Making Simulation Model of Acasia Eatery using Simio Simulation Software

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***Abstract*—One issue that frequently arises in the restaurant business is queueing at the counter for food ordering. Because of an imbalance between people serviced and the services provided, these queues form. In street restaurants like Acasia, lines typically form during lunch. This study aims to simulate the queuing model of Acasia restaurant and assess whether it is acceptable and effective that were performed with the Simio software. The researchers were successful in simulating the line at Acasia Eatery in Capihan San Rafael Bulacan using Simio Simulation Software. The t-test was used by the researchers to validate the data and test their hypothesis. The simulation system was also tested twenty and one hundred times to ensure accurate results, and the results of the simulation were then validated using a t-test. Additional experiments can be conducted using this system, such as recreating it with an additional counter to see whether the length of time spent in the counter or the line can be reduced.**

***Index Terms*—queue, queuing simulation, Simio Software**

I. Introduction

For a business, having a large number of customers is beneficial because a lot of potential sales are simply waiting to happen. However, the issue develops when the number of customers surpasses the capacity of the personnel. The fewer service clerks there are, the fewer consumers they can handle. In 2012, 51 percent of US consumers changed service providers owing to unsatisfactory customer service experiences (Tšernov, 2022).

For those who proactively want to manage revenue, applying Queuing Theory to a restaurant operation may be helpful (OpEx Learning Team, 2014). The capacity of a restaurant to serve customers during a shift and the average order value are the main factors influencing revenue. They must implement many restaurant renovations and kaizen to meet the customers' needs.

When serving customers, fast-food businesses adhere to conventional operating procedures. Customers place their orders and then collect their food at the counters, as is customary routine. Typically, a lengthy queue of people is waiting during busy times, particularly during lunch, supper, and significant events. By enabling the testing of various scenarios or process improvements, a simulation is a model replicating the operation of a current or proposed system, providing evidence for decision-making (TWI, n.d).

This paper aims to understand and identify the queuing simulation of Acasia Eatery. We describe the development using the method Discrete Event Simulation (DES), designed using the Simio tool. Simio is an intelligent object-based simulation modeling system, and it can utilize the modelers to create these items in different modeling projects. Acasia Eatery's queuing model will be tested by comparing the previous results from the output of the simulation.

II. Review of Related Literature

Usman (2020) claims that crowd simulation analytics significantly aided in the analysis of human dynamic mobility, operational effect and efficiency, and space use. Usman (2020) said that adequate equipment is also necessary to get good accuracy in this kind of simulation.

Mallieswari and Akshitha (2020) state that researching queuing systems helped the models become more effective in terms of usage and waiting times, which benefits users by reducing the length of time they must wait when servers are overloaded. In order to do this, actual data on checkout process arrival and service times were studied and documented.

Sinha and Pandit (2021) claim that agent-based simulation is a huge help to their hyper-local food delivery system because the simulator can simulate fleet size, average order distance traveled, average order number delivered, and average idle time spent by a delivery worker—which greatly helped on serving customers with high accuracy estimated time. Additionally, by providing this information, consumers' worry about lengthy lines will be reduced.

Adesina (2018) said that a user-friendly spreadsheet or excel platform will make it easier to simulate a process-driven queuing system. Furthermore, according to Adesina (2018), spreadsheet queuing simulation is more advantageous to students, professionals, and even managers since it offers a better knowledge of queue behavior than specialized simulation software.

III. Methodology

The stages of research conducted at Acasia Eatery are as follows:

A. Data Gathering

The data was acquired by directly observing a video filmed by the researchers on the 10th of July in the year 2022 at Acasia Eatery in Capihan San Rafael Bulacan. The researchers also created a simple console application written in Python programming language to tally customer arrival at the counter, service start time, and the time it takes to complete a customer's order. Data to be taken is the average time of service/process. It is also a good thing to remember that this queue that is being observed is following First In, First Out (FIFO) which is a valuation method in which the assets produced or acquired first are sold, used, or disposed of first. Lastly, the actual data gathering started at time zero of the video, and ended at the one hours, twenty-one minute, and forty-second mark.

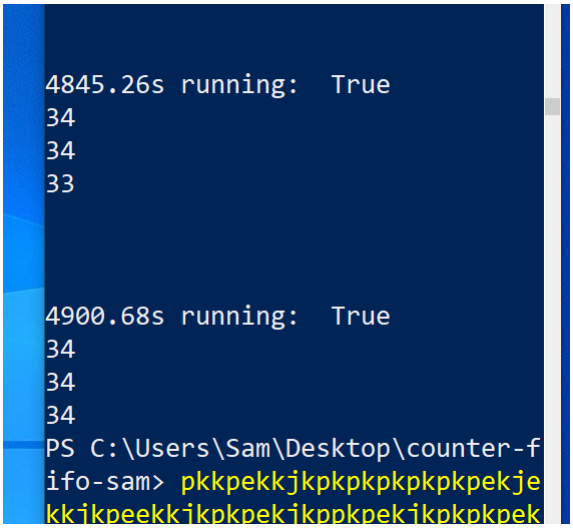

Fig. 1. Python Console Program.

B. Creating the System

The system is designed using Simio Simulation Software so that the system designed can display the number of queues and idle time per counter and perform other experimental simulation tasks.

C. Distribution Methods

1) Source: Exponential Distribution was used for the source or the entrance of the queuing system in the simulation software. From the raw data, specifically arrival time, we can get the mean of all the delta which will yield 147 seconds. This value will then be used in our Source item in the simulation software to simulate the incoming customers.

Fig. 2. Source Settings.

2) Server: Triangular function was used to operate the server. From the raw data, subtract customer n's Service End to its own Service Start to get the delta value. After acquiring the delta value, the minimum, the mode/s and the maximum value can be obtained. In the data's case, it is evident that there are multiple modes.

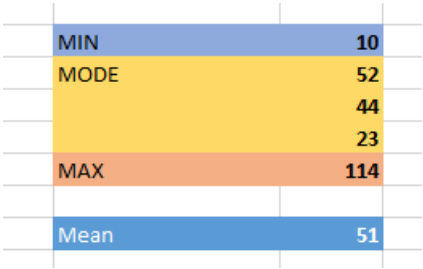

Fig. 3. Min, Mode and Max.

D. System Design

The Queueing System will be made using Simio Software and will be validated using the Z-statistics test to test hypothesis and prove that the results of the simulations are close to the observed data from the video recording. The researchers will also simulate the system twenty and one-hundred times to verify that the system working properly.

Below are the visual designs of the system in 3D and 2D View inside Simio Simulation software.

IV. Result Of the Simulation

A. Comparing the Results of the Main Scenario and the Observed data

Comparing the Results of the Main Scenario and the Observed data. From the observed data, we get 9.27 for the Average Waiting Time (AWT) and 50.54 for the Order Time or the Processing Time (PT). If the first mode is used, the AWT is 9.49 and the PT is 54.95 which are both close to the

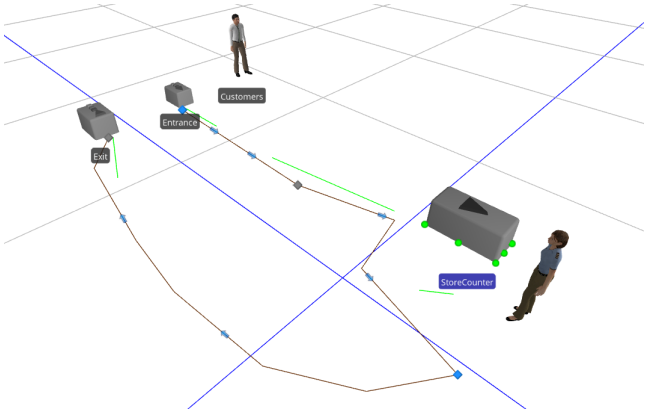

Fig. 4. 3D View.

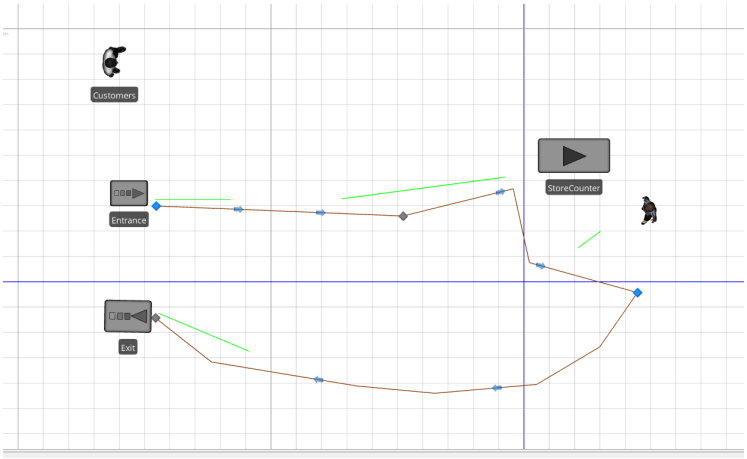

Fig. 5. 2D View.

observed numbers. But when the second mode plugged, the results are still closer to the observed data which are 8.3 and 52.2 for the AWT and PT respectively.

B. 20 and 100 Simulation Experiment Results

Using both the first and second mode from the delta almost doubles the value of the observed data. In the 20 and 100 simulations, when using 52 as the mode, both AWT rounds up to 19 while the PT are both close to 58.

Surprisingly enough, when using the third mode which is 23 seconds for the verification, the values from the result comes closer to the original observed data from the recorded video. The AWT for both 20 and 100 simulations are both close to 12 and both PT are close to 49. It is a good idea to keep in mind that all of the said numbers are all in seconds

Observation	Simio Results (Triangular)	Simio Results (Triangular) 20 Simulations	Simio Results (Triangular) 100 Simulations
	Mode1 (52)	Mode1 (52)	Mode1 (52)
9.272727273	9.4937	19.3719	18.5765
50.54545455	54.9518	58.2225	58.6851
	Mode2 (44)	Mode2 (44)	Mode2 (44)
	8.3291	17.054	16.4686
	52.2079	55.8366	56.0094
	Mode3 (23)	Mode3 (23)	Mode3 (23)
	6.0014	12.5297	12.3015
	44.9379	48.6762	48.8964

Fig. 6. 20 and 100 Simulations.

V. Conclusion

Using Simio Simulation Software, the researchers were able to successfully create a simulation of the queue in Acasia Eatery in Capihan San Rafael Bulacan. The researchers were able to validate the data using t-test to test the hypothesis. The simulation system was also verified by running the simulation twenty and one-hundred times to and getting proper results that was also validated using the t-test on the results of the simulation. Using this system, further experiments can be applied, like simulating it with another extra counter and observing if time in the counter or in the line can still be shortened.

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