

## Queuing System of a Busy Restaurant Using Arena Simulation Software

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**Abstract:** Waiting times and queuing in a long line is a common phenomenon and has become a major problem in a busy restaurant that full with customers especially during peak hours. Time spent for the customers to being serve especially when waits for a long time can affect them in several of ways such as fatigue. This research is regarding a queuing simulation of a busy restaurant by using Arena Simulation Software. The purpose of this study is to explore more on Arena Simulation Software and to analyze the queuing problem at the busy restaurant. Throughout this study, there are three variables has been analyzed such as Average Waiting Time of Customer, Average Number of Waiting Customer and Instantaneous Utilization. The result obtained from simulation for base model shows the total Average Waiting Time of a customer in queue is 55.3131 minutes with the total Average Number of Customers Waiting in queue is 10 and the Instantaneous Utilization of the waiters are 72.22% and 71.33% for the cashier which is consider as well utilized and in a busy condition. Therefore, the customers flow in the busy restaurant system is still needed to be improved. Based on this situation, this research also provides two (2) scenarios that help to reduce the waiting time in a busy restaurant as well as to improve the customer's satisfaction and increase the restaurant efficiency.

**Keywords:** Arena Simulation Software, Queuing System, Busy Restaurant

## 1. Introduction

The modern society is increasingly transforming into a service leading one in today's competitive business phenomena. As a result, waiting in a line has drawn great attention to all operation management specialists. A queuing system occurs when individuals who are usually customers involved in counting on one or more servers that provide a service to them. There are several factors to consider a restaurant as a good or bad restaurant. Taste, cleanliness, restaurant layout and settings are some of the most important factors in order to attract customers. There is also another aspect that needs to be considered particularly when the restaurant has succeeded in attracting customers, which is the queuing time for the customer. Waiting in lines are typically the worst annoyance which makes the waiting time is feeling like they waited longer than they actually did. This unpleasant experience of waiting in line can often have a negative effect on the rest of a customer's experience of the restaurant. Queues occur at the restaurant is because of queues number that they need to take in order to get their meals. Time spent for customers to get their service at the counter especially when waits at a long time can affect customers in several of inefficient outcome. Often, customers may get fatigue by waiting and may be discouraged from pursuing valuable services by a long length of the waiting lines. At other times, waiting might even causes the customers to delay or miss important events [1-6].

## 2. Materials and Methods

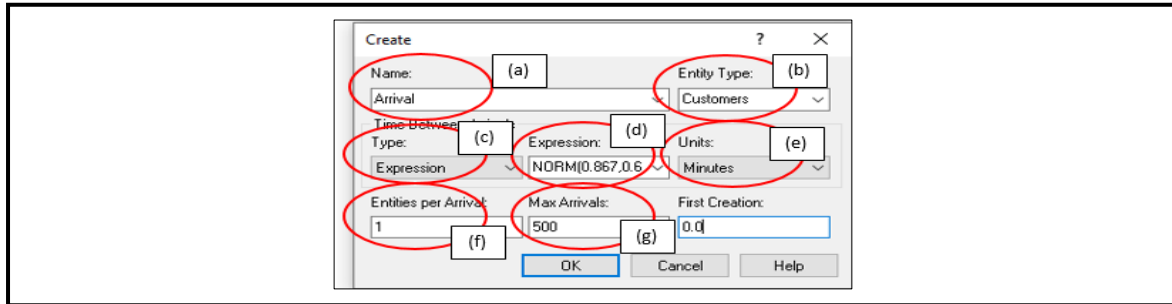
All the expressions of data for this simulation study is based on Table 1 that has been done from previous researcher since this research is only focused on simulation technique instead of data collection. These expressions are obtained based on the inter-arrival times for each server in order to serve their service and also inter-arrival times of the arrival customers that enter the restaurant. All the inter-arrival times was then analyzed by Arena Input Analyzer to provide a summary of sample statistics with the best fit of data distribution for each data set.

**Table 1: Data Distribution by Arena Input Analyzer [1]**

<b>DATA DISTRIBUTION</b>	
<i>NAME</i>	<i>EXPRESSION</i>
Arrival Time	NORM (0.867,0.618)
Waiter 1	4.5+GAMM (0.663,2.87)
Waiter 2	4.5+LOGN (2.16,1.79)
Waiter 3	UNIF (3.5,8.5)
Waiter 4	3.5+5*BETA (0.508,0.433)
Waiter 5	TRIA (3.5,5.6,9.5)
Waiter 6	5.5+WEIB (0.797,1.92)
Cash Service	0.35+LOGN (0.699,0.755)

### 2.1 Create Pop-Up Box

Create is the first part of every simulation. Entities arrival will be generated in the simulation. To run the simulation, the required information needs to be filled-in completely in the Create pop-up box and double-click the Create button in order to open the Create pop-up box. To open the Create pop-up box, double-click on Create button. The Create Pop-up box will then appear as shown in Figure 1. There are seven fields in the pop-up box that must be filled-in.

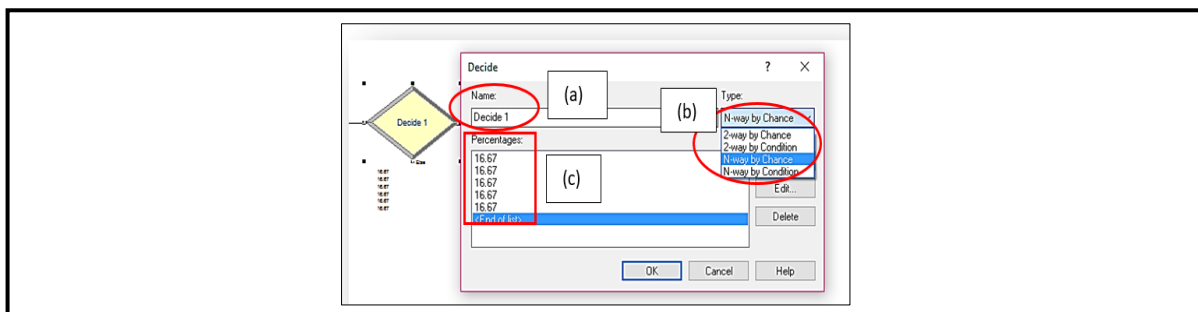


**Figure 1: Create Pop-Up Box**

- (a) **Name Field:** In this field, simply put any name to refer customer’s arrival, hence for this research, it will be named as ‘Arrival’.
- (b) **Entity Type Field:** There are three options to be selected in this field, ‘Entity’, ‘Customers’ and ‘Order’. Entity is general arrival that enter the queue. Meanwhile, the second and third options appear since ‘Customers’ and ‘Order’ will be stated in the entity field. If ‘Customers’ is chosen, it means that the system only allowed the customers to enter the queuing system. Hence, ‘Customers’ will be selected in this field.
- (c) **Type field:** There are three options of time between arrivals which consists of type, value and units. For type, there are four type that can be chosen: (i) Random (expo), (ii) Schedule, (iii) Constant and (iv) Expression. In this field, Expression will be chosen as the arrival of customers assume to be generated as Normal Distribution as follow in Table 1.
- (d) **Value Field:** This field need us to fill-in the time value to run the simulation. Value text box refers to mean time between arrivals. In this study, the value is set to NORM (0.867,0.618).
- (e) **Units Field:** There are three options such as hour, minutes and seconds. In this research, the Value field will be set as Random (expo) with the inter-arrival time between customers is 1 minutes.
- (f) **Entities per Arrival Field:** Entities per arrival specifies how many customers that arrive at each arrivals. In this research, entities per arrival will be set as 1 to make it easier while analysis the result.
- (g) **Max Arrivals Field:** Max Arrivals is the total number of customers that will enter the system. It means that the number of customers that will enter the system can be set. In this research, the Max arrival will be set to 500, means that only 500 customers will be allowed to enter and leave the system per day. Then after finished fill in the information, click OK to save the information.

## 2.2 Decide Pop-Up Box

To model the situation that an arriving restaurant customer may decide to get a service from a different waiter, a condition within Decide module need to be used.



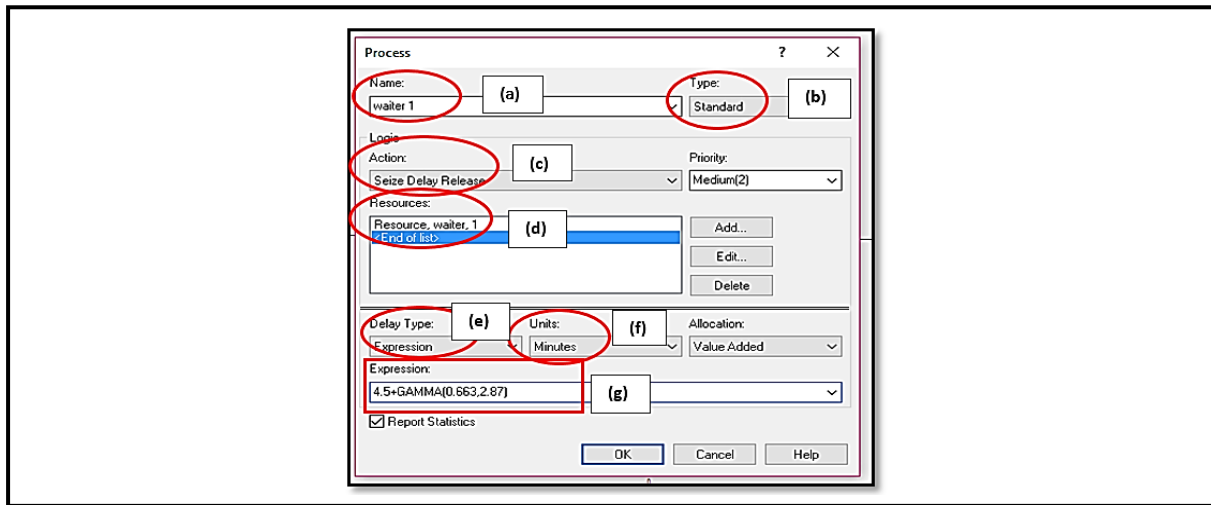
**Figure 2: Decide Pop-Up Box**

- (a) **Name Field:** In this field, simply put any name to refer decision of the system. Hence for this research, simply let it as ‘Decide 1’.

- (b) **Type Field:** There are four options in this “Type” field which consists of 2-way by Chance, 2-way by Condition, N-way by Chance and N-way by Condition. In this research, the N-way by Chance will be chosen since there are six probabilities of decision for the arrival customers get served by any of six waiters.
- (c) **Percent True Field:** The probability of arrival of any server is considered by same percentage, for six servers of waiters the probability is considered as 16.67% for each of them.

### 2.3 Process Pop-Up Box

Next, it is necessary to complete and put the required information into the Process pop-up box. In order to open the Process pop-up box, it needs to double click at the Process button, thus the Process pop-up box will appear as shown in Figure 3. There are several fields that need to be filled-in in the Process pop-up box.



**Figure 3: Process Pop-Up Box**

- (a) **Name field:** In this field, simply put any name in the simulation to refer the process. In this research, it will be named as Waiter 1, Waiter 2, until Waiter 6 and Cash Service.
- (b) **Type field:** There are two options from type field, Submodel and Standard. Submodel is used when there are many model that link to each other. Standard has been chosen as the standard queuing will only be used in the system to run this simulation.
- (c) **Action field:** There are four options and Seize Delay Release will be chosen. Consider that customers will enter the restaurant system, delay as the customers will wait for the waiter to order their meals and paid for their meals at the Cash Counter then release once the customers finished with their services.
- (d) **Resources field:** This field will appear if Seize Delay Release option chosen in the action field. Instead, except for Resource name field, keep the other details the same as it pop-up. Resource field will be named as Waiter and Cashier since they is the one that provides the customers with the services.
- (e) **Delay type field:** There are five options; Triangular, Constant, Normal, Uniform and Expression. This delay type will be obtained from the result of input analyzer once we keyed-in the data. However, in this study, we just refer to data from Table 1.
- (f) **Units field:** This field indicate the time units that will be used in the simulation. Let this field as Minutes to obtain the result in minutes.
- (g) **Expression field:** This field is consequence from Delay type field and it follows the data distribution in Table 1. Then, “OK” button will be clicked to save the information and proceed with the next step.

### 3. Results and Discussion

After running the simulation model, the Arena Simulation Software will execute the results of the simulation. From this simulation, we focused our study on three variables, which are Average Number Waiting Customer ( $L_q$ ), Average Waiting Time ( $W_q$ ) and Instantaneous Utilization ( $\frac{c}{c}$ ) used to analyse the performance of the busy restaurant. There are two (2) scenarios have been proposed in this study in order to reduce the Average Number Waiting Customer ( $L_q$ ) and Average Waiting Time ( $W_q$ ).

Scenario 1: Maintain the number of customer's arrival and hiring another one waiter and cashier.

Scenario 2: Proposed two shifting schedules for the waiters.

**Table 2: Comparison of two scenarios with the original data analysis result**

Performance Measurement		Base Model	Scenario 1	Scenario 2
<b>Total Average Waiting Time (Minutes)</b>		55.3131	24.897	40.275
<b>Total Average Number Waiting (Person)</b>		10	3	16
<b>Instantaneous</b>	<b>Waiters</b>	72.22	61.85	72.34
<b>Utilization (%)</b>	<b>Cash Service</b>	71.33	36.32	70.05

Table 2 summarizes all the results obtained throughout the study in term of Average Waiting Time, Average Number Waiting and Instantaneous Utilization for the original model and two scenarios proposed. Based on the table, it shows that the Total Average Waiting Time ( $W_q$ ) for the original model analysis is 55.3131 minutes. We consider it as a long queue for the customers in the system and we need to overcome this problem because it may affect the customer's behavior as well as they will left from the restaurant without being served due to long waiting time.

From Scenario 1 analysis which is by hiring another one waiter and one cashier into the system, the Total Average Waiting Time ( $W_q$ ) is reduced to 24.897 minutes. While Scenario 2 shows the Total Average Waiting Time ( $W_q$ ) is 40.275 minutes. This result indicates that scenario 1 is better with the least Total Average Waiting Time compared to scenario 2. So, the customers do not have to queue for a long time to being served by the server.

The Total Average Number of Waiting Customer ( $L_q$ ) for the original model, scenario 1 and scenario 2 is approximate to 10, 3 and 16 customers respectively. Among the scenarios suggested, scenario 1 found to be the best strategy to be proposed with the least Total Number of the Waiting Customers in the system.

Next, the Instantaneous Utilization ( $\frac{c}{c}$ ) for the waiters are 72.22% while 71.33% for the cashier in the original model. From this result, it shows that the waiters and cashier are well utilized and busy during the operation hour. When we proposed the scenario 1, Instantaneous Utilization ( $\frac{c}{c}$ ) for the waiters is reduced to 61.85% while 36.32% for the cashier. As the Instantaneous Utilization ( $\frac{c}{c}$ ) for the waiters are below 70%, they are not fully utilized but still in optimum condition since it is more than 50%. However, the cashier is not in optimum condition during the operation hour since it is below 50% utilization. Therefore, we assume to hire another one cashier only during peak hour. Then, for scenario 2, the Instantaneous Utilization ( $\frac{c}{c}$ ) are 72.34% and 70.05% for the waiters and cashier respectively indicate that the servers are also busy and well utilized.

#### 4. Conclusion

In conclusion, Arena Simulation Software is a software that used to simulate the queuing situation. Through this research, we able to analyze the queuing system at the restaurant by using suitable queuing analysis tools which is Arena Output Result [7]. ‘What if’ analysis was implemented to come out with several scenarios to make some improvements for the queuing system at the restaurant in order to reduce the customer’s waiting time.

From the result, it is stated that the Total Average Waiting Time ( $W_q$ ) is 24.897 minutes. Thus, we consider that the customers do not have to wait for a longer time to get serve by the server in the restaurant with only three (3) Total Average Number of Waiting Customer ( $L_q$ ). The Instantaneous Utilization ( $\frac{c}{c}$ ) for the waiters indicates that the waiters are well utilized with less than 40% of idleness to have a break during the operation hour. However, we assume to hire another one cashier only during peak hours in the restaurant so that it can help to minimize the labor cost since the Instantaneous Utilization ( $\frac{c}{c}$ ) for the cashiers drop to 36.32%. Hence, scenario 1 is the best strategy to be proposed in the system for a better operation compared to scenario 2 by hiring another one waiter and cashier which means there are seven waiters and two cashiers in the system.

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