JOURNAL OF CRITICAL REVIEWS

ISSN- 2394-5125 VOL 8, ISSUE 02, 2021

A Study on the Waiting Line Operations of Assam University Canteens

***Mr. Dhritiman Chanda **Mr. Nilanjan Mazumdar ***Dr.D.Ghose**
*Assistant Professor, Department of Management, Vishwakarma University, Pune, Email: operationsdchanda@gmail.com, mobile: 9678826452
*Research Scholar, Department of Business Administration, Assam University, Silchar, Email: operations.nilanjan@gmail.com, mobile: 9864073443
***Associate Professor, Department of Business Administration, Assam University, Silchar, Email:operationsdghosh@gmail.com mobile: 7002408399

ABSTRACT
The formation of waiting lines or queue is most common in manufacturing and service process. The waiting line or queues are formed due to the mismatch between the arrival rate of materials/ customers and the service rate of the server or the service station. It is up to the manufacturers or the service providers to decide about the number of windows or service stations need to provide to better handle the arrival rate. Due to the formation of queue or waiting line customers become impatient or dissatisfied. On the other hand the decision to incorporate number of windows or servers are guided by a cost of creating new facilities and also the cost of missing customers due to customer dissatisfaction. Taking five canteens in the University under perspective, this study has been made and by using Anova testing and Queuing methodologies, a clear picture of their performance is obtained.
Keywords: waiting lines, service rate, arrival rate, customer dissatisfaction, Anova, Queuing.

1. **INTRODUCTION**: Any service process or manufacturing process need to consider its sequencing of set of activities. More precisely in case of manufacturing, the setup should consider its set of equipment alignments and sequencing of equipment. The same holds true for the service delivery process. Both manufacturing and service processes need to consider the waiting line issues in the process. The conditions of resource constraint are considered while preparing the sequencing and designing layout plan for manufacturing and service process. There are different established waiting lines models are available in the different studies. The models are based on considering finite population, infinite population, calling sources and number of servers. The organizations may apply the models of waiting lines to solve the waiting line problems.

2. **NEED OF THE STUDY**: As waiting line creation is often unavoidable but still organizations may try to adopt different waiting line models to solve the situations. The length of queue or waiting line develop in the system often creates dissatisfaction and thus impart pressure to the management. Institutional canteens are subjected to different scenario; here calling source is most of the time finite and experience different variations in the customers at different point of time. The present study has been undertaken considering the scenario of University's canteen to cater the foods of the staffs, students and visitors. As the canteens are operating with resource constraints in terms of employees working hour, funds, facility layout and materials, thus proper waiting line model may be applied to study the operations of waiting lines in the canteens.

3. **LITERATURE REVIEW**: In 1908, Agner K. Erlang was asked to exemplify his expertise at a telephone control unit for managing the waiting times by the Copenhagen telephone Corporation. Eventually a study was conducted by him; subsequently identifying that the number of telephone conversations and the waiting time of the telephone demonstrated a Poisson distribution and are distributed exponentially. This was the foundation of the learning of queue theory. The complexity was that during periods of high activity, telephone operators could not answer calls when they were made, causing delays in calls. A. K. Erlang focused his first efforts to identify the delay for an operator and then the results were extended to find the delay for several operators. Studies on mitigating problems regarding idle time on telephone lines and managing the queue was further developed by Molins and Thornton in 1927 & 1928 respectively. The general issues related to the queue system were addressed practically only after the World War II. The works of Erlang helped engineers and mathematicians to identify any and address the issues in queuing problems using probabilistic methods. Queue theory has become an applied probability field and many of its results have been used in operations research, information technology, telecommunications, traffic engineering and reliability theory. It is a prominent branch of living science in which experts publish many articles and books.. Priyangika and Cooray(2016), In their document "Analysis of the payment transaction in supermarkets using queue theory" they explain the analysis of queue systems for the pragmatic data of the supermarket payment service unit using queue theory. The main objective of this document is to review the application of queue theory and evaluate the parameters involved in the service unit for the payment transaction in the supermarket counters. Hence, a mathematical model was devised to measure the performance of the verification service units. Prasad, et.al (2014) in their article "Mathematical analysis of multi-server queues and multi-server queues: comparative study" obtained the total cost assuming a

ISSN- 2394-5125 VOL 8, ISSUE 02, 2021

certain cost of idle times in mutual cases, and demonstrated that the cost total likely is lower for the multi-queue single-server model than the multi-queue multi-server model. Chinwuko,Daniel, Ugochukwu, Obiora(2014) in their paper on queuing system adaption in a business with the case of First Bank PLC, Nigeria, The study was summarized and concluded with a proposition to increment the number of servers in the system .It was observed that they need 5 servers instead of the 3 at present. It suggests a need to increase the number of servers in order to serve the customer better.

4. **SCOPE OF THE STUDY**: The present study explored in detail the operations of canteens from the point of view of waiting line. Detail considerations with respect to factors of waiting line were also taken in the study. The study tries to find essential factors necessary for finding the canteen performance like probability that the canteen is free, average waiting number of customer in the queue, average waiting number of customer in the system, average waiting time per customer in the queue, average waiting time per customer in the system. Thus the above study may be applicable in similar types of businesses.

5. **LIMITATIONS OF THE STUDY**: Due to time constraint the study emphasized only in the canteen operations of a specific Institution. The considerations of factors may also be different if the study could have considered more number of institutions spreading across a variety of geographical locations. Further considering the cost aspect the study was limited up to five canteens inside the Assam University campus.

6. **OBJECTIVES OF THE STUDY**: The present study has the following objectives:

- To assess the waiting line performance parameters of the different canteens adopted in the study.
- To compare the waiting line performance parameters of the different canteens with respect each other.

7. **HYPOTHESIS**: Following null hypothesis has been formulated for the study:
H01: There is no significant difference between the waiting line performance parameters of the same canteen during different days.
H02: There is no significant difference between the waiting line performance parameters among the different canteens during different days.

8. **RESEARCH METHODOLOGY AND DATA**:
The present study is of the nature of exploratory type. The study explored different types of data from the canteens regarding their performance. For the study, the following structured methodology has been adopted.
The study obtained data regarding the incoming traffic of the customers in the canteens. The canteens served food from morning 10am up to 5pm in the evening. A per hour reading was taken and for a week.
Sources of data are primary in nature. The data has been collected through data sheets and observation methods.
The number of customers arriving per day per hour for a week is recorded as follows:
TABLE 1: Parameters readings of five canteens for six days (sample table)

Time	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
10am-11am						
11am-12pm						
12pm-01pm						
01pm-02pm						
02pm-03pm						
03pm-04pm						
04pm-05pm						

Source: Primary data collected by the authors for the study
From the above reading, the Service rate of the canteens and the Arrival rate of the customers were found out, which helped in find out the following variables.

- Probability that the canteen is free
- Average waiting number of customer in the queue
- Average waiting number of customer in the system
- Average waiting time per customer in the queue
- Average waiting time per customer in the system

By finding the above mentioned values for each of the 5 canteens, a comparative analysis is completed.

Model Specification

The process of transforming the theory into a regression model is called model specification. The study has taken a queuing model in the format M/M/C/N/FCFS where

M = arrivals and service times,
C = number of servers,

ISSN- 2394-5125 VOL 8, ISSUE 02, 2021

FCFS = first come first serve regulation
N = finite population

The model selected for this study is (M/M/1): (GD/N/N)

The canteens had only cook and one attendant, thus it was taken as an m/m/1 model. The service discipline was General discipline and maximum number of customers in the system and the size of calling source were finite.

Model Formulation

The attributes that will relate to the (M/M/1): (GD/N/N) are

Arrival Rate = A,

Service Rate = S,

Utilization Factor (U) = A/S,

Probability that the canteen is free (P_0) = $\{ \sum_{n=0}^{C} N\ C_n\ U^N + \sum_{n=C+1}^{N} N\ C_n\ \frac{n!\ U^n}{C!C^{n-C}} \}^{-1}$

Average waiting number of customer in the queue (L_Q) = N - (1+ (1/U)) (1-P_0)

Average waiting number of customer in the system (L_s) = N-(1-P_0/U)

Average waiting time per customer in the queue ($W_{Q)} = L_Q/A_{EFF} = L_Q/ S (1-P_0)$

Average waiting time per customer in the system (W_S) = L_S/A_{EFF}

Assumptions

- The size of the calling population is finite
- The arrival rate is taken By Poisson's distribution
- The customers regularly join the queue
- The discipline follows First Come First Serve
- The allowable length of the queue is finite
- The time for the preparation of each food item is considered to be uniform.
- The food items offered are uniform in type.

9. ANALYSIS OF DATA AND FINDINGS:

Based on the study ANOVA have been applied. Thus, the researchers have made an attempt to justify the hypothesis by creating individual parameter tables considered under the study for each canteen for 7(seven) days of the week as per the Performa below;

Successively, the analysis was undertaken for each parameter (referring table 1). The outcomes of the ANOVA are as follows;

Table 2: Representation of P values for Anova Two factor testing.

	P-value	
Parameters of waiting line	Within	Among
Utilization Factor	0.732293	0.571521
Probability that the canteen is free (Po)	0.474469	0.820259
Average waiting number of customer in the queue (Lq)	0.785811	0.911257
Average waiting number of customer in the system (Ls)	0.786535	0.54549
Average waiting time per customer in the queue (Wq)	0.340434	0.505242
Average waiting time per customer in the system (WS)	0.994917	0.141998

Source: Primary data collected &test value calculated by the authors for the study

As per the laid hypothesis it can be observed from the analysis that the P-value for each of the parameter is greater (>) than 0.05. Hence, it can be concluded there is no significant difference between the waiting line performance parameters of the same canteen during different days. And there is no significant difference between the waiting line performance parameters among the different canteens during different days; hence, we failed to reject the hypothesis by accepting the null hypothesis.

H01: There is no significant difference between the waiting line performance parameters of the same canteen during different days.

H02: There is no significant difference between the waiting line performance parameters among the different canteens during different days.

Further the values obtained from the analysis were taken calculated and inserted in the respective tables and every individual canteen was taken into the concern.

ISSN- 2394-5125 VOL 8, ISSUE 02, 2021

Table 3: Weekly values of parameters for five canteens

Attributes	Canteen 1	Canteen 2	Canteen 3	Canteen 4	Canteen 5
Utilization Factor	1.1209603	1.067001675	1.256487026	1.04572564	1.13636363
Probability that the canteen is free	0.0019301	0.002361318	0.001200784	**0.00256230**	0.00182467
Average waiting number of the customers in the queue	3.1115597	3.067368706	3.206286713	**3.0487388**	3.12343038
Average waiting number of customer in the system	4.1096296	4.065007389	4.205085929	**4.04617649**	4.12160571
Average waiting time per customer i the queue	0.1209033	**0.108152775**	0.134556825	0.25522061	0.15317468
Average waiting time per customer i the system	0.1596844	**0.143328654**	0.176472993	0.33871961	0.20212573

Source: Primary data collected & parameters values calculated by the authors for the study

It was found from the table:

- Probability that the canteen is free was best for Canteen 4
- Average waiting number of customer in the queue was best for Canteen 4
- Average waiting number of customer in the system was best for Canteen 4
- Average waiting time per customer in the queue was best for Canteen 2
- Average waiting time per customer in the system was best for Canteen 2

Results

- The probability that the canteen will be free was highest for Canteen 4 and it was seen that they procure raw materials before the day of production and they have cold storage space for storing the items. Further a continuous check of the tables that are left empty is done. Food production starts from early in the morning and the finished products are stored in the inventory.
- The average waiting number of customers in the queue and in the system was found least for the Canteen 4 and it was seen that Canteen 4 applies self service method. Furthermore, they implement pre ordering systems where orders can be placed prior to two hours of consumption.
- The average waiting time per customer in the queue and in the system was found least for Canteen 2 and it was observed that they provide the finished products at the disposal of the customers with the price of the items mentioned below. They implement self service and the customer pays for the items he/she picked from the counter.

10. CONCLUSION

Proper utilization of time while the meal breaks in the university canteens not just accelerates the process of food distribution but also enhances the student's interest of having food from the canteens. If the mentioned results are being followed and implemented for the canteens that excelled in their respective attributes it is expected that a fruitful outcome will be seen in its performance.

11. REFERENCES

- Bakari, H. R., Chamalwa, H. A., & Baba, A. M. (2014). Queuing process and its application to customer service delivery (A case study of Fidelity Bank Plc, Maiduguri). *International Journal of Mathematics and Statistics Invention (IJMSI)*, *2*(1), 14-21.

- Bonga, W. G. (2013). An Empirical Analysis of the Queuing Theory and Customer Satisfaction: Application in Small and Medium Enterprises–A Case Study of Croc Foods Restaurant. *Available at SSRN 2348304*.

- Girden, E. R. (1992). *ANOVA: Repeated measures* (No. 84). Sage.

- Hongbo, C. J. W. (2011). Optimal Management Model of University Canteen Based on Mixed Queuing Theory [J]. *Journal of Huangshi Institute of Technology*, *3*.
- Igwe, A., Onwumere, J. U. J., & Egbo, O. P. (2014). Efficient Queue Management in Supermarket: A Case Study of Makurdi Town, Nigeria. *European Journal Of Business & Management*, *6*(39).

- Keppel, G. (1991). *Design and analysis: A researcher's handbook*. Prentice-Hall, Inc.

- Priyangika, J. S. K. C., & Cooray, T. M. J. A. (2016). Analysis of the Sales Checkout Operation in Supermarket Using Queuing Theory. *Universal Journal of Management*, *4*(7), 393-396.
- Prasad, V., Badshah, V. H., & Koka, T. A. (2015). Mathematical analysis of single queue multi server and multi queue multi server queuing models: comparison study. *Global Journal of Mathematical Analysis*, *3*(3), 97-104.
- R.Panneerselvam. (2009). *Operations Rsearch*. New Delhi: PHI Private Limited, 300-301,318-325.
- Sharma, A., & Barua, P. B. (2015). Application of Queuing Theory in a Small Enterprise. *International Journal of Engineering Trends and Technology (IJETT)*, *27*(2), 105-110.

Appendix

Utilization Factor

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Rows	0.09268	4	0.02317	0.505619	0.732293	3.006917
Columns	0.13772	4	0.03443	0.751337	0.571521	3.006917
Error	0.7332	16	0.045825			
Total	0.9636	24				

Probability that the canteen is free (Po)

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Rows	1.7E-05	4	4.24E-06	0.923747	0.474469	3.006917
Columns	6.96E-06	4	1.74E-06	0.379085	0.820259	3.006917
Error	7.34E-05	16	4.59E-06			
Total	9.74E-05	24				

Average waiting number of customer in the queue (Lq)

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Rows	0.163176	4	0.040794	0.428711	0.785811	3.006917
Columns	0.091517	4	0.022879	0.240442	0.911257	3.006917
Error	1.522479	16	0.095155			
Total	1.777172	24				

Average waiting number of customer in the system (Ls)

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Rows	0.224501	4	0.056125	0.427672	0.786535	3.006917
Columns	0.417399	4	0.10435	0.79514	0.54549	3.006917

ISSN- 2394-5125 VOL 8, ISSUE 02, 2021

Error	2.099751	16	0.131234			
Total	2.741651	24				

Average waiting time per customer in the queue (Wq)

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Rows	0.018775	4	0.004694	1.221895	0.340434	3.006917
Columns	0.01331	4	0.003327	0.866197	0.505242	3.006917
Error	0.061463	16	0.003841			
Total	0.093549	24				

Average waiting time per customer in the system (WS)

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows	0.001051	4	0.000263	0.049513	0.994917	3.006917
Columns	0.042614	4	0.010653	2.006878	0.141998	3.006917
Error	0.084935	16	0.005308			
Total	0.128601	24				