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

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Abstract: *In this paper we analyze the comparison of queuing models to vehicular traffic at kanyakumari district in different places.This section introduces the data sources discuss the M/M/1 and M/D/1 queuing models which this article uses to model vehicular traffic could be minimized using queuing theory in kannyakumari district .The result showed that traffic intensity* $\rho < 1$*.This paper compares the result obtained from both methods and describes how these data collected at various places in Kanyakumari district.*
Keywords: *M/M/1 queuing model, M/D/1 queuing model, probability distribution,Queuing theory, Poisson process.*

I. Introduction:

The analysis of queuing system and it variables has been focus of many studies and researches for many decade.Traffic characteristics of a road way are influenced by various factor like surface type road way width, driver skill, side activities, road maintenance etc. Traffic congestion significantlyaffects economicperformance of the nation and living standards of the people .In majority of urban areas travel demand exceeds highway capacity occasionally during peak periods.In addition that vehicles break downs, workzones, weather,signal timing etc. We see the peak time of incoming traffic is from 7.30 a. m to 9.30 a. m and the rush hours the outgoing traffic is during 4.30 p .m to 6.30 p. m.

The traffic activity is particularly in urban areas .One of the main reason is most of the urban people usingtheir own vehicles .In school opening times arranged to avoid rush hour traffic in some places, private buses school pickup and drop-off traffic are substantial percentage of peak hour traffic. Traffic congestion is a condition on road networks that occurs as we increases and is characterized by slower speeds longer trip times and increased vehicular queuing. The trafficorganization is more serious day after day, it is based on queuing theory. In this model is constructed mean queue length, mean waiting time, customermean service time and arrival rate and traffic intensity.

M/M/1 Queuing model:

The simplest queuing modal is M/M/1,where both thearrival time and servicetime are exponentially distributed .M/M/1 queuing system assume a Poisson arrival process. This assumption is very good approximation for arrival process in real system that meet the following rules.

I) The number of customer in the system is very large.

II) Theimpact of the single customer for the performance of the system is very small, that is a single customer consumes a very small percentage of system resources.

III) All customers are independent. Their decision to use the system are independent of other users.

This probability density distribution equation for a Poisson process describes the probability of seeing n arrivals in aperiod from 0 to t.

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

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.

First we define the traffic intensity. It is define as the average arrival rate λdivided 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.$\rho = \frac{\lambda}{\mu}$

Mean number of customer in the system can be found using the following equation n $L_s = \frac{\lambda}{\mu - \lambda}$.

Mean number of customer in the queue $L_s = \frac{\rho^2}{1-\rho}$.

The total waiting time including service time $W_s = \frac{1}{\mu - \lambda}$.

Mean time spent waiting in queue $W_q = \frac{\rho}{\mu(1-\rho)}$.

M/D/1 queue model:

The M/D/1 model has exponentially distributed arrival times but fixed service time (constant).We can compute the same result using M/D/1 equations, the results are shown in the table below.

Traffic intensity $\rho = \frac{\lambda}{\mu}$.

Average number of customer in the system$L_s = \boldsymbol{\rho} + \frac{\boldsymbol{\rho}^2}{2(1-\boldsymbol{\rho})}$.

Average number of customer in the queue $L_q = \frac{\rho^2}{2(1-\rho)}$.

Average number of customer in the waitingtime $W_s = \frac{1}{\mu} + \frac{\rho}{2\mu(1-\rho)}$.

Average number of customer time spent in queue $W_q = \frac{\rho}{2\mu(1-\rho)}$.

Table 1

Traffic Location	Session	Arrival No. of buses	Time in minutes	Service No. of buses	Time in minutes
Kaliyakka vilai	Morning	35	1.35	40	1.30
Martandam	Morning	20	1.30	28	1.35
Thuckalay	Morning	50	2.15	60	1.45
Nagercoil	Morning	25	1.15	35	1.45
Kaliyakka vilai	Evening	40	1.45	55	1.30
Martandam	Evening	38	1.30	45	2.00
Thuckalay	Evening	30	2.00	50	1.34
Nagercoil	Evening	20	1.15	30	1.30

Table 2: The situation of traffic at kanyakumari district at various places using M/M/1 queuing model

Traffic location	Session	Arrival No. of buses	ρ	L_s	L_q	W_s	W_q
Kaliyakka vilai	Morning	26	0.8387	5	4	0.1677	0.0200
Martandam	Morning	15	0.7143	3	2	0.1190	0.1660
Thuckalay	Morning	23	0.5600	1	0	0.0310	0.5550
Nagercoil	Morning	22	0.7857	4	3	0.1666	0.1300
Kaliyakka vilai	Evening	27	0.6428	2	1	0.1428	0.0425
Martandam	Evening	29	0.8280	5	4	0.0660	0.1375
Thuckalay	Evening	15	0.4050	5	4	0.0455	0.0180
Nagercoil	Evening	17	0.7390	3	2	0.3400	0.1230

Table 3: The situation of traffic at kanyakumari district at various places using M/D/1 queuing model

Traffic location	Session	Arrival No. of busesλ	Service No. of busesμ	ρ	L_s	L_q	W_s	W_q
Kaliyakka vilai	Morning	26	28	0.8789	4	3	0.1675	0.1316
Martandam	Morning	15	19	0.7894	3	2	0.1512	0.0986
Thuckalay	Morning	17	24	0.7080	2	1	0.1428	0.1010
Nagercoil	Morning	23	41	0.5600	1	0	0.0310	.5550
Kaliyakka vilai	Evening	27	38	0.7105	2	1	0.0585	0.0027
Martandam	Evening	20	24	0.8333	3	2	0.1452	0.1039
Thuckalay	Evening	15	34	0.4412	1	0	0.0410	0.0116
Nagercoil	Evening	17	21	0.8095	3	2	0.1900	0.1424

Numerical Study

Categories	**M/M/1**	**M/D/1**
Average number of customer in the system	3.500	2.375
Average queue length	2.500	1.500
Average customer waiting time	0.135	0.116
Average number of customer time spent in queue	0.149	0.143

II. Conclusion

In the above discussion we calculate average queuelength, average number of customer in the system, average customer waiting time and average number of customer time spent in the queue in kanyakumari district at various places. Comparing these two models the values of M/M/1 model is greater than the values of M/D/1 model.

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