and what the service rate would have to be so that 95 percent of the time there will not be more than three cars in the system at any time. China Bank is considering opening a drive-through window for customer service. Management estimates that <https://assignbuster.com/a-queueing-system-study-for-refueling-service-at-shell-gasoline-station-of-mahayag/>

customers will arrive at the rate of 15 per hour. The teller who will staff the window car service customers at the rate of one every three minutes.

The bank assuming Poisson arrivals and exponential service, find (utilization of the teller, average number in the waiting line, average number in the system, average waiting time in line, average time in the system, including service). Using formulas, they can solve and know the results of each problem. Which utilization is 75%, average number in the waiting line is 2.25 customers, the average number in the system is 3 customers, the average waiting time in line is 0.15, or 9 minutes, and the average waiting time in the system is 0.2 hour, or 12 minutes. * The Valdese Machine Tool Company operates an inventory warehouse which issues raw material to supervisors. Currently, two persons are assigned to operate the system. The number of supervisors who use the warehouse is 10.

Beth James a senior member of the operations department believes that the line of supervisors which develops at the warehouse every day is inefficient. She realizes from her knowledge of queueing models that the number of supervisors is probably too small to be represented by an infinite population; she also has come to the conclusion that the distribution of the number of arrivals per unit of time is not Poisson; neither is the distribution of service times exponential. She realizes that with a multi-channel queueing situation which doesn't meet those conditions, finding an analytical model is almost impossible. Therefore she decides to simulate the system. * In this study of queueing system for refuelling service at Isabel shell gasoline station is the researcher will show how to simulate part of an operations management system by building a mathematical model that comes as close as possible to <https://assignbuster.com/a-queueing-system-study-for-refueling-service-at-shell-gasoline-station-of-mahayag/>

represent the validity of the system especially on minimizing queue length. * Operation Management for Competitive Advantages, Chase, Aquilano, Jacobs; 243. ** Quantitative Approaches to Management, Richard I. Levin, David S. Rubin, Joel P. Stinson, Everette S. Gardner, Jr. ; 728. CHAPTER III METHODOLOGY In order to have the specified data needed for the whole study, the researcher conducted the following: ? Necessary data related to the study were gathered from the internet, existing books of waiting line or (queue) in the library and other research materials for the references as well as related examples. To be familiar with the situation of the forecourt area, and collect data, observation was made. ? Selection of appropriate tools to be used on this study. The researcher conduct simulation model to determine the characteristics of the queue such as (average number of people in line, average time that person waits, average utilization of the server system, average time that a person is in the system), and see the system (especially pump 1 and 2) which is the highest average arrival or service rate. RESEARCH DESIGN: The design used in this study is the descriptive method for the reason that it involves the analysis, interpretation and evaluation of the data gathered.

Descriptive Method aim to describe the nature of situation as it is exist at the time of the study and to explore the causes (Travers, 1978). RESEARCH INSTRUMENT: In operations system queuing theory (waiting lines) is an important part and a valuable tool for the operations manager. A waiting-line model is useful in service area. Analysis of queues in terms of waiting-line length, average waiting time, and other factors helps us to understand service systems. On this study, the researcher is used Time Study Sheet

Form for gathering data of Arrival and Service rate of customers. (See Appendixes: 4, Arrival and Service Time Data Form). The Form was designed to generate the simulation model.

On this model random numbers are generated to treat the variables simultaneously. Where it uses 1000 samples or 1000 simulated days to have an accurate results. With these numbers of samples, it cannot be handled by manual calculation alone. It requires a program or application such as Microsoft Excel to have an easy and efficient calculation. RESEARCH VALIDATION: This study is authorized by the manager of shell station Engr. Romelo Mappala. RESEARCH PROCEDURE: In every study, it is important to establish a research procedure in a scientific way. In which every factors should be considered on a study like, the important data to be gathered and how to treat that data reflecting its primary objectives.

Data gathering procedure is first and foremost before applying the simulation model. These are the data required for the simulation model: ? Arrival rate These are the expected number of customers that arrive each period. These data are needed to get the total arrival of customers per hour and until 8 hours. ? Service rate These are the capacity of a server measured in number of units that can be processed over a given time period. These data are needed for the computation of customers time spend in a system for a service that will be used for the simulation model. The next procedure is to treat the data with specified tool being used on this study which is the Simulation.

The following are the procedures used in such simulation: 1. Setting up a probability distribution for important variables. And building a cumulative probability distribution for these variables. 2. Establishing an interval of random numbers for each variable. 3. Generating random numbers.

STATISTICAL TREATMENT OF THE STUDY After data gathering procedure, the researcher treats these data using singlechannel, multiphase formula. ? The average utilization $\rho = \lambda / \mu$? The average number in the waiting line $n_L = \frac{\lambda}{\mu(\mu - \lambda)}$? The average number in the system $n_S = n_L + \lambda$? The average waiting time in line $t_L = \frac{\lambda}{\mu(\mu - \lambda)}$? The average time in the system $t_S = t_L + 1/\mu$ where: λ arrival rate, μ = service rate

The Simulation Procedure: ? Setting up a probability distribution for important variables. And building a cumulative probability distribution for important variables. These important variables include the Arrival rate and Service rate of customers. Excel Formula “ = Vlookup(lookup_value, table_array, col_index_num, [range_lookup])”. ? Establishing an interval of random numbers for each variable. ? Generating random numbers. With the use of the Excel formula “= Rounddown(number, num_digits)”, or “= Rounddown(Rand()*100, 0)”, it can create a series of random numbers within a matter of seconds. CHAPTER IV RESULTS AND DISCUSSION

On this chapter the researcher presents all data had been gathered on this study as well as on its statistical treatment or analysis where he presents some important variables through tables and figures to widely explain about the study. And this part also shows how the simulation process conducted for this kind of this study. 4. 1. Arrival Rate, Service Rate, Behavioral

Characteristics of Waiting Line. 4. 1. A. Monday Arrival Rate The table shows

the frequency and probability. The table shows the arrival rate of customers in a day. As you can see the table 1, the customers arrive in the station to refuel or buy super premium gasoline for the vehicles especially motor, auto, multicab are 21 to 39 customers per hour, indicate the highest probability.

The table 1 also reflects the cumulative probability distribution for the arrival rate of customers. The conversion from a regular probability distribution, to a cumulative probability distribution is an easy job. In column 4, the cumulative probability of arrival rate of customers, is the sum of the number in the probability column (column 3) added to the previous probability. In column 5 random numbers is reflected. If random numbers fall from 00 until 02 reflects a 2 customers per hour. Another are, if the random number falls between 03 to 05 it will results a 7 customers per hour that is arrive at the system, and so on. Table 1: Monday Arrival Rate of Customers

Arrival Rate (CUSTOMERS PER HOUR)	Frequency	Probability of Occurrences	Cumulative Probability	Random Numbers
2	1	1/32 = 0.031	1/32 = 0.031	00
7	1	1/32 = 0.031	2/32 = 0.063	03
9	1	1/32 = 0.031	3/32 = 0.094	06
11	1	1/32 = 0.031	4/32 = 0.125	09
12	1	1/32 = 0.031	5/32 = 0.156	12
13	1	1/32 = 0.031	6/32 = 0.188	15
14	2	2/32 = 0.063	8/32 = 0.250	18
16	1	1/32 = 0.031	9/32 = 0.281	21
17	1	1/32 = 0.031	10/32 = 0.313	24
18	2	2/32 = 0.063	12/32 = 0.375	27
20	1	1/32 = 0.031	13/32 = 0.406	30
21	1	1/32 = 0.031	14/32 = 0.438	33
22	1	1/32 = 0.031	15/32 = 0.469	36
25	1	1/32 = 0.031	16/32 = 0.500	39
27	1	1/32 = 0.031	17/32 = 0.531	42
28	1	1/32 = 0.031	18/32 = 0.563	45
29	1	1/32 = 0.031	19/32 = 0.594	48
32	1	1/32 = 0.031	20/32 = 0.625	51
33	1	1/32 = 0.031	21/32 = 0.656	54
34	1	1/32 = 0.031	22/32 = 0.688	57
39	1	1/32 = 0.031	23/32 = 0.719	60
43	1	1/32 = 0.031	24/32 = 0.750	63
49	1	1/32 = 0.031	25/32 = 0.781	66
TOTAL	32	1.000	1.000	99

Service Rate The table shows the service time of the systems of Monday. The table shows the computation of unit of service that would be customers per hour. (See table 2, Monday Service Rate of customers). It is showing also frequency, probability and cumulative probability. The service rate computed as 1 minute divided by 60 minute is equals to 0. 01667 hours. Convert hour to customer per hour is 1 customer divided by 0. 01667 hour is equal to 60 customers per hour, and so on. The table shows, that a 0. 01667 hour or 1 minute get the highest probability of 0. 93. Another outcome shows that a 0. 033 hour or 2 minutes get 0. 06 probability and a 0. 0667 hour or 3 minutes also get 0. 01 probabilities.

The same interpretation with the arrival rate table, column 4 or cumulative probability of service rate is the sum of the number in the probability column (column 3) added to the previous cumulative probability. In column 5, random numbers intervals are reflected. If a random numbers fall from 00 until 92 reflects a 60 customers per hour. Another is, if the number falls between 93 to 98 it will results a 30 customers per hour that is serve by the system, and so on. Table 2: Monday Service Rate of Customers

(1) Service Rate (CUSTOMERS PER HOUR)	(2) Frequency	(3) Probability of Occurrences	(4) Cumulative Probability	(5) Random Numbers
60	38	0. 93	0. 93	00 - 92
30	20	0. 06	0. 99	93 - 98
20	9	0. 01	1. 00	99 - 99
TOTAL	638	0. 93	99%	100%

Simulation Result of Monday The table 3 shows that in every hour there are 25 customers arrive at the station to refuel their vehicles. The service rate is 59 customers served the system in every hour. Therefore, there is no queues form on Monday because the arrival rate is smaller than to service rate. The <https://assignbuster.com/a-queueing-system-study-for-refueling-service-at-shell-gasoline-station-of-mahayag/>

system was servicing customers only about 6.88 hours out of 16 hour operation. The remaining 9.12 hours is the idle time of the system. This idle time is utilized to other systems. There is 1 customer wait in line at 0.01 or 36 seconds of waiting line. And there is only 1 customer served the system after 0.04 hour or 2.4 minutes. The table shows the results of the simulation based on 1000 simulated days.

Table 3: Monday Simulation Results Averages Arrival rate Service rate

Utilization Number of customers waiting in line Number of customer in the system Waiting time in line Total time in the system Results 25 customers per hour 59 customers per hour 43 percent 1 customer 1 customer 0.01

hour (0.6 min) 0.04 hour (2.4 min) 4. 1. B. Tuesday Arrival Rate of

Customers The table shows the frequency, probability of occurrences,

cumulative probability and random numbers. The customers arrive in the

station to refuel or buy super premium gasoline for the vehicles especially motor, auto, multicab is 25 customers per hour, indicate the highest

probability If random numbers fall from 00 until 02 reflects a 3 customers per hour.

Another are, if the random number falls between 03 to 08 it will results a 7 customers per hour that is arrive at the system, and so on. Table 4: Tuesday

Arrival Rate of Customers (1) Arrival Rate (CUSTOMERS PER HOUR) (3)

Probability of Occurrences (4) Cumulative Probability (5) Random Numbers

(2) Frequency 3 7 10 13 14 16 17 18 19 21 24 25 26 27 28 29 31 33 35 37

TOTAL 1 2 1 2 1 1 1 1 2 1 2 4 2 3 1 2 1 2 1 1 32 0.031 0.063 0.031 0.063

0.031 0.031 0.031 0.031 0.063 0.031 0.063 0.125 0.063 0.094 0.031

0.063 0.031 0.063 0.031 0.031 1.000 3 9 13 19 22 25 28 31 38 41 47 59

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66 75 78 84 88 94 97 100 00 03 09 13 19 22 25 28 31 38 41 47 59 66 75 78
84 88 94 97 - 2 08 12 18 21 24 27 30 37 40 46 58 65 74 77 83 87 93 96 99

Service Rate of customers The table shows the service time of the systems of Tuesday. To know how to get the Service Rate as to customer per hour sees the discussion of the Monday service rate. As you can see the table above, it show that 60 customers per hour indicate the highest probability and 20 customers per hour indicate the lowest probability. In column 5, it reflects the random numbers. If a random numbers fall from 00 until 91 reflects a 60 customers per hour. Another is, if the number falls between 92 to 96 it will results a 30 customers per hour that is serve by the system, and so on. Table 5: Tuesday Service Rate of Customers

1) Service Rate
(CUSTOMERS PER HOUR) (3) Probability of Occurrences (4) Cumulative
Probability (5) Random Numbers (2) Frequency 60 30 20 598 32 18 TOTAL

648 0. 92 0. 05 0. 03 1. 00 92 97 100 00 92 97 - 91 96 99 Simulation Result
of Tuesday The table above shows that in every hour there are 22 customers arrive at the station to refuel their vehicles. The service rate is 58 customers served the system in every hour. Therefore, there is no queues form on Tuesday because the arrival rate is smaller than to service rate. The system was servicing customers only about 6. 24 hours out of 16 hour operation. The remaining 9. 76 hours is the idle time of the system. This idle time is utilized to other systems. There is 1 customer wait in line at 0. 1 or 36 seconds of waiting line. And there is only 1 customer served the system after 0. 04 hour or 2. 4 minutes. The table shows the results of the simulation based on 1000 simulated days. Table 6: Tuesday Simulation Results

Averages Arrival rate Service rate Utilization Number of customers waiting in
line Number of customer in the system Waiting time in line Total time in the
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system Results 22 customers per hour 58 customers per hour 39 percent 1 customer 1 customer 0. 01 hour (0. 6 min) 0. 04 hour (2. 4 min) 4. 1. C. Wednesday Arrival Rate of customers The table shows the frequency, probability of occurrences, cumulative probability and random numbers.

The customers arrive in the station to refuel or buy super premium gasoline for the vehicles especially motor, auto, multicab is 21 customers per hour, indicate the highest probability If random numbers fall from 00 until 02 reflects a 5 customers per hour. Another are, if the random number falls between 03 to 05 it will results a 7 customers per hour that is arrive at the system, and so on. Table 7: Wednesday Arrival Rate of Customers (1) Arrival Rate (CUSTOMERS PER HOUR) (3) Probability of Occurrences (4) Cumulative Probability (5) Random Numbers (2) Frequency 5 7 16 17 20 21 22 23 24 25 27 29 30 34 35 36 39 40 44 49 50 TOTAL 1 1 2 1 1 5 3 1 1 2 4 1 1 1 1 1 1 1 1 1 1 1 1 32 0. 031 0. 031 0. 063 0. 031 0. 031 0. 156 0. 094 0. 031 0. 031 0. 063 0. 125 0. 031 0. 031 0. 031 0. 031 0. 031 0. 031 0. 031 0. 031 0. 031 0. 031 1. 000 6 13 16 19 34 44 47 50 56 69 72 75 78 81 84 88 91 94 97 100 00 03 06 13 16 19 34 44 47 50 56 69 72 75 78 81 84 88 91 94 97 - 02 05 12 15 18 33 43 46 49 55 68 71 74 77 80 83 87 90 93 96 99 Service Rate of customers The table shows the service time of the systems of Wednesday. To know how to get the Service Rate as to customer per hour sees the discussion of the Monday service rate. As you can see the table above, it show that 20 customers per hour indicate the highest probability and 12 customers per hour indicate the lowest probability. In column 5, it reflects the random numbers. If a random numbers fall from 00 until 29 reflects a 60 customers per hour.

Another is, if the number falls between 30 to 44 it will results a 30 customers per hour that is serve by the system, and so on. Table 8: Wednesday Service Rate of Customers (1) Service Rate (CUSTOMERS PER HOUR) (3) Probability of Occurrences (4) Cumulative Probability (5) Random Numbers (2)

Frequency 60 30 20 216 113 217 15 12 Total 132 54 732 0. 30 0. 15 0. 30 0.

18 0. 07 1. 00 30 45 75 93 100 00 30 45 75 93 - 29 44 74 92 99 Simulation

Results of Wednesday The table above shows that in every hour there are 36 customers arrive at the station to refuel their vehicles. The service rate is 33 customers served the system in every hour. Therefore, the queues are form on Wednesday because the arrival rate is higher than to service rate.

This day reflects the busy day because the system was servicing customers over 100 percent of the time, which is 17. 44 hour. There are 6 customer leave in line at 11 minutes. And there are 4 customers not served the system after 9 minutes. The table shows the results of the simulation based on 1000 simulated days. Table 9: Wednesday Simulation Results Averages Arrival rate Service rate Utilization Number of customers waiting in line Number of customer in the system Waiting time in line Total time in the system Results 36 customers per hour 33 customers per hour 109 percent -6 customers -4 customer -0. 18 hour (11 min) -0. 15 hour (9 min) 4. 1. D.

Thursday Arrival Rate of customers The table shows the frequency, probability of occurrences, cumulative probability and random numbers. The customers arrive in the station to refuel or buy super premium gasoline for the vehicles especially motor, auto, multicab is 22 to 28 customers per hour, indicate the highest probability If random numbers fall from 00 until 02

reflects a 3 customers per hour. Another are, if the random number falls <https://assignbuster.com/a-queueing-system-study-for-refueling-service-at-shell-gasoline-station-of-mahayag/>

between 03 to 05 it will results a 4 customers per hour that is arrive at the system, and so on. Table 10: Thursday Arrival Rate of Customers (1) Arrival Rate (CUSTOMERS PER HOUR) (3) Probability of Occurrences (4) Cumulative Probability (5) Random Numbers (2) Frequency

Arrival Rate (CUSTOMERS PER HOUR)	Frequency	Probability of Occurrences	Cumulative Probability	Random Numbers
4	1	0.031	0.031	00
7	1	0.031	0.063	01
9	1	0.031	0.094	02
14	2	0.063	0.157	03
15	1	0.031	0.188	04
18	2	0.063	0.251	05
19	2	0.063	0.314	06
20	3	0.094	0.408	07
22	2	0.063	0.471	08
23	1	0.031	0.502	09
24	1	0.031	0.533	10
25	1	0.031	0.564	11
26	1	0.031	0.595	12
27	1	0.031	0.626	13
28	1	0.031	0.657	14
29	1	0.031	0.688	15
31	3	0.094	0.782	16
34	6	0.188	0.970	17
36	9	0.282	1.000	18
40	13	0.408		19
42	19	0.595		20
56	25	0.782		21
TOTAL	187	1.000		22

Service Rate of customers The table shows the service time of the systems of Thursday. To know how to get the Service Rate as to customer per hour sees the discussion of the Monday service rate.

As you can see the table above, it show that 20 customers per hour indicate the highest probability and 30 customers per hour indicate the lowest probability. In column 5, it reflects the random numbers. If a random numbers fall from 00 until 22 reflects a 60 customers per hour. Another is, if the number falls between 23 to 36 it will results a 30 customers per hour that is serve by the system, and so on. Table 11: Thursday Service Rate of Customers (1) Service Rate (CUSTOMERS PER HOUR) (3) Probability of Occurrences (4) Cumulative Probability (5) Random Numbers (2) Frequency

Service Rate (CUSTOMERS PER HOUR)	Frequency	Probability of Occurrences	Cumulative Probability	Random Numbers
60	23	0.23	0.23	00
30	37	0.37	0.60	01
20	74	0.74	1.00	02
169	101	0.60		03
101	274	0.27		04
15	Total	1.00		05
187	731			06
0.23				07
0.14				08
0.37				09
0.26				10
1.00				11
0.23				12
0.37				13
0.74				14
1.00				15

Simulation Results of Thursday The table above shows that in every hour there are 30 customers arrive at the station to refuel their vehicles. The service rate is 29 customers served the system

in every hour. Therefore, the queues are form on Thursday because the arrival rate is higher than to service rate. This day reflects the busy day because the system was servicing customers over 100 percent of the time, which is 16. 64 hour. There are 16 customer leave in line at 31 minutes. And there are 15 customers not served the system after 29. 4 minutes. The table shows the results of the simulation based on 1000 simulated days.

Table 12: Thursday Simulation Results Averages Arrival rate Service rate Utilization Number of customers waiting in line Number of customer in the system Waiting time in line Total time in the system Results 30 customers per hour 29 customers per hour 104 percent -16 customers -15 customer -0. 52 hour (31 min) -0. 49 hour (29. 4 min) 4. 1. E. Friday Arrival Rate of customers The table shows the frequency, probability of occurrences, cumulative probability and random numbers. The customers arrive in the station to refuel or buy super premium gasoline for the vehicles especially motor, auto, multicab is 21 customers per hour, indicate the highest probability If random numbers fall from 00 until 02 reflects a 1 customers per hour.

Another are, if the random number falls between 03 to 05 it will results a 4 customers per hour that is arrive at the system, and so on. Table 13: Friday

Arrival Rate of Customers (1) Arrival Rate (CUSTOMERS PER HOUR) (3)
 Probability of Occurrences (4) Cumulative Probability (5) Random Numbers
 (2) Frequency 1 4 15 16 17 18 19 20 21 24 25 27 28 29 33 37 38 42 43
 TOTAL 1 1 1 1 3 3 3 2 5 1 2 1 1 1 1 1 1 2 1 1 32 0. 031 0. 031 0. 031 0. 031 0. 094 0. 094 0. 094 0. 063 0. 156 0. 031 0. 063 0. 031 0. 031 0. 031 0. 031 0. 031 0. 063 0. 031 0. 031 1. 000 3 6 9 13 22 31 41 47 63 66 72 75 78 81 84
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88 94 97 100 00 03 06 09 13 22 31 41 47 63 66 72 75 78 81 84 88 94 97 - 2
05 08 12 21 30 40 46 62 65 71 74 77 80 83 87 93 96 99 Service Rate of
customers The table shows the service time of the systems of Friday. To
know how to get the Service Rate as to customer per hour sees the
discussion of the Monday service rate. As you can see the table above, it
show that 60 customers per hour indicate the highest probability and 20
customers per hour indicate the lowest probability. In column 5, it reflects
the random numbers. If a random numbers fall from 00 until 89 reflects a 60
customers per hour. Another is, if the number falls between 90 to 96 it will
results a 30 customers per hour that is serve by the system, and so on.

Table 14: Friday Service Rate of Customers (1) Service Rate (CUSTOMERS
PER HOUR) (3) Probability of Occurrences (4) Cumulative Probability (5)
Random Numbers (2) Frequency 60 30 20 668 54 22 TOTAL 744 0. 90 0. 07
0. 03 1. 00 90 97 100 00 90 97 - 89 96 99 Simulation Results of Friday The
table above shows that in every hour there are 23 customers arrive at the
station to refuel their vehicles. The service rate is 57 customers served the
system in every hour. Therefore, there is no queues form on Friday because
the arrival rate is smaller than to service rate. The system was servicing
customers only about 6. 72 hours out of 16 hour operation. The remaining 9.
8 hours is the idle time of the system. This idle time is utilized to other
systems. There is 1 customer wait in line at 0. 01 or 36 seconds of waiting
line. And there is only 1 customer served the system after 0. 04 hour or 2. 4
minutes. The table shows the results of the simulation based on 1000
simulated days. Table 15: Friday Simulation Results Averages Arrival rate
Service rate Utilization Number of customers waiting in line Number of

customer in the system
 Waiting time in line
 Total time in the system
 Results
 24 customers per hour
 57 customers per hour
 42 percent
 1 customer
 1 customer
 0.01 hour (0.6 min)
 0.04 hour (2.4 min)
 4.1 F.

Saturday Arrival Rate of customers
 The table shows the frequency, probability of occurrences, cumulative probability and random numbers. The customers arrive in the station to refuel or buy super premium gasoline for the vehicles especially motor, auto, multicab is 23 customers per hour, indicate the highest probability
 If random numbers fall from 00 until 05 reflects a 4 customers per hour. Another are, if the random number falls between 06 to 08 it will results a 12 customers per hour that is arrive at the system, and so on.

Table 16: Saturday Arrival Rate of Customers

(1) Arrival Rate (CUSTOMERS PER HOUR)	(2) Frequency	(3) Probability of Occurrences	(4) Cumulative Probability	(5) Random Numbers
12	2	0.031	0.031	00
14	1	0.031	0.063	01
15	1	0.031	0.094	02
17	2	0.063	0.157	03
18	1	0.031	0.188	04
19	1	0.031	0.219	05
21	1	0.031	0.250	06
22	3	0.094	0.344	07
23	1	0.031	0.375	08
26	1	0.031	0.406	09
27	1	0.031	0.437	10
28	1	0.031	0.468	11
32	1	0.031	0.500	12
33	0	0.000	0.500	13
34	6	0.219	0.719	14
37	9	0.313	1.032	15
39	13	0.438	1.470	16
40	19	0.625	2.095	17
46	22	0.719	2.814	18
47	31	1.000	3.814	19
49	34	1.032	5.246	20
TOTAL	125	1.000	6.490	21
				22
				23
				24
				25
				26
				27
				28
				29
				30
				31
				32
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				88
				89
				90
				91
				92
				93
				94
				95
				96
				97
				98
				99
				100

Service Rate of customers
 The table shows the service time of the systems of Saturday. To know how to get the Service Rate as to customer per hour sees the discussion of the Monday service rate.

As you can see the table above, it show that 20 customers per hour indicate the highest probability and 30 customers per hour indicate the lowest

probability. In column 5, it reflects the random numbers. If a random
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numbers fall from 00 until 25 reflects a 60 customers per hour. Another is, if the number falls between 26 to 39 it will results a 30 customers per hour that is serve by the system, and so on. Table 17: Saturday Service Rate of Customers (1) Service Rate (CUSTOMERS PER HOUR) (3) Probability of Occurrences (4) Cumulative Probability (5) Random Numbers (2) Frequency

60	30	20	187	95	312	15	Total	114	708	0.26	0.13	0.44	0.16	1.00	26	40	84
100	0	26	40	84	-	25	39	83	99	Simulation Results of Saturday							

The table above shows that in every hour there are 34 customers arrive at the station to refuel their vehicles. The service rate is 32 customers served the system in every hour. Therefore, the queues are form on Saturday because the arrival rate is higher than to service rate. This day reflects the busy day because the system was servicing customers over 100 percent of the time, which is 16.80 hour. There are 9 customers leave in line at 19 minutes. And there are 8 customers not served the system after 14.4 minutes. The table shows the results of the simulation based on 1000 simulated days.

Table 18: Saturday Simulation Results Averages Arrival rate Service rate Utilization Number of customers waiting in line Number of customer in the system Waiting time in line Total time in the system Results 34 customers per hour 32 customers per hour 105 percent -9 customer -8 customer -0.27 hour (16min) -0.24 hour (14.4 min) 4.1. G. Sunday Arrival Rate of customers The table shows the frequency, probability of occurrences, cumulative probability and random numbers. The customers arrive in the station to refuel or buy super premium gasoline for the vehicles especially motor, auto, multicab is 25 customers per hour, indicate the highest

probability If random numbers fall from 00 until 02 reflects a 4 customers per hour.

Another are, if the random number falls between 03 to 05 it will results a 5 customers per hour that is arrive at the system, and so on. Table 19: Sunday Arrival Rate of Customers (1) Arrival Rate (CUSTOMERS PER HOUR) (3)

Probability of Occurrences (4) Cumulative Probability (5) Random Numbers

(2) Frequency 4 5 16 17 18 19 20 21 24 25 26 27 30 32 36 37 41 43 44

TOTAL 1 1 1 1 1 2 3 3 3 4 3 1 2 1 1 1 1 1 1 1 32 0. 031 0. 031 0. 031 0. 031 0.

031 0. 063 0. 094 0. 094 0. 094 0. 125 0. 094 0. 031 0. 063 0. 031 0. 031 0.

031 0. 031 0. 031 0. 031 1. 000 3 6 9 13 16 22 31 41 50 63 72 75 81 84 88

91 94 97 100 00 03 06 09 13 16 22 31 41 50 63 72 75 81 84 88 91 94 97 - 2

05 08 12 15 21 30 40 49 62 71 74 80 83 87 90 93 96 99 Service Rate of

customers The table shows the service time of the systems of Sunday. To

know how to get the Service Rate as to customer per hour sees the

discussion of the Monday service rate. As you can see the table above, it

show that 60 customers per hour indicate the highest probability and 20

customers per hour indicate the lowest probability. In column 5, it reflects

the random numbers. If a random numbers fall from 00 until 90 reflects a 60

customers per hour. Another is, if the number falls between 91 to 96 it will

results a 30 customers per hour that is serve by the system, and so on. Table

20: Sunday Service Rate of Customers 1) Service Rate (CUSTOMERS PER

HOUR) (3) Probability of Occurrences (4) Cumulative Probability (5) Random

Numbers (2) Frequency 60 30 20 TOTAL 632 44 20 696 0. 908 0. 063 0. 029

1. 000 91 97 100 00 91 97 - 90 96 99 Simulation Results of Sunday The table

above shows that in every hour there are 24 customers arrive at the station

to refuel their vehicles. The service rate is 58 customers served the system in every hour. Therefore, there is no queues form on Tuesday because the arrival rate is smaller than to service rate. The system was servicing customers only about 7.04 hours out of 16 hour operation. The remaining 8.96 hours is the idle time of the system. This idle time is utilized to other systems.

There is 1 customer wait in line at 0.01 or 36 seconds of waiting line. And there is only 1 customer served the system after 0.04 hour or 2.4 minutes. The table shows the results of the simulation based on 1000 simulated days. Table 21: Sunday Simulation Results Averages Arrival rate Service rate Utilization Number of customers waiting in line Number of customer in the system Waiting time in line Total time in the system Results 24 customers per hour 58 customers per hour 44 percent 1 customer 1 customer 0.01 hour (0.6 min) 0.04 hour (2.4 min) The table below reflects that there is no queues form on Monday, Tuesday, Friday, and Sunday.

Wednesday, Thursday, and Saturday the system is over utilized therefore the queues are form. TABLE 22: SUMMARY OF SIMULATION RESULTS Total Utilization No. of Arrival Rate of Days customers customers (%) line system (hr) (hr) Mon Tues Wed Thu Fri Sat Sun 25 22 36 30 23 34 24 59 58 33 29 57 32 58 43 39 109 104 42 105 44 1 1 -6 -16 1 -9 1 1 1 -4 -15 1 -8 1 0.01 0.01 -0.18 -0.52 0.01 -0.27 0.01 0.04 0.04 -0.15 -0.49 0.04 -0.24 0.04 No. of Waiting time in Service of the Rate of system waiting in in the line Customers Customer time in the System 4.2. Raw Data of Overall A. Arrival Rate The table shows the frequency and probability. The table shows the arrival rate of customers from Monday to Sunday.

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As you can see the table 23 (Overall Arrival Rates of Customers from Monday to Sunday), the customers arrive in the station to refuel or buy super premium gasoline for the vehicles especially motor, auto, multicab are 21 customers per hour, indicate the highest probability. Table: 23 Overall Arrival Rates of Customers from Monday to Sunday Arrival Rate (PERSONS PER HOUR)

4	7	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	32	33	34	36	37	39	40	43	49																															
Total Frequency																																																											
5	5	3	5	4	6	9	10	10	9	18	9	7	9	15	7	12	7	7	3	5	6	5	3	4	5	3	3	3																															
197																																																											
Probability of Occurrences (%)																																																											
2.	54	2.	54	1.	52	2.	54	2.	03	3.	05	4.	57	5.	08	5.	08	4.	57	9.	14	4.	57	3.	55	4.	57	7.	61	3.	55	6.	09	3.	5	3.	55	1.	52	2.	54	3.	05	2.	54	1.	52	2.	03	2.	54	1.	52	1.	52	1.	52	100.	00

B. Service Rate These data are needed for the computation of the time spend by the customers in a system for a service that will be used for the simulation model. The table below shows the summary for the service rate of the system for 7 days of observation. Table 24: Raw Data of Service Rate

Mon	FREQ	638	38	9	2	0	687	Tue	FREQ	598	32	18	2	0	650	Wed	FREQ	216	113	217	132	54	732	Thu	FREQ	169	101	274	187	0	731	Fri	FREQ	668	54	22	0	0	744	Sat	FREQ	187	95	312	114	0	708	Sun	FREQ	632	44	20	3	0	699
Time spend (hour)		0.	02	0.	03	0.	05	0.	07	0.	08	TOTAL		TOTAL		3108	477	872	440	54	4951																																		

After obtaining those results, the table below can be acquired. The table shows, the service time of the systems. The table shows the computation of unit of service that would be person per hour. (See table 25, Overall Service Rates of Customers from Monday to Sunday). It is showing also frequency and probability. The table 25 shows, that 0. 02 hours or 1 minute get the highest probability of 0. 63. Another outcome shows that 0. 08 hours get 0.

01 Probability. Table 25: Overall Service Rates of Customers from Monday to Sunday

SERVICE RATE FREQUENCY PROBABILITY of OCCURRENCES 3108 0.

63 477 0.10 872 0.18 440 0.09 54 0.01 4951 1.00 PERSON PER HOUR

1person/0.0166667 hour= 60 1person/0.333333 hour= 30 1person/0.05

hour= 20 1person/0.0666667 hour= 15 1person/0.0833333 hour= 12 Total:

4.3. The Simulation Process On this part the simulation process can now be

obtain by just following its procedure stated below: 1. Setting up a

probability distribution for important variables. And building a cumulative

probability distribution for important variables. A. Arrival rate The probability

and cumulative probability distribution for this variable was based on actual

observation of the system. This was based from table 23: (Overall Arrival

Rates of Customers from Monday to Sunday). Table 26: Probability for Arrival

Rate for the customers 1) Arrival Rate (PERSONS PER HOUR) 4 7 13 14 15 16

17 18 19 20 21 22 23 24 25 26 27 28 29 30 32 33 34 36 37 39 40 43 49

Total (2) Frequency 5 5 3 5 4 6 9 10 10 9 18 9 7 9 15 7 12 7 7 3 5 6 5 3 4 5 3

3 3 197 (3) Probability of Occurrences $5/197 = 2.54\%$ $5/197 = 2.54\%$ $3/197 =$

1.52% $5/197 = 2.54\%$ $4/197 = 2.03\%$ $6/197 = 3.05\%$ $9/197 = 4.57\%$

$10/197 = 5.08\%$ $10/197 = 5.08\%$ $9/197 = 4.57\%$ $18/197 = 9.14\%$ $9/197 = 4.$

57% $7/197 = 3.55\%$ $9/197 = 4.57\%$ $15/197 = 7.61\%$ $7/197 = 3.55\%$ $12/197 =$

6.09% $7/197 = 3.55\%$ $7/197 = 3.55\%$ $3/197 = 1.52\%$ $5/197 = 2.54\%$ $6/197 =$

3.05% $5/197 = 2.54\%$ $3/197 = 1.52\%$ $4/197 = 2.03\%$ $5/197 = 2.54\%$ $3/197 =$

1.52% $3/197 = 1.52\%$ $3/197 = 1.52\%$ 100% (4) Cumulative Probability 3%

5% 7% 9% 11% 14% 19% 24% 29% 34% 43% 47% 51% 55% 63% 66% 73%

76% 80% 81% 84% 87% 89% 91% 93% 95% 97% 98% 100% B. Service Rate

The table 26 reflects the probability and cumulative probability distribution

for the arrival rate of customers.
<https://assignbuster.com/a-queueing-system-study-for-refueling-service-at-shell-gasoline-station-of-mahayag/>

The same interpretation with the previous table 23, only the cumulative probability column where added. The values reflects from the table below were based from table 25, again cumulative probability column were added on this table. The conversion from a regular probability distribution, such as in column 3 of table 26 & 27, to a cumulative probability distribution is an easy job. In column 4, the cumulative probability for each level of arrival and service rate of customers, is the sum of the number in the probability column (column 3) added to the previous cumulative probability. Table 27:

Probability for Service Rate for the customers (1) SERVICE RATE PERSON PER HOUR 60 30 20 15 Total: (2) FREQUENCY 3108 477 872 440 4897 3) PROBABILITY OF OCCURRENCE $3108/4897= 63\%$ $477/4897= 10\%$

$872/4897= 18\%$ $440/4897= 9\%$ 100% (4) CUMULATIVE PROBABILITY 63%

73% 91% 100% 2. Setting random number intervals Random numbers

intervals for this table were based on Table 26. If Random numbers fall from 00 until 02 reflects a 4 person per hour. Another are, if the number falls between 03 to 04 it will results a 7 person per hour that is arrive at the system, and so on. Table 28: Random Number Assignment (Arrival Rate)

Random Numbers 00 02 03 04 05 06 07 08 09 10 11 13 14 18 19 23 24 28 29 33 34 42 43 46 47 50 51 54 55 62 63 65 66 72 73 75 76 79 80 80 81 83 84 86 87 88 89 90 91 92 93 94 95 96 97 97 98 99 Total

Arrival Rate (Person per hour) 4 7 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 32 33 34 36 37 39 40 43 49 Probability 2. 54% 2. 54% 1. 52% 2. 54% 2. 03% 3. 05% 4. 57% 5. 08% 5. 08% 4. 57% 9. 14% 4. 57% 3. 55% 4. 57% 7. 61% 3. 55% 6. 09% 3. 55% 3. 55% 1. 52% 2. 54% 3. 05% 2. 54% 1. 52% 2. 03% 2. 54% 1. 52% 1. 52% 1. 52% 100% Cumulative

Probability 3% 5% 7% 9% 11% 14% 19% 24% 29% 34% 43% 47% 51% 55%
63% 66% 73% 76% 80% 81% 84% 87% 89% 91% 93% 95% 97% 98% 100%

Random numbers intervals for this table were based on table 27. If a Random numbers fall from 00 until 62 reflects a 60 person per hour. Another are, if the number falls between 63 to 72 it will results a 30 person per hour that is serve by the system, and so on.

After setting random numbers interval, next to do is to generate random numbers through MS Excel. For the overview (See appendixes 1: Generating Random Numbers). Table 29: Random Number Assignment (Service Rate)

Random Numbers	00	62	63	72	73	90	91	99	Total	Service Rate (Person per hour)
	60	30	20	15						
Probability	63%	10%	18%	9%					100%	Cumulative

Probability 63% 73% 91% 100% 4. 4. The Simulation Results These are the results reflected on the simulation model based on the number of arrival and estimated time spends the customer on the system for a service. The results show the system utilization, number of customer in the waiting line, number of customer in the system, waiting time in line and the waiting time in the system.

The result on the simulation model can be found on the next page. The Simulation was tested on a 1000 simulated days. On a day column reflects the number of days, which is from 1 to 1000. The tables, show from 1 to 40 and proceed to day 1000 that is for presentations only. Values for Arrival rate and Service rate was based on the reference lookup values based on the raw data tables. The researcher used this Vlookup functions in MS Excel spreadsheets to calculate the values for ease usage. The values in the

column of random numbers for Arrival rate & random number for the Service rate were generated with the use of random generation function in MS Excel.

This is a common function in Excel spreadsheets in order to generate the numbers randomly or without bias. And the remaining columns on the simulation fields can be acquired through their given formulas that have been discussed on the previous part of this study. SIMULATION RESULTS THE

SIMULATION MODEL No. of Samples = 1000 Arrival Rate λ (persons per DAY # hour) ? λ Ran # Service Rate (persons per hour) μ Utilization ? (λ / μ) Ave. No. Waiting in Line (NL) Ave. No. in the System (NS) Ave. Time Waiting in Line (tl) (hour) Ave. Total Time in the System (ts) (hour)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	47	7	55	82	64	82	64	87	3	5	98	30	46	34	5	58	96	75	61	82	32	70	19	76	2	14	24	32	26	32	26	34	7	7	43	20	22	21	7	25	40	28	25	32	20	27	18	28	41	16	37	94	84	6	31	41	73	40	67	40	71	45	53	0	75	71	11	60	82	27	15	64	60	60	60	15	20	60	60	60	30	60	30	60	30	60	60	60	20	30	60	60	20	60	60	30	0.	37	0.	23	0.	40	2.	13	1.	30	0.	53	0.	43	0.	57	0.	23	0.	12	1.	43	0.	33	0.	73	0.	35	0.	12	0.	42	2.	00	0.	93	0.	42	0.	53	1.	00	0.	45	0.	30	0.	93	0.	11	0.	04	0.	13	-2.	01	-2.	82	0.	30	0.	17	0.	37	0.	04	0.	01	-2.	37	0.	08	1.	01	0.	09	0.	01	0.	15	-2.	00	6.	53	0.	15	0.	30	0.	00	0.	18	0.	06	6.	53	0.	47	0.	27	0.	53	0.	13	-1.	52	0.	84	0.	60	0.	94	0.	27	0.	12	-0.	94	0.	42	1.	74	0.	44	0.	12	0.	57	0.	00	7.	47	0.	57	0.	84	1.	00	0.	63	0.	36	7.	47	0.	00	0.	00	0.	01	-0.	06	-0.	11	0.	01	0.	01	0.	01	0.	1	0.	00	-0.	06	0.	00	0.	05	0.	00	0.	00	0.	01	-0.	05	0.	23	0.	01	0.	01	0.	00	0.	01	0.	00	0.	23	0.	03	0.	02	0.	03	-0.	12	-0.	28	0.	05	0.	04	0.	05	0.	05	0.	02	-0.	13	0.	03	0.	17	0.	03	0.	02	0.	03	-0.	10	0.	73	0.	03	0.	05	0.	00	0.	04	0.	03	0.	73	25	28	26	2	27	15	28	97	29	88	30	75	31	43	32	10	33	33	34	18	35	58	36	1	37	38	38	28	39	68	40	10	995	73	996	73	997	11
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998 98 999 38 1000 75 AVERAGE 19 4 17 43 34 28 22 15 20 17 25 4 21 19
 27 15 28 28 15 43 21 28 24. 00 20 25 82 53 0 32 92 24 45 42 87 44 29 73
 29 94 8 74 90 37 92 78 60 60 20 60 60 60 15 60 60 60 20 60 60 30 60 15 60
 20 20 60 15 20 47. 00 0. 32 0. 07 0. 85 0. 72 0. 57 0. 47 1. 47 0. 25 0. 33 0.
 8 1. 25 0. 07 0. 35 0. 63 0. 45 1. 00 0. 47 1. 40 0. 75 0. 72 1. 40 1. 40 0. 51
 0. 07 0. 00 2. 41 0. 91 0. 37 0. 20 -2. 30 0. 04 0. 08 0. 06 -3. 13 0. 00 0. 09 0.
 55 0. 18 0. 00 0. 20 -2. 45 1. 13 0. 91 -2. 45 -2. 45 8. 17 0. 39 0. 07 3. 26 1.
 62 0. 94 0. 67 -0. 84 0. 29 0. 42 0. 34 -1. 88 0. 07 0. 44 1. 18 0. 63 1. 00 0.
 67 -1. 05 1. 88 1. 62 -1. 05 -1. 05 8. 68 0. 00 0. 00 0. 14 0. 02 0. 01 0. 01 -0.
 10 0. 00 0. 00 0. 00 -0. 13 0. 00 0. 00 0. 03 0. 01 0. 00 0. 01 -0. 09 0. 08 0.
 02 -0. 12 -0. 09 0. 01 0. 03 0. 02 0. 48 0. 08 0. 05 0. 04 -0. 25 0. 03 0. 03 0.
 03 -0. 33 0. 02 0. 03 0. 12 0. 04 0. 00 0. 04 -0. 21 0. 28 0. 08 -0. 28 -0. 21 0.
 03

Figure 2: Simulation Result PROBABILITY TABLE Arrival Rate (Person per
 hour) FREQ Probability REFERENCE FOR LOOKUP VALUES Lower Upper Arrival
 Rate (Person per hour) 4 7 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
 29 30 32 33 34 36 37 39 40 43 49 5 5 3 5 4 6 9 10 10 9 18 9 7 9 15 7 12 7 7
 3 5 6 5 3 4 5 3 3 3 197 2. 54 2. 54 1. 52 2. 54 2. 03 3. 05 4. 57 5. 08 5. 08 4.
 57 9. 14 4. 57 3. 55