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A comparison between M/M/1 and M/D/1 queuing models to vehicular traffic at Tirunelveli district

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Abstract

In this we can analyze the vehicular traffic at better places in Tirunelveli District utilizing lining model. We present the information sources $M/M/1$ and $M/D/1$ lining models with the assist we with canning limited the traffic in Tirunelveli District. From this we indicated that traffic force $\rho < 1$. This paper look at the two models and depicts how these information gathered at different places in Tirunelveli region.

Keywords

$M/M/1$ queuing model, $M/D/1$ queuing model, probability distribution, Queuing theory, Poisson process.

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1. Introduction

A Queuing Model is an appropriate model to speak to an administration situated issue where clients show up haphazardly to get some help, the administration time being likewise an arbitrary variable. A lining framework is determined totally by the accompanying five essential qualities

1. The Input Process
2. The Queue Disline
3. The Service Mechanism
4. The Capacity of the System
5. Service Channels

There are part of traffic issues in Tirunelveli region it is because of huge measure of schools, universities. Chiefly in palyamkottai and intersection consistently it will be traffic because of the shopping center and renowned shops. In greater part of metropolitan regions travel request surpass course ability regularly all through pinnacle periods. Also there ought to be vehicles break downs, work zones, climate, signal worldly plan and so forth we will in general see the tallness season of approaching traffic is from 7.00 am to 11.30 pm. This model is assembled mean line length, mean holding up time, customer mean help time and appearance rate and traffic power.

2. M/M/1 Queuing model

The least complex lining modular is $M/M/1$, where both the appearance time and administration time are dramatically disseminated $M/M/1$ lining framework accept a Poisson appearance measure. This supposition that is generally excellent estimation for appearance measure in genuine framework that meet the accompanying guidelines.

- The quantity of client in the framework is extremely huge.
- The effect of the single client for the exhibition of the

Table 1

Traffic Location	Session	Arrival No. of buses	Times in Minutes	Service No. of buses	Times in Minutes
Vallivoor	Forenoon	15	1.25	65	1.30
Ervadi	Forenoon	20	1.20	23	1.35
Palayamkottai	Forenoon	80	2.00	60	1.45
Nanguneri	Forenoon	25	1.00	30	1.45
Radhapuram	Aftemooon	12	1.15	65	1.30
Kalakadu	Aftemooon	28	1.20	32	2.00
Cheranmahadevi	Aftemooon	56	1.50	70	1.34
Manur	Aftemooon	20	2.15	15	1.30

Table 2. The situation of traffic at Tirunelveli district at various places using $M/M/1$ queuing model

Traffic Location	Session	Arrival No.or buses	ρ	L_s	L_q	W_s	W_q
Valliyoor	Forenoon	35	0.5384	5	4	0.0333	0.0133
Ervadi	Forenoon	18	0.7826	3	2	0.2	0.0503
Palayamkottai	Forenoon	33	0.6667	1	0	0.0370	0.0194
Nanguneri	Forenoon	22	0.7333	4	3	0.125	0.0388
Radhapuram	Aftemooon	32	0.1692	2	1	0.0303	0.0179
Kalakadu	Aftemooon	38	0.7187	5	4	0.1666	0.0377
Cheranmahadevi	Aftemooon	18	0.2571	5	4	0.3333	0.0166
Manur	Aftemooon	13	0.8666	3	2	0.5	0.0777

framework is minuscule, that is a solitary client burns-through a little level of framework assets.

- All clients are free. Their choice to utilize the framework is autonomous of different clients.

This likelihood thickness dissemination condition for a Poisson cycle depicts the likelihood of seeing n appearances in a period from 0 to t.

$$p(t) = \frac{(\lambda t)^n e^{-\lambda t}}{n!}$$

Where t - is used to define the interval 0 to t
N - Total number of arrivals in the interval 0 to t
λ - is the total average arrival rate in arrivals/second.

2.1 Stationary Analysis

The model is viewed as steady just if $\lambda < \mu$. By and large, appearances happen quicker than administration fulfillments the line will develop inconclusively long and the framework won't have a fixed dissemination. The fixed appropriation is the restricting dispersion for huge estimations of t.

Different execution measures can be registered unequivocally for the $M/M/1$ line. We compose $\rho = \lambda/\mu$ for the usage of the cradle and require $\rho < 1$ for the line to be steady. ρ speaks to the normal extent of time which the worker is involved.

2.2 Response Time

The normal reaction time or stay time (absolute time a client spends in the framework) doesn't rely upon booking teach and can be registered utilizing Little's law as $1/(\mu - \lambda)$. The normal time spent holding up is $1/(\mu - \lambda) - 1/\mu = \rho/(\mu - \lambda)$. The dissemination of reaction times experienced relies upon booking discipline.

2.3 Traffic Intensity

Let the average arrival rate λ divided by the average service rate μ. For a stable system the average service rate should always be higher than the average arrival rate.
ρ – should always be less than one

$$\rho = \lambda/\mu$$

Mean number of customer in the system can be found using the following equation

$$L_s = \frac{\lambda}{\mu - \lambda}$$

Mean number of customer in the queue

$$L_q = \frac{\rho^2}{1 - \rho}$$

The total waiting time including service time

$$W_s = \frac{1}{\mu - \lambda}$$

Table 3. The situation of traffic at Tirunelveli district at various places using $M/D/1$ queuing model

Traffic Location	Session	Arrival No.or buses (λ)	Service No.or buses	ρ	L_s	L_q	W_s	W_q
Valliyoor	Forenoon	28	30	0.9333	4	3	0.2654	0.2332
Ervadi	Forenoon	19	23	0.8260	3	2	0.1465	0.1031
Palayamkottai	Forenoon	23	24	0.9583	2	1	0.5203	0.9575
Nanguneri	Forenoon	28	41	0.6829	1	0	0.2863	0.0262
Radhapuram	Aftemoon	27	38	0.7105	2	1	0.0158	0.1869
Kalakadu	Aftemoon	32	24	0.333	3	2	0.5408	0.7561
Cheranmahadevi	Aftemoon	15	34	0.4411	1	0	0.2736	0.3652
Manur	Aftemooon	17	21	0.8095	3	2	0.1482	0.6523

Mean time spent waiting in queue

$$W_q = \frac{\rho}{\mu(1-\rho)}$$

3. M/D/1 Queue Model

In queueing hypothesis, an order inside the numerical hypothesis of likelihood, a M/D/1 line speaks to the line length in a framework having a solitary worker, where appearances are dictated by a Poisson cycle and occupation administration times are fixed (deterministic). The model name is written in Kendall's documentation Agner Krarup Erlang originally distributed on this model in 1909, beginning the subject of queueing hypothesis.

A M/D/1 line is a stochastic cycle whose state space is the set 0,1,2,3,... where the worth compares to the quantity of substances in the framework, incorporating any presently in help.

- Arrivals occur at rate λ according to a Poisson process and move the process from state i to $i+1$.
- Service times are deterministic time D (serving at rate $\mu = 1/D$).
- 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.
- The buffer is of infinite size, so there is no limit on the number of entities it can contain.

The M/D/1 model has dramatically disseminated appearance times however fixed help time (steady). We can register a similar outcome utilizing $M/D/1$ conditions, the outcomes are appeared in the table underneath. Traffic power $\rho = \lambda/\mu$.
Average number of customer in the system

$$L_s = \rho \frac{\rho^2}{2(1-\rho)}$$

Average number of customer in the queue

$$L_q = \frac{\rho^2}{2(1-\rho)}$$

Average number of customer in the waiting time

$$c = \frac{1}{\mu} + \frac{\rho}{2\mu(1-\rho)}$$

Average number of customer time spent in queue

$$W_q = \frac{\rho}{2\mu(1-\rho)}$$

4. Numerical Study

Table 4

Categories	$M/M/l$	$M/D/l$
Average number of customer in the system	1.4255	2.1969
Average queue length	2.500	
Average customer waiting time	0.135	1.500
Average number of customer time spent in queue	0.149	0.116

5. Conclusion

We have figure normal line length, number of client in the line, number of client in the framework, client holding up time and number of client time spent in line. Looking at these two models the estimations of $M/M/1$ model is more prominent than the estimations of $M/D/1$ model.

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