A SURVEY ON FUTURE BEHAVIOR OF RAILWAY SYSTEM UNDER M/M/1 QUEUEING MODELS

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Abstract: This paper analyzes the future behavior of railway system under M/M/1 queueing system using Monte Carlo simulation. This study based on the arrival pattern and service pattern of a single railway station. Also we analyze the queue length of each queues and waiting time of a customer in the system. The graph shows the conclusion.

Keywords: Single channel queueing model, Monte-Carlo simulation, probability distribution, queue length, system length and queue time and system time.

Introduction : In the modern era, even though advanced technologies have emerged in handy eradicate the common public problems, still at large a proper solution to many basic issue are at lag, for Example. Lengthy queue or crowd in public gathering places like Railway ticket counter, supermarket and other public service providing organization. Most of them are facing a serious problem like customer queuing.

Waiting on a long queue is not ideal purchasing environment for people. Most of the people will prefer to give up or going away instead of waiting queue. This study reveals ways to reduce waiting time of customer in southern railway ticket counter.

Queueing theory is the mathematical study of waiting lines or queues [1].So that queue lengths and waiting time can be predicted [1]. Queueing theory examines every component of waiting in line to be served, including the arrival process, service process, number of servers, number of system places and the number of "customer". Real life applications of queueing theory include providing faster customer service, improving traffic flow, shipping orders efficiently from a warehouse and designing telecommunications systems such as call centers.

Queueing theory is used to develop more efficient queueing system that reduce customer waiting times and increase the number of customers that can be served.

The history of Queueing Theory goes back nearly 100 years. It was born with the work of A.K. Erlang who published in 1909 his paper, The Theory of Probabilities and Telephone Conversations, [2]. His most important work, Solutions of Some Problems in the Theory of Probabilities of Significance in Automatic Telephone Exchanges , [3] was published in 1917, which contained formulas for loss and waiting probabilities which are now known as Erlang's loss formula (or Erlang B-formula) and delay formula (or Erlang C-formula), respectively. Erlang's loss model assumes Poisson arrivals of telephone calls, namely, the number of sources or subscribers is sufficiently large. If the number of sources is finite and not so large, then a more accurate loss formula is provided by the Engset'loss formula, which was published by the Norwegian mathematician Engset. We should mention that the Erlang and the Engset loss model and their loss formulas remained the most widely used results in telephone engineering. Erlang laid the foundation for the place of Poisson (and hence, exponential) Queueing Theory and its Applications, A Personal View 13 distribution in queueing theory. His papers written in the next 20 years contain some of the most important concepts and techniques; the notion of statistical equilibrium and the method of writing down balance of state equations (later called Chapman-Kolmogorov equations) are two such examples.

Simulation is imitation of some real thing or a process. Simulation is a very flexible modeling approach, which makes it one of the most widely used Operational Research techniques [4]. Simulation is the process of designing a model of a real system and conducting experiments with this model for the purpose of either understanding the behavior of the system and/or evaluating various strategies for the operation of the system. The act of simulating something generally entails representing certain key characteristics or behaviours of a selected physical or abstract system[11]. The history of computer simulation dates back to World War II when two mathematicians Jon Von Neumann and Stanislaw Ulam were faced with the puzzling problem of behavior of neutrons [5].

Monte Carlo simulations are used to model the probability of different outcomes in a process that cannot easily be predicted due to the intervention of random variables. Monte Carlo simulations have countless applications outside of business and finance, such as in meteorology, astronomy and particle physics. In various fields like transportation, hospitality, toll plaza etc. [8, 9, and 10]

Description of the problem : Such an application we choose in southern railway, main purpose of this study is to reduce customer waiting time. We have already seen "A study on single server queueing system" [6].In this we analyze the queue length of the system that was very high. Therefore we go to next stage of queueing simulation "A study on M/M/C queueing simulation" [7].That paper also have a queue length.

So we analyzes this paper is future behavior of the system. In Erode railway station is a junction that means it has multiple channels (or a directions), like Chennai, Thiruppathy, Kerala, Trichy and Nagarkovil. Here we use Monte Carlo Simulation method to calculate a simulation table

Arrival distribution:

Place	Chennai	Thiruppathy	Kerala	Trichy	Nagarcoil
Number of Customers	2767	453	801	742	1295
Probability	0.457	0.075	0.132	0.122	0.214

Tag Number table for Arrival Distribution:

Place	Chennai	Thiruppathy	Kerala	Trichy	Nagarcoil
Cum.prob.	0.457	0.532	0.664	0.786	1.000
Tag number	000-456	457-531	532-663	664-785	786-999

Service distribution:

Place	Chennai	Thiruppathy	Kerala	Trichy	Nagarcoil
Number of customers	2624	404	778	729	1256
probability	0.453	0.070	0.134	0.126	0.217

Tag Number table for Service Distribution:

Place	Chennai	Thiruppathy	Kerala	Trichy	Nagarcoil
Cum.prob.	0.453	0.523	0.657	0.783	1.000
Tag number	000-452	453-522	523-656	657-782	783-999

Distribution for places:

Place	Chennai	Thiruppathy	Kerala	Trichy	Nagarcoil
Probability	0.525	0.125	0.242	0.080	0.028

Tag Number table for places:

Place	Chennai	Thiruppathy	Kerala	Trichy	Nagarcoil
Cum.prob.	0.525	0.650	0.892	0.972	1.000
Tag number	000-524	525-649	650-891	892-971	972-999

Simulation table

Trail no	R.No for pattern	pattern	R.No for Arrival	Arrival	R.No for service	Service	Chen Ser 1	Thiru ser 2	Ker ser 3	Tri Ser4	N.c Ser 5	waiting for servers					waiting for customers				
							no. services	no. services	no. services	no. services	no. services	S-1	S-2	S-3	S-4	S-5	P-1	P-2	P-3	P-4	P-5
1	178	chennai	115	2767	655	778	778										1989				
2	86	chennai	994	1295	863	1256	1256										39				
3	859	kerala	778	742	9	2624			2624					√							
4	707	kerala	274	2767	321	2624			2624										143		
5	395	chennai	107	2767	469	404	404										2363				
6	802	kerala	460	453	599	778			778					√							
7	779	kerala	934	1295	500	404			404										891		
8	507	chennai	682	742	706	729	729										13				
9	249	chennai	739	742	15	2624	2624					√									
10	349	chennai	37	2767	853	1256	1256										1511				
11	741	kerala	950	1295	508	404			404										891		
12	43	chennai	853	1295	699	729	729										566				
13	998	nagar coil	623	801	82	2624					2624					√					
14	961	trichy	331	2767	886	1256				1256										1511	
15	117	chennai	624	801	382	2624	2624					√									
16	703	kerala	355	2767	788	1256			1256										1511		
17	169	chennai	177	2767	144	2624	2624					√					143				
18	895	trichy	74	2767	332	2624				2624					√					143	
19	597	thirupathy	711	742	645	778		778					√								
20	736	kerala	569	801	840	1256								√							
21	422	chennai	760	742	779	729	729		1256								13				
22	708	kerala	483	453	924	1256								√							
23	293	chennai	121	2767	263	2624	2624		1256			√					143				
24	761	kerala	787	1295	71	2624								√							
25	514	chennai	107	2767	652	778	778		2624								1989				
26	842	kerala	468	453	12	2624								√							
27	383	chennai	775	742	294	2624	2624		2624			√									
28	810	kerala	828	1295	778	729													566		

Trail no	R.No for pattern	pattern	R.No for Arrival	Arrival	R.No for service	Service	Chen Ser 1	Thiru ser 2	Ker ser 3	Tri Ser4	N.c Ser 5	waiting for servers					waiting for customers				
							no. services	no. services	no. services	no. services	no. services	S-1	S-2	S-3	S-4	S-5	P-1	P-2	P-3	P-4	P-5
29	640	thirupathy	66	2767	901	1256		1256	729									1511			
30	727	kerala	540	801	734	729													72		
31	738	kerala	431	2767	890	1256			729										1511		
32	990	nagar coil	914	1295	489	404			1256		404										891
33	776	kerala	42	2767	268	2624													143		
34	848	kerala	973	1295	164	2624			2624					√							
35	511	chennai	381	2767	782	729	729		2624								2038				
36	710	kerala	452	2767	125	2624			2624					√					143		
37	346	chennai	411	2767	876	1256	1256										1511				
38	961	nagar coil	453	2767	161	2624					2624										143
39	123	chennai	439	2767	724	729	729										2038				
40	843	kerala	111	2767	663	729			729										2038		
41	410	chennai	570	801	263	2624	2624					√									
42	447	chennai	122	2767	58	2624	2624										143				
43	303	chennai	806	1295	335	2624	2624					√									
44	978	nagar coil	553	801	713	729					729										72
45	497	chennai	732	742	404	2624	2624					√									
46	441	chennai	849	1295	294	2624	2624					√									
47	163	chennai	527	453	769	729	729					√									
48	759	kerala	142	2767	707	729			729										2038		
49	473	chennai	287	2767	271	2624	2624										143				
50	889	kerala	614	801	245	2624			2624					√							
Total	**29177**		**25131**	**86437**	**24905**	**81779**	**38966**	**2034**	**30518**	**3880**	**6381**						**14642**	**1511**	**9947**	**1654**	**1106**

S-1 Server 1
S-2 server 2
S-3 Server 3
S-4 Server 4
S-5 Server 5
P-1 passenger on counter 1(Chennai)
P-2 Passenger on counter 2(Thirupathi)
P-3 passenger on counter 3(Kerala)
P-4 passenger on counter 4(Trichy)
P-5 Passenger on counter 5(Nagarcoil)

Simulation techniques

Average Queue length on

counter 1= $\frac{14642}{50} = 292.84$

Counter 2= $\frac{1511}{50} = 30.22$

Counter 3= $\frac{9947}{50} = 198.94$

Counter 4= $\frac{1654}{50} = 198.94$

Counter 5= $\frac{1106}{50} = 22.12$ Average queue length =

$$\frac{292.84 + 30.22 + 198.94 + 33.08 + 22.12}{5}$$

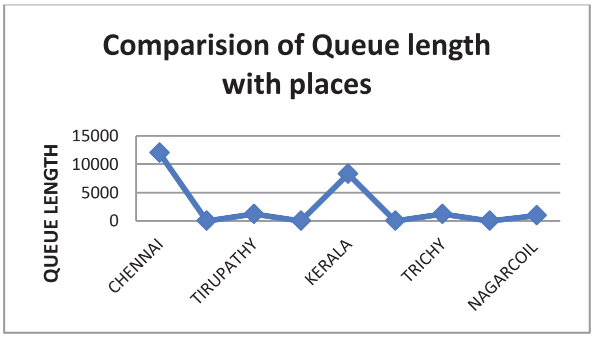
$= 115.44$

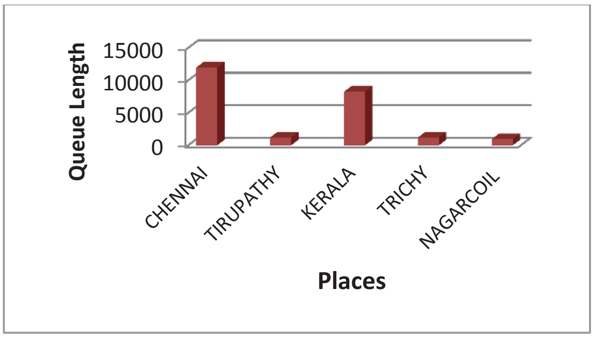
Average number of arrival

$= \frac{86347}{50} = 1728.74$

Average number service

$= \frac{81779}{50} = 1635.58$





Conclusion : In the above table we infer that Chennai counter has more number of customer in that queue, therefore it is advised to increase the number of counters for Chennai. As for as other counters in concern, it has very little passengers so it can be merge as single counter. Hence the number of customer waiting in the queue may be reduced. This advise is given to General Manager of Erode Junction.

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