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Short Communication

Time Allocation at a Single-Channel Fast Food Restaurant – An Application of Waiting Line Model

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ABSTRACT

The major objectives of this study were: to assess the time spent for service/order filling and the time spent in the overall operating system by a customer at a single-line fast food restaurant. The analysis is based on actual data by visiting four randomly selected fast food restaurants located in the twin cities of Rawalpindi and Islamabad. The data were collected during rush hours in the afternoon between 12:00 noon to 2:00 p.m. and in the evening during 7.00 p.m. to 9:00 p.m. It was found in a single-channel that there are 7% chances a customer arrives in the over all operating system in the restaurant. In the over all operating system, one customer has to wait for service in the time period of 4 h. There will always be four customers present in the over all operating system in the restaurant. For only 0.124 min, a customer has to wait for the service in the over all operating system. A customer stays for about 18 min in the over all operating system in the restaurant. There is only 6% chance that a customer has to wait in the line for the service in the over all operating system in the restaurant.

Key Words: Fast food; Time allocation; Single-channel; Waiting line model

INTRODUCTION

The word ‘fast food’ means the food that can be served in the shortest time by a fast food restaurant. Over the years, fast food restaurants are increasing in numbers throughout the country. The population in general and working people in particular find fast food a quick way to finish meals in order to save time. Fast food is more suitable to working people as they have limited time during official break time. However, fast food is becoming equally popular among non-working people and families.

A fast food restaurant follows a particular system of service. It may follow a single-channel to serve the customers who wait in a line to fill their orders. Sometimes, it may cost the customer to spend a longer time to wait in the line or queue. For example, it may take a longer time for a customer to fill the order during afternoon and/or evening rush hours.

At single-channel in a fast food restaurant, there is a single cash counter where the server takes the orders of customers who wait in the line for their turn, determines the cost of the bill, receives the cash and fills the order. Once the order is filled the customer leaves the counter and the next customer is attended and so on. During the rush hours more customers are expected to arrive at the fast food restaurant and this may lead to formation of long queues at the restaurant.

This paper examines the process of customer arrivals and the allocation of time at a single-channel steady-state operation fast food restaurant. The major objectives of this study were, 1) To assess the time spent by a customer for service/order filling at a single-line fast food restaurant, and 2) To estimate the time spent by the customer in the overall operating system at a single-line fast food restaurant

RESEARCH METHODOLOGY

According to Davis (1966), and Hillier and Lieberman (1986) waiting line follows two parameters: 1) average arrival rate of customers (λ), and 2) average service time (μ). This study empirically examines the single-channel waiting line model as suggested by Davis (1966) and Hillier and Lieberman (1986).

Data collection. The empirical analysis of the waiting line model was based on the primary data collected through personal observations by visiting four randomly selected fast food restaurants located in the twin cities of Rawalpindi and Islamabad. The data were collected during rush hours in the afternoon between 12:00 noon to 2:00 p.m. and in the evening during 7.00 to 9:00 p.m. In all, 100 customers were accounted for during the survey time period in four restaurants. The data were collected during the last week of October 2001. The models suggested by Davis (1966) and Hillier and Lieberman (1986) are discussed below:

Analytical procedure

1. The process of customer arrivals. Arrivals in a restaurant occur in a random fashion. Arrivals follow Poisson probability distribution given as under:

$P(x) = e^{-\lambda}\lambda^{x}/x!$

Where, λ = average arrival rate

x = number of arrivals in a given time period

e = 2.718

2. Distribution of service time in the restaurant. Service time varies form customer to customer depending upon the size of the order placed by the customer. Service time follows an exponential distribution function given as under:

$P(X \le x) = 1 - e^{-x/u}$

Where, μ = average service time

3. Operating characteristics of the restaurant. The values of average arrival rate (λ**)** and average service time **(**μ) are used to determine the operating characteristics of a single-channel waiting line. The series of formula calculations describing operating characteristics are given below (Davis, 1966; Hillier & Lieberman, 1986).

a. probability that there is no unit in the system and is idle

$P_0 = 1 - \lambda/u$

b. average number of units in the waiting line

$L_q = \lambda^2/\mu(\mu-\lambda)$

c. average number of units in the system

$L = L_q + \lambda / \mu$

d. average time a unit spends in the waiting line

$W_q = L_q / \lambda$

e. average time a unit spends in the system

$W = W_q + 1/\mu$

f. probability that an arriving unit has to wait for service

$P_w = \lambda/\mu$

RESULTS AND DISCUSSION

1. **The process of customer arrivals.** Average number of customer arrivals (λ) worked out to be = 0.416 / minute. In other words, there were 25 customer arrivals per hour in a restaurant. The calculated Poisson probabilities based on actual data are shown below in Table I:

Table I. Poisson probability distribution of customer arrivals in a restaurant

No. of customer arrivals (x)	$P(X = x) = e^{-\lambda} \lambda^x / x!$
0	$P(X = 0) = e^{-(0.416)} (0.416)^0/0! = 0.65$
1	$P(X = 1) = e^{-(0.416)} (0.416)^1/1! = 0.27$
2	$P(X = 2) = e^{-(0.416)} (0.416)^2/2! = 0.05$
3	$P(X = 3) = e^{-(0.416)} (0.416)^3/3! = 0.008$
4	$P(X = 4) = e^{-(0.416)} (0.416)^4/4! = 0.0008$

x = number of customer arrivals in a given period

2. Distribution of service time in the restaurant. Average service time per customer **(**μ) was worked out. The average service time **(**μ) came to be = 6 min per customer. Based on μ = 6 Table II was developed. The calculated exponential probabilities based on actual data are shown in Table II below:

Table II. Exponential probability distribution of service time in the restaurant

Service time (x)	$P(X \le x) = 1-e^{-x/u}$	
0	$P(X \le 1) = 1-e^{-1/6}$	= 0.15
1	$P(X \le 2) = 1-e^{-2/6}$	= 0.28
2	$P(X \le 3) = 1-e^{-3/6}$	= 0.39
3	$P(X \le 4) = 1-e^{-4/6}$	= 0.51
4	$P(X \le 5) = 1-e^{-5/6}$	= 0.56

3. Operating characteristics of the restaurant. The information of Tables I and II was used to develop Table III which is shown below. This shows the operating characteristics of a restaurant:

Table III. Operating characteristics of the restaurant

Operating characteristics		
1.	P_0	0.931
2.	L_q	.00516=1 customer/ hour
3.	L	0.074 = 4 customers/ 4 hours
4.	W_q	0.0124 minutes
5.	W	0.179 minutes
6.	P_w	0.0693

All the results shown in Tables I, II and III above are discussed as under. Average number of customer arrivals (λ) = 0.416 per min. In other words, on an average 25 customers per hour are expected to arrive at the fast food restaurant. According to Poisson probabilities shown in Table I above, there are 65% chances of no arrival at the restaurant on an average. There are 27% chances of one arrival, 5% chance of two arrivals and 0.8% chance of three arrivals, 0.08% chance of four arrivals at the fast food restaurant at a given time. It is inferred that there are as many as 35% chances of any arrival at a given time in the restaurant on an average.

The average service time (μ) came to be six minutes per customer. It means that on an average a customer is expected to wait in the line for six minutes before the order is filled at the fast food restaurant. Table II shows the results of distribution of service time. For example, on an average there are 15% chances that service is provided to a customer within a minute or less. Similarly, on an average there are 28% chances that service is provided within two minutes or less, 39% chances that service is provided within three minutes or less, 51% chances that service is provided within four minutes or less, and 56% chances that service is provided within five minutes or less at the fast food restaurant on an average. It is inferred that there are more than half chances that a customer will wait in the line for 4-5 minutes on an average.

The results of operating characteristics of the restaurant system are shown in Table III above. The first result of Table III above shows that there are 7% chances that a customer arrives in the over all operating system. The second result shows that in the over all operating system one customer has to wait for service in the time period of 4 h. The third result indicates that on an average four customers will always be present in the restaurant. The fourth result indicates that for only 0.124 minutes a customer has to wait for the service in the over all operating system. The fifth result in Table III shows that a customer stays for about 18 min in the over all operating system. The sixth and last result in Table III above shows that there is only 6% chance that a customer has to wait in the line for the service in the over all operating system in the restaurant.

CONCLUSION

Based on the results of this study, there seems no pressure on the management of fast food restaurants of long queue formation at the restaurant at the current time period. Perhaps a larger proportion of the population of twin cities of Rawalpindi and Islamabad does not prefer to eat out side at a fast food restaurant.

RECOMMENDATIONS

The management of fast food restaurants should bear in mind that future demand of fast food may expand. They should be aware that during rush hours a queue may become long and customers would wait for order filling for extended time given that the demand of fast food expand in the future time period.

REFEFENCES

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