COMPARISON BETWEEN M/M/1 AND M/D/1 QUEUING MODELS TO MINIMIZING WAITING TIME OF FARMERS IN REGULATED MARKET COMMITTEE

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Abstract: Recent days waiting time and service systems in queue are important parts of the business world. To get the best service, waiting is unavoidable one, for example in super market, banks, Ticket booking centres, Automated Teller Machine (ATM), etc., Customers are often to wait in queue whenever the service is busy. We have compute to minimize the waiting time of Farmers in Regulated Market Committee (FRMG) at Ulundurpet of Vilupuram district in Tamil Nadu using M/M/1 and M/D/1 models.

Keywords: M/M/1 Queuing Model, M/D/1 Queuing Model, Poisson Process.

1. INTRODUCTION

In [3] Agriculture is the prime profession that helps in the overall development of the economy of Tamil Nadu. Various steps taken by the government to increase the investment in agriculture, (agro-based technologies, marketing development, planning, approach etc.,) have brought substantial improvement in production. Agricultural marketing has become the key driver of the agriculture sector today due to private market realities posed by increasing accent on globalization, liberalization and privatization of the economy. The Department of Agricultural Marketing functioning since 1977 for regulating agricultural marketing, which had been renamed as "Department of Agricultural Marketing and Agro Business" to focus on other latest technologies like post harvest management, grading, packaging, food processing and export. The core objective of the Department of Agricultural Marketing and Agribusiness is to help the farmers in marketing their agricultural produce at a fair price and to ensure remunerative returns to them.

The Government of Madras enacted the Madras Commercial Crops Market Act in 1933. In order to extend the scope of the Act to all agricultural producers, the Act was modified as Tamil Nadu Agricultural produce Market Act in 1999. The era of regulated markets started in Tamil Nadu in 1936 with the establishment of the first regulated market for cotton at Tiruppur under the Coimbatore Market Committee. The second Regulated Market Committee was established in Tindivanam in 1939 under the South Arcot Market Committee. Now-a-days all districts in Tamil Nadu have Regulated Market Committees except

Chennai district. At present there are 21 Market Committees and 268 Regulated Markets are in operation in Tamil Nadu.These Market committees are functioning with members nominated by Government and Chairpersons elected by the members. The primary object of regulating the market is to safeguard the interest of the producer sellers and raise the standards of the local markets where the first exchange of the goods take place. Market Committees are established consisting of the representatives of the growers, traders, local bodies, sellers, co-operative shops and the government nominee.

In India, Tamil Nadu is selected as a best performing State in total food grain production in 2015-2016. In Tamil Nadu, Vilupuram district secured the first place in contributing to higher yield (9.3%). Regulated Markets provide various kinds of facilities like electronic weigh bridges, Weighing balances, godown, daily price information, rest sheds, immediate payment. The following picture is showing that a long waiting line in queue.

A Queuing model is to predict the queue length and waiting time. Queuing theory has its origins in research by Agner Krarup Erlang, where he created models to describe the Copenhagen Telephone Exchange. In 1909 Erlang experimented with fluctuating demand in telephone traffic. Father of Queuing theory is known as Agner Erlang.

Different terms of Queues are waiting lines, machines waiting to be repaired, trucks in line to be unloaded, or airplanes lined up on a runaway waiting for permission to take off. Traffic characteristics of Regulated market are influenced by various factors like lack of space, poor layout, manpower, godown facility, natural calamities, poor functioning of Electronic weighing machine, weighing bridges.

In this study, we have mainly focussed the traffic activity is particularly in rural areas because most of the rural people using their own vehicle like cart loads, trucks, tractors, Tataace, mini-lorries, etc. We see the peak time of incoming traffic is from 7.00 am to 9.00 am and the rush hours of outgoing traffic is during 4.00 pm to 8.00 pm. Traffic congestion is the most serious phenomenon in day to day life. In this model, we calculated mean queue length, mean waiting time, customer mean service time and arrival rate and traffic intensity. The three basic components of queuing process are arrivals, the actual waiting line and service facilities.

2. METHODOLOGY

We will make the following assumptions for queuing system in accordance with queuing theory.

Step-1: Arrivals of no. of crop bags follow a Poisson probability distribution at an average rate of λ number of farmers per unit time.

Step-2: The queue discipline is First Come First Served (FCFS) basis by any of the server. There is no priority classification for any arrival.

Step-3: Service times are distributed exponentially, with an average of μ number of farmers per unit of time.

Step-4: There is no limit to the number of the queue.

Step-5: The service providers are working at their full capacity.

Step-6: Arrival of farmers is independent. Their decision to use the system is independent of other users.

Step-7: We defined that the traffic intensity is less than one.

Step-8: We compared M/M/1 and M/D/1 models to minimize the waiting time.

Step-9: We compute the average queue length, average number of farmers in the system, average waiting time of farmers and average number of time spent by a farmer in the queue.

Step-10: We have to minimize the waiting time of farmers and improve the best service provided.

2.1 M/M/1 QUEUING MODEL

M/M/1 queuing model means that the arrival and service time are exponentially distributed (Poisson Process).

λ : The mean customer's arrival rate.

μ : The mean service rate.

$\rho = \frac{\lambda}{\mu}$: Utilization factor.

2.2 M/D/1 QUEUING MODEL

In queuing theory, a discipline within the mathematical theory of probability, an M/D/1 Queue represents the queue length in a system having a single server, where arrivals are determined by Poisson process and service times are fixed (deterministic). The modal name is written in Kendall's notation.

An M/D/1 queue is a stochastic process whose state space is the set {0, 1, 2,...} where the value corresponds to

(1) Arrivals occur at rate λ according to Poisson process and move the process from state i to i+1.

(2) Service times are deterministic and termed as D (serving at rate $\mu = \frac{1}{D}$)

(3) A single server serves entities one at a time from the front of the queue, according to a First –Come First – served discipline. When the service is complete the entity leaves the queue and the number of entities in the system reduces by one. **Figure-1**, shows that the state diagram for M/D/1 queues.

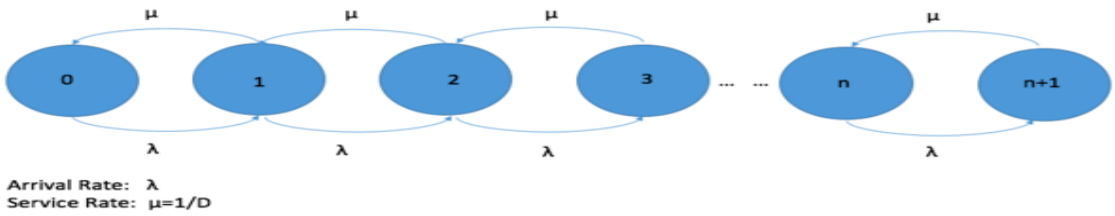

Figure-1

3. MINIMIZING WAITING TIME OF FARMERS IN REGULATED MARKET COMMITTEE (RMC)

In this section we have discussed to minimize waiting time of farmers in Regulated Market Committee at Ulundurpet of Vilupuram District in Tamil Nadu. We have compared the single server systems of (M/M/1) model and(M/D/1) model.

Sl No	TRAFFIC LOCATION	SESSION	ARRIVAL NO. OF CROPS BAGS	TIME IN MINUTES	SERVICE NO. OF CROPS BAGS	TIME IN MINUTES
1	SERNTHANADU	MORNING	1200	3.00	1800	3.30
2	ELAVASANURKOTTAI	MORNING	800	3.15	900	3.45
3	KEERIMEDU	MORNING	1000	4.00	1200	3.50
4	MANGALAMPETTAI	MORNING	500	4.30	1700	4.45
5	VEPUR	MORNING	1000	5.30	1200	5.15
6	SERNTHANADU	EVENING	1500	3.15	1800	3.30
7	ELAVASANURKOTTAI	EVENING	900	3.30	1100	3.50
8	KEERIMEDU	EVENING	700	4.00	800	4.55
9	MANGALAMPETTAI	EVENING	900	4.15	1300	5.30
10	VEPUR	EVENING	500	5.30	1000	6.00

Table-1

Table- 1: Shows that raw data regarding the number of crop bags arrived which were collected from various places at Ulundurpet of Vilupuram District in Tamil Nadu.

Traffic Location	Session	Arrival No. of crops bags	ρ	L_s	L_q	W_s	W_q
SERNTHANADU	MORNING	1200	0.6666	2	0	0.0016	0.0011
ELAVASANURKOTTAI	MORNING	800	0.8888	8	7	0.01	0.0088
KEERIMEDU	MORNING	1000	0.8333	5	4	0.005	0.0041
MANGALAMPETTAI	MORNING	500	0.2941	0	0	0.0008	0.0002
VEPUR	MORNING	1000	0.8333	5	4	0.005	0.0041
SERNTHANADU	EVENING	1500	0.8333	5	4	0.003	0.0027
ELAVASANURKOTTAI	EVENING	900	0.8181	4	41	0.005	0.0004
KEERIMEDU	EVENING	700	0.875	7	6	0.01	0.0087
MANGALAMPETTAI	EVENING	900	0.6923	2	2	0.0025	0.0017
VEPUR	EVENING	500	0.5	1	5	0.002	0.001

Table - 2

The situation of traffic created due to arrival of crop bags from various places to Ulundurpet Regulated Market Committee at Vilupuram district using M/M/1 queuing model. With the help of Raw Data in **Table-1**, we constructed **Table-2** using M/M/1 Model. We computed the traffic intensity, average number of farmers in the system, average number of farmer in the queue, average number of customer in waiting and average time spent in queue by farmer.

Traffic Location	Session	Arrival No.of crops bags	Service No. of crops bags	ρ	L_s	L_q	W_s	W_q
SERNTHANADU	MORNING	1200	1400	0.8571	3	3	0.0028	0.0021
ELAVASANURKOTTAI	MORNING	600	800	0.75	2	1	0.003	0.0018
KEERIMEDU	MORNING	1000	1150	0.869	4	3	0.001	0.0002
MANGALAMPETTAI	MORNING	450	1600	0.2812	0	0	0.0007	0.0001
VEPUR	MORNING	800	1000	0.8	2	2	0.003	0.002
SERNTHANADU	EVENING	1300	1700	0.7647	2	1	0.0008	0.0003
ELAVASANURKOTTAI	EVENING	600	1000	0.6	1	0	0.0017	0.0007
KEERIMEDU	EVENING	500	750	0.6666	1	1	0.0026	0.0013
MANGALAMPETTAI	EVENING	650	1200	0.5416	1	0	0.0012	0.0004
VEPUR	EVENING	475	950	0.5	1	0	0.006	0.0005

Table-3

The situation of traffic is due to arrival of crop bags from various places to Ulundurpet Regulated Market Committee at Vilupuram district using M/D/1 queuing model. By using **Table-3**, we computed traffic intensity, the mean arrival rate of farmers, the mean service rate, average number of farmers in the system and in the queue, average time spent in the system and the average waiting time in the queue. The following **Table-4**, shows the Numerical comparison between M/M/1 and M/D/1 model .

CLASSIFICATION	M/M/1	M/D/1
Average number of customer(farmers)in the system	3.9	1.7
Average queue length	7.3045	1.1
Average customer (farmer) Waiting time in system	0.0044	0.0022
Average number of customer Time spent in queue	0.00328	0.0012

Table-4

4. CONCLUSION

We have computed to minimize the waiting time according to the factors such as average queue length, average number of customers in the system, average waiting time of customers and average number of farmer spending time in the queue from different places to Regulated Market Committee (RMC) at Ulundurpet of Vilupuram district in Tamil Nadu. The best Service rendered to farmers is greater in M/M/1 than M/D/1 model, because M/D/ 1 model is deterministic. Non-deterministic model is the best one to give more service in less time which leads to minimize the waiting time for the farmers. To minimizing waiting time in the deterministic as well as to give more service. Because of deterministic the number of farmers having service is fixed one. Hence the service may delay even in the extra token gives more service. We suggest advance token system, which helps them to minimize the waiting time of farmers as well as rendering the service in a best approach.

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