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Analyses of Queuing Characteristics of Customers on Enterprise Efficiency, a Case of Meemee Restaurant

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Abstract: *In our everyday business affairs, we encounter traffics in the course of providing a product/service or consuming a product/service. Such traffic, nay queues tend to be an inconvenience both to the consumers and service providers. It then becomes important for the management to devise means for dealing with such queues effectively and efficiently. One of such ways is to develop and apply model that will manage such queues. But, it is only possible to apply such queuing model when the operating characteristics of the queuing systems are studied, known and conform to the basic features of a Queuing model.*

This study, thus attempts to analyze the arrival pattern of customers, the service (departure) mechanism to see if it follows a discrete probability distribution (DPD) such as Poisson distribution and negative Exponential distribution respectively, which are one of the basic features of a queuing system. This will help us know if the queuing model can be applied or not because unless the arrival pattern of customers fits into a Poisson distribution and the Service mechanism is exponentially distributed, the large numbers of customers waiting to be served in Meemee restaurant do not represent the operating characteristics of a queuing system.

Keywords*: Queue, Traffic, Arrival Pattern, Service Mechanism, Model, Discrete Probability Distribution, Negative Exponential Distribution, Queuing System.*

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I. Introduction

A queue simply means a waiting line. Queuing model is a quantitative technique used to evaluate the time it takes for a customer to arrive at a service point, the time it takes for a customer to wait until served or attended to and the time it takes for the customer to leave a service point after being served. Queuing model also determines the probability of there being no customer in the system and the traffic intensity otherwise known as Utilization factor. But the arrival pattern and service mechanism are a very important and distinguishing factors of a queuing systems as they show if customers arrive at the same time or not and/or if all customers leave the service point at the same time or not.

These in depth analyses have overall goal of quality assurance of service to customers even though there are several determining factors for a restaurant to be considered a good or bad one. These include taste, cleanliness, the restaurant layout and settings. These factors when managed carefully will be able to attract plenty of customers (M. Dharmawirya, E. Adi, 2011).

Objectives

a. To find out whether or not the arrival pattern of customers in Meemee restaurant fits into a Poisson distribution.
b. To determine whether or not the service mechanism of customers in Meemee Restaurant follows a negatives exponential distribution.

Hypotheses

a. Arrival pattern of customers in Meeme Restaurant does not fit into a Poisson distribution.
b. Service mechanism of customers in Meeme Restaurant does not follow a negative exponential distribution.

II. Methodology

This is a survey research. Data were collected from Meemee Restaurant by direct personal observation and personal interview. The restaurant is one the busiest in the city. A thirty (30) miniutes interval was adopted for the five days period covered during the research. Variance , Chi-square and Mean and are used to compute the data so as to see if arrival pattern and service mechanism of customers in the restaurant fits into Poisson distribution and negative exponential distribution respectively.

III. Observations/Discussions

DISTRIBUTION OF CUSTOMERS' ARRIVAL

Table A.

Time Period	Saturday	Sunday	Monday	Tuesday	Wednesday	Total
10:00 - 10:30	66	44	34	41	50	235
10:30 - 11:00	40	30	28	25	38	161
11:00 - 11:30	32	45	30	32	49	188
11:30 - 12:00	23	38	25	39	27	152
12:00 - 12:30	29	31	27	31	33	151
12:30 - 01:00	37	43	38	22	28	168
01:00 - 01:30	25	18	27	38	43	151
01:30 - 02:00	40	29	15	20	40	144
02:00 - 02:30	35	40	29	33	26	163
02:30 - 03:00	43	29	37	32	18	159
TOTAL	**370**	**347**	**290**	**313**	**352**	**1672**

Source: **PERSONAL OBSERVATION 2019**

DISTRIBUTION OF SERVICE RATE

Table B

Time Period	Saturday	Sunday	Monday	Tuesday	Wednesday	Total
10:00- 10:30	45	45	35	31	30	160
10:30- 11:00	42	39	34	30	37	182
11:00- 11:30	45	35	31	28	37	176
11:30- 12:00	42	29	33	31	42	177
12:00- 12:30	43	40	31	35	35	184
12:30- 01:00	36	40	39	36	36	187
01:00- 01:30	36	39	34	28	31	168
01:30- 02:00	39	36	31	29	40	175
02:00- 02:30	45	45	28	28	25	171
02:30- 03:00	45	30	26	25	29	155
TOTAL	**418**	**378**	**322**	**301**	**342**	**1761**

Source: **PERSONAL OBSERVATION 2019**

Calculations

In Table A, there are ten "thirty minutes" periods. The total number of observations for the 5-day period covered during the week is 50 while the total number of arrival rate is 1672. Therefore, the average arrival rate is = 33.4 which approximately gives 33 customers. This means that 33 customers arrived in 30 minutes.

In Table B, there are ten "Thirty Minutes" periods. 50 observations were recorded for the 5-day period covered during the week of the study. The total number of arrival rate is 1761. Therefore the average service rate is 1761/50 = 35.22

The data presented in both Tables A and B are now calculated using Chi-square and Variance analysis.

Chi – square is given

$$X_c^2 = \sum \frac{(o - e)^2}{e}$$

where o = Observed Value or frequence

e = Expected Value

$$e = \frac{\text{row total x column total}}{\text{Grand total}}$$

The frequency Table A is summarized into 2x5 contingency table below as:

Time Period	Saturday	Sunday	Monday	Tuesday	Wednesday	Total
10:00 - 12:30	190	188	144	168	197	887
12:30 - 03:00	180	159	146	145	155	785
TOTAL	**370**	**347**	**290**	**313**	**352**	**1672**

$$e_{11} = \frac{887\ x\ 370}{1672} = 196.29$$

$$e_{12} = \frac{887\ x\ 347}{1672} = 184.08$$

$e_{13} = \frac{887 \, x \, 290}{1672} = 153.85$

$e_{14} = \frac{887 \, x \, 313}{1672} = 166.05$

$e_{15} = \frac{887 \, x \, 352}{1672} = 186.74$

$e_{21} = \frac{785 \, x \, 370}{1672} = 173.71$

$e_{22} = \frac{785 \, x \, 347}{1672} = 162.92$

$e_{23} = \frac{785 \, x \, 290}{1672} = 136.15$

$e_{24} = \frac{785 \, x \, 313}{1672} = 146.95$

$e_{25} = \frac{785 \, x \, 352}{1672} = 165.26$

but $X_c^2 = \sum \underline{(o - e)^2}$

$$e = \frac{(190-196.29)^2}{196.29} + \frac{(188-184.08)^2}{184.08} + \frac{(144-153.85)^2}{153.85}$$

$$+ \frac{(168-166.05)^2}{166.05} + \frac{(197-186.74)^2}{186.74} + \frac{(180-173.71)^2}{173.71}$$

$$+ \frac{(159-162.92)^2}{166.05} + \frac{(146-.15)^2}{186.71364} + \frac{(145-146.95)^2}{173.71}$$

$$+ \frac{(155-165.26)^2}{165.26}$$

⇒ 0.20 + 0.08 + 0.63 + 0.02+ 0.56 + 0.23 + 0.09 + 0.71 + 0.03 + 0.64

$X_c^2 = 3.19$

The data in Table B will be analyzed using Variance to determine the value. The value so obtained using Variance will then be compared with the mean value to see if they are approximately equal.

Variance = $\frac{\sum(X-\overline{X})^2}{n-1}$

Where x = Values

$\overline{x}$ = the mean of the service rate

$x - \overline{x}$ = the mean deviation

n = number of observations

Hence, Table C below shows the corresponding computations of the above variables for the Variance.

But the mean can be calculated as: $\frac{\sum fx}{\sum f}$ or $\frac{Total number of values}{number of observations}$

Thus mean = $\frac{1761}{50} = 35.22$

This approximately gives 35.20

Table C COMPUTATION OF VARIABLES TO OBTAIN VALUE OF VARIANCE

X	**X - $\overline{X}$**	**$(X - \overline{X})^2$**
45	9.78	95.65

42	6.78	45.97
45	9.78	95.65
42	6.78	45.97
43	7.78	60.53
36	0.78	0.61
36	0.78	0.61
39	3.78	14.29
45	9.78	95.65
45	9.78	95.65
45	9.78	95.65
39	3.78	14.29
35	- 0.22	0.05
29	- 6.22	38.69
40	4.78	22.85
40	4.78	22.85
39	3.78	14.29
36	0.78	0.61
45	9.78	95.65
30	- 5.22	27.25
35	- 0.22	0.05
34	- 1.22	1.49
31	- 4.22	17.81
33	- 2.22	4.93
31	- 4.22	17.81
39	3.78	14.29
34	- 1.22	1.49
31	- 4.22	17.81
28	- 7.22	52.13
26	- 9.22	85.01
31	- 4.22	17.81
30	- 5.22	27.25
28	- 7.22	52.13
31	- 4.22	17.81
35	- 0.22	0.05
36	0.78	0.61
28	- 7.22	52.13
29	- 6.22	38.69
28	- 7.22	52.13
25	- 10.22	104.45
30	- 5.22	27.25
37	1.78	3.17
37	1.78	3.17
42	6.78	45.97
35	- 0.22	0.05
36	0.78	0.61
31	- 4.22	17.81
40	4.78	22.85
25	- 10.22	104.45
29	- 6.22	38.69
		1722.66

$$\text{Variance} = \frac{\sum(X-\overline{X})^2}{n-1}$$

$$= \frac{1722.66}{50-1}$$

Variance = 35.15

This approximately gives 35.20 as the variance

IV. Discussion of Results

a. From the computations on Chi-square, the result obtained is as thus $X_c^2 = 3.19$ while critical region or value = 9.488.

b. The mean values of the frequency distribution of customers' service rate = 35.20

c. From the computation of the variables in Variance, the value = 35.22 which approximately gives 35.20.

Test of Hypotheses

a. Decision Rule: If the mean and variance are approximately equal, we reject the hypothesis otherwise we accept.

Remark: the mean = 35.20 (approximately) while the variance = 35.20 (approximately), therefore we reject.

***b. Decision Rule*:** if $X_c^2 > X_{T,}^2$ we reject the hypothesis otherwise we accept.

***Remark*:** Since $X_c^2 = 3.19 < X_T^2 = 9.488,$ we reject the hypothesis.

V. Conclusions

The results obtained from observations and calculations of the data collected have shown that the mean and variance are approximately equal hence the arrival pattern of customers in Meemee restaurant follows a Poisson distribution. Similarly, the Chi-square value is less than the critical region (value) thus indicating the service mechanism of the customers follows a negative exponential distribution. Thus we conclude that the arrival pattern of customers and their service (departure) mechanisms are typical characteristics of a queuing model. Consequently, Queuing model can be applied to Meemee restaurant to help the management with tips on how best to manage the traffic.

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