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A Comparitive Study on M/M/1 and M/M/C Queueing Models Using Monte Carlo Simulation

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Abstract

This paper explored the future behavior of railway system, using Monte Carlo Simulation techniques, where find out and to reduce the customer waiting time and also ensure to provide the better service to the customers .Hence this studies revealed and fulfilled the customer needs and expectations and also maintaining the customer satisfaction level. This study based on the arrival and service patterns and purely on time dependent.

Keywords: Probability distribution, single channel queueing model (M/M/1),multi channelqueueing model(M/M/C),Monte Carlo Simulation, queue length, system length.

INTRODUCTION

In general, a queue is a waiting line of people or things waiting to be handled, usually in sequential order starting at the beginning or top of the line or sequence.A waiting line especially of persons or vehicles. In computer technology, a queue is a sequence of work objects that are waiting to be processed. The possible factors, arrangements, and processes related to queues are known as queueing theory.

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].Queueing theory is the mathematical study of waiting lines, or queues. In queueing theory, a model is constructed so that queue lengths and waiting time can be predicted [1].A mathematical method of analyzing the congestions and delays of waiting in line. 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 "customers" (which might be people, data packets, cars, etc.).

Simulation was introduced Mr.John Von Neuman and StanishlawUlam [5] were given the first important application in the behavior of neutrons in a nuclear shielding problem with this remarkable success, it because very popular and it's a base for many applications in business and industry development.

Simulation is the imitation of the operation of a real-world process or system over time[3].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 [4].Simulation is a very flexible modeling approach, which makes it one of the most widely used Operational Research techniques. The approach taken is to model the behaviour of individual elements within the system, often using random sampling to generate realistic variability.

The Monte Carlo approach has proved to be a valuable and flexible computational tool in modern finance. This paper discusses some of the recent applications of the Monte Carlo method to security pricing problems, with emphasis on improvements in efficiency. We first review some variance reduction methods that have proved useful in finance. Then we describe the use of deterministic low-discrepancy sequences, also known as quasi-Monte Carlo methods, for the valuation of complex derivative securities. We summarize some recent applications of the Monte Carlo method to the estimation of partial derivatives or risk sensitivities and to the valuation of American options. We conclude by mentioning other applications.

DESCRIPTION OF THIS MODEL

Waiting times or queues are a common phenomenon in everyday life, especially in the public service organizations that are for profit making. A queue form because resources are limited generally queues is forming in such places like Railway ticket counters [7] using Monte Carlo simulation method are used to reduce the system queue length.Simililarly the Monte Carlo simulation method where had been used in medical centre[8] and toll plaza[9], super markets,cinema theaters and public services departments etc... In fact it makes economic sense to have queues. For an interesting factor as queue length or waiting time which is evaluating the system performance of the organization, especially in terms of average service time, system utilization and explicit cost implied for the assigned task.

Research and Analysis in most cases have revealed that the customers will often leave a counter without making a purchase rather than stand in a long queue or slow

moving, causes the customer will desperate to get the end results. Despite in the modern era and advanced technology designed to minimize waiting times, queue management remains is a challenging task for every organization. When queue are not managed well, undoubtedly result will have more and more unhappy customers.

The objective of this study was to identify and minimize the customer waiting time and efficient and effective queuing management system.

In these studies analyzed which are the main factors influenced to reduce the customer waiting time in the queuing system M/M/1 as well as the organizational benefits.

There are 3 counters in erode railway station which means consisting of three servers. A queue forms whenever current demand exceeds the existing capacity to serve when each counter is so busy that arriving customers cannot avail the immediate service facility. So each server process is done as a queuing model in this situation. Necessary data are collected in Erode railway ticket counter, the observations for number of customers in a queue, and time to be taken each customer to avail the service, arrival time and departure time were taken. Based on the data the whole procedure of the service unit was observed and recorded using Monte Carlo simulation M/M/1 method to arrive the results.

The aim of study is queuing system is trying to detect the variability in a quality of service due to queues in avail results , find the average queue length before getting served in order to improve the quality of the services where required.

Already we studied in [6] and [10] the future behavior of railway system in single and multi-channel Queueing model using Monte Carlo simulation method. In this paper we analyzed the some other Queue of Southern Railway system both single and multi-channel Queueing model. The results were found that waiting time of customer marginally reduced in multi-channel. This study is purely based on time based because each customer the waiting time can be calculated accurately.

In single channel Queueing model the Queue length is so high, so we go for multi-channel Queueing model. Hence multi channels would be a more beneficial rather than the single servers.

Arrival distribution for each place

Chennai		
Arrival Time	No. of Arrival	Prob.
0.3	82	0.030
1.0	158	0.057
1.3	365	0.132
2.0	416	0.150
2.3	312	0.113
3.0	427	0.154
3.3	675	0.244
4.0	332	0.120

Thirupathy		
Arrival Time	No. of Arrival	Prob.
0.3	21	0.046
1.0	49	0.108
1.3	145	0.321
2.0	-	-
2.3	-	-
3.0	198	0.437
3.3	-	-
4.0	40	0.088

Kerala		
Arrival Time	No. of Arrival	Prob.
0.3	56	0.070
1.0	98	0.122
1.3	248	0.309
2.0	41	0.051
2.3	-	-
3.0	128	0.160
3.3	103	0.129
4.0	127	0.159

Trichy		
Arrival Time	No. of Arrival	Prob.
0.3	-	-
1.0	87	0.117
1.3	153	0.206
2.0	168	0.226
2.3	-	-
3.0	245	0.330
3.3	-	-
4.0	89	0.121

NagarKoil		
Arrival Time	No. of Arrival	Prob.
0.3	-	-
1.0	-	-
1.3	462	0.357
2.0	235	0.182
2.3	-	-
3.0	367	0.283
3.3	126	0.097
4.0	105	.081

Service Distribution for each place

Chennai		
Service Time	No. of Service	Prob.
0.30	56	0.021
1.00	148	0.056
1.30	357	0.136
2.00	395	0.151
2.30	286	0.109
3.00	419	0.160
3.30	643	0.245
4.00	320	0.122

Thirupathy		
Service Time	No. of Service	Prob.
0.30	40	0.099
1.00	61	0.151
1.30	98	0.243
2.00	-	-
2.30	-	-
3.00	187	0.462
3.30	-	-
4.00	18	0.045

Kerala		
Service Time	No. of Service	Prob.
0.30	-	0
1.00	97	0.133
1.30	149	0.204
2.00	158	0.217
2.30	-	-
3.00	236	0.324
3.30	-	-
4.00	89	0.122

Trichy		
Service Time	**No. of Service**	**Prob.**
0.30	49	0.063
1.00	102	0.131
1.30	227	0.292
2.00	63	0.081
2.30	-	-
3.00	124	0.159
3.30	98	0.126
4.00	115	0.148

Nagarkoil		
Service Time	**No. of Service**	**Prob.**
0.30	-	-
1.00	-	-
1.30	457	0.364
2.00	225	0.180
2.30	-	-
3.00	371	0.295
3.30	106	0.084
4.00	97	0.077

Distribution for places

Places	**Prob.**
Chennai	0.525
Thirupathy	0.125
Kerala	0.242
Trichy	0.080
Nagarkoil	0.028

Service time for each places

Places	**Service Time(Per min)**
Chennai	0.55
Thirupathy	3.56
Kerala	1.85
Trichy	1.96
Nagarkoil	1.15

Tag number table for Arrival distribution

Chennai	
Cum. Prob.	**Tag No.**
0.030	000-029
0.087	030-086
0.219	087-218
0.369	219-368
0.482	369-481
0.636	482-635
0.880	636-879
1.000	880-999

Thirupathy	
Cum. Prob.	**Tag No.**
0.046	000-045
0.154	046-153
0.475	154-474
0.475	475
0.475	475
0.912	476-911
0.912	912
1	913-999

Kerala	
Cum. Prob.	**Tag No.**
0.070	000-069
0.192	070-191
0.501	192-500
0.552	501-551
0.552	552
0.712	553-711
0.841	712-840
1.000	841-999

Trichy	
Cum. Prob.	Tag No.
0	000
0.117	000-116
0.323	117-322
0.549	323-548
0.549	549
0.879	550-878
0.879	879
1000	880-999

Nagarkoil	
Cum. Prob.	**Tag No.**
-	-
-	-
0.357	000-356
0.539	357-538
0.539	539
0.822	540-821
0.919	822-918
1.000	919-999

Tag number table for Service distribution

Chennai	
Cum. Prob.	**Tag No.**
0.021	000-020
0.077	021-076
0.213	077-212
0.364	213-363
0.473	364-472
0.633	473-632
0.878	633-877
1.000	878-999

Thirupathy	
Cum. Prob.	**Tag No.**
0.099	000-098
0.250	099-249
0.493	250-492
0.493	493
0.493	493
0.955	494-954
0.955	955
1.000	956-999

Kerala	
Cum. Prob.	**Tag No.**
0	-
0.133	000-132
0.337	133-336
0.554	337-553
0.554	554
0.878	555-877
0.878	878
1.000	879-999

Trichy	
Cum. Prob.	**Tag No.**
0.063	000-062
0.194	063-193
0.486	194-485
0.567	486-566
0.567	567
0.726	568-725
0.852	726-851
1.000	825-999

NagarKoil	
Cum. Prob.	**Tag No.**
-	-
-	-
0.364	000-363
0.544	365-543
0.544	544
0.839	545-838
0.923	839-922
1.000	923-999

Tag number table for places

Cum. Prob.	Tag No.
0.525	000-524
0.650	525-649
0.892	650-891
0.972	892-971
1.000	972-999

Simulation Table for single channel

											Chennai		Thirupathy		Kerala		Trichy		Nagar Koil		Waiting for Servers					No. of Customers				
Tr.No.	R.No. Pattern	Pattern	R.N.Arrival	Arrival	R.N. Service	Service	Inter Arrival Time	Clock Arrival Time	Service Time		Ser. Beg.	Ser end	Ser Beg.	Ser end	Ser Beg.	Ser end	Ser Beg.	Ser end	Ser Beg.	Ser end	S1	S2	S3	S4	S5	P1	P2	P3	P4	P5
1	036	Chennai	192	365	180	357	1.30	1.30	3.27		1.30 4.57	4.57 5.04														8				
2	842	Kerala	417	248	143	102	1.30	1.30	3.15						1.30	4.45												146			
3	379	Chennai	593	427	299	395	3.00	4.30	4.02		5.04	9.06			4.45	9.35										32 (0.34)				
4	733	Kerala	639	128	891	115	3.00	4.30	3.55		9.06	9.35			9.35	13.30												13 (5.05)		
5	877	Kerala	703	128	512	63	3.00	7.30	2.34						13.30 14.10	14.10 16.44												65 (6.40)		
6	176	Chennai	169	365	798	643	1.30	6.00	3.35		9.35	13.10			16.44	18.00					v					3.35				
7	48	Chennai	892	332	370	286	4.00	10.00	3.02		13.10	16.12														46 (3.10)				
8	109	Chennai	518	427	526	419	3.00	13.00	4.24		16.54 21.18	16.54 21.18														8 (3.54)				
9	520	Chennai	931	332	119	357	4.00	17.00	3.04		21.25	24.29									v					4.25				
10	971	Trichy	435	168	755	236	2.00	2.00	5.48								2.00	7.48						v						
11	338	Chennai	21	82	379	286	0.30	17.30	1.15		0.29	1.44									v					7.09				
12	790	Kerala	498	248	735	124	1.30	9.00	4.20						18.00 28.22	22.22 02.44												124 (9.00)		
13	176	Chennai	476	312	683	643	2.30	20.00	3.26		1.44	5.10									v					5.44				
14	56	Chennai	957	332	713	643	4.00	24.00	3.04		5.10	8.14									v					5.1				
15	298	Chennai	27	82	399	286	0.30	0.30	1.15		8.14	9.29														7.44				
16	872	Kerala	632	128	194	227	3.00	12.00	4.34						2.44	7.18							v					14.44		
17	67	Chennai	543	427	476	419	3.00	3.30	4.24		9.29 13.53	13.53 14.00														8 (5.59)				
18	554	Thirupathy	497	198	949	98	3.00	3.00	6.21				3.00 9.21	9.21 15.54													100			
19	747	Kerala	433	248	827	98	1.30	13.30	3.02						7.18 10.20	10.20 15.22												150 (17.48)		
20	190	Chennai	974	332	39	148	4.00	7.30	1.36		14.00 15.36	15.36 17.44														184 (6.30)				
21	381	Chennai	413	312	897	320	2.30	10.00	3.26		17.44	21.10					7.48 13.14	13.14 16.28			v					7.44				
22	777	Kerala	508	41	648	124	2.00	15.30	1.26						15.22	16.48							v					23.5		
23	882	Kerala	698	128	924	115	3.00	18.30	3.55						16.48 20.43	20.43 21.23												13 (22.18)		
24	300	Chennai	72	158	271	395	1.00	11.00	1.45		21.10	22.55									v					10.1				
25	902	Trichy	664	245	250	179	3.00	5.00	5.26																				96 (2.22)	
26	765	Kerala	291	248	753	98	1.30	20.00	3.02						21.23 0.25	24.25 5.27												150 (25.23)		
27	609	Thirupathy	711	198	322	61	3.00	6.00	4.01				15.54 19.55	19.55 4.08													137 (9.54)			

											Chennai		Thirupathy		Kerala		Trichy		Nagar Koil		Waiting for Servers					No. of Customers				
Tr.No.	R.No. Pattern	Pattern	R.N.Arrival	Arrival	R.N. Service	Service	Inter Arrival Time	Clock Arrival Time	Service Time		Ser. Beg.	Ser end	Ser Beg.	Ser end	Ser Beg.	Ser end	Ser Beg.	Ser end	Ser Beg.	Ser end	S1	S2	S3	S4	S5	P1	P2	P3	P4	P5
28	22	Chennai	372	312	406	286	2.30	13.30	3.02		22.55 1.57	1.57 2.19														26 (9.25)				
29	524	Chennai	557	427	353	395	3.00	16.30	4.02		2.19 6.21	6.21 6.50														32 (9.49)				
30	60	Chennai	822	675	125	357	3.30	20.00	3.27		6.50 10.17	10.17 13.48														318 (10.50)				
31	389	Chennai	928	332	883	320	4.00	24.00	3.33		13.18 17.21	17.21 17.32														12 13.48)				
32	949	Trichy	346	168	330	179	2.00	7.00	5.26								16.28 21.54	21.54 22.56											19 (9.28)	
33	840	Kerala	976	127	601	124	4.00	24.00	4.22				5.27 9.49	9.49 9.58														3 (29.27)		
34	321	Chennai	467	312	840	643	2.30	2.30	3.26		17.32	20.58									v					15.02				
35	404	Chennai	7.45	675	332	395	3.30	6.00	4.02		20.58 1.00	1.00 3.56														280 (14.58)				
36	305	Chennai	145	365	654	643	1.30	7.30	3.35		3.56	7.31									v					20.26				
37	16	Chennai	337	416	60	148	2.00	9.30	1.35		7.31 9.06	9.06 11.51														268 (22.01)				
38	384	Chennai	770	675	392	286	330.00	13.00	3.02		11.51 14.53	14.53 183.49														389 (22.51)				
39	850	Kerala	719	103	32	19	3.30	3.30	0.59						9.58 10.57	10.57 13.56												84 (30.28)		
40	571	Thirupathy	558	198	747	187	3.00	9.00	11.09				4.08 15.17	15.17 16.22													11 (19.08)			
41	145	Chennai	849	675	201	357	3.30	16.30	3.27		18.49 22.16	22.16 1.47														318 (26.19)				
42	354	Chennai	531	427	623	419	3.00	19.30	4.24		1.47 6.11	6.11 6.18														8 (30.17)				
43	142	Chennai	222	416	332	395	2.00	21.30	4.02		6.11 6.18	6.18 10.20														21 (32.48)				
44	272	Chennai	110	365	646	643	1.30	23.00	3.35		10.20 10.39	10.39 14.14									v					35.39				
45	275	Chennai	537	427	876	643	3.00	2.00	4.31		14.14	18.45									v					36.14				
46	839	Kerala	353	248	168	102	1.30	5.00	3.17						13.56 17.10	17.10 22.00												146 (32.56)		
47	319	Chennai	133	365	871	643	1.30	3.30	3.35		18.45	22.20									v					39.15				
48	323	Chennai	62	158	49	148	1.00	4.30	1.35		22.20	23.55														41.5				
49	541	Thirupathy	429	145	140	61	1.30	10.30	4.02				16.22 20.24	20.24 2.02													84			
50	443	Chennai	877	675	227	395	3.30	8.00	4.02		23.55 3.57	3.27 6.53														280 (39.15)				
																									Total	2238	332	894	115	-

S-1 Server 1 S-3 Server 3 P-1 passenger on counter 1(Chennai) P-3 passenger on counter 3(Kerala)

S-2 server 2 S-4 Server 4 P-2 Passenger on counter 2(Thirupathy) P-4 passenger on counter 4(Trichy)

S-5 Server 5 P-5 Passenger on counter 5(NagarKoil)

Simulation Table for Multi channel

										Chennai S1		Chennai S2		Thirupathy		Kerala		Trichy		Nagar Coil		Waiting for Servers						No. of Customers					
Tr. No.	R.No. Pattern	Pattern	R.N. Arrival	Arrival	R.N. Service	Service	Inter Arrival Time	Clock Arrival Time	Service Time	Ser. Beg.	Ser end	Ser. Beg.	Ser end	Ser Beg.	Ser end	Ser Beg.	Ser end	Ser Beg.	Ser end	Ser Beg.	Ser end	S1	S2	S3	S4	S5	S6	P1	P2	P3	P4	P5	P 6
1	229	Chennai	433	312	316	395	2.30	2.30	2.86	2.30	5.56												v									
2	270	Chennai	283	416	524	419	2.00	4.30	3.81			4.30	8.51										v									
3	567	Thirupathy	58	49	341	98	1.00	1.00	2.91					1.00	4.31									v								
4	60	Chennai	862	675	833	643	3.30	8.00	5.89	8.00 14.19	14.19 14.48																32					
5	401	Chennai	170	365	917	320	1.30	9.30	2.93			9.30 13.03	13.03 13.44															45				
6	540	Thirupathy	103	49	372	98	1.00	2.00	2.91					4.31	8.02									v				2.31				
7	970	Trichy	556	245	799	236	3.00	3.00	7.70									3.00 11.10	11.10 11.39													9	
8	383	Chennai	809	675	628	419	3.30	13.00	3.84			13.44 18.08	18.08 20.43															0.44				
9	104	Chennai	565	427	459	286	3.00	16.00	2.62	16.00 19.02	19.02 20.31																					
10	398	Chennai	176	365	48	148	1.30	17.30	1.36	20.31 22.07	22.07 0.46																3.00 (217)					
11	418	Chennai	539	427	110	357	3.00	20.30	3.27			20.43 0.10	0.10 1.14															0.13 (70)				
12	636	Thirupathy	647	198	897	187	3.00	5.00	4.10					8.02 19.12	19.12 20.17														3.02 (11)			
13	814	Kerala	557	128	632	124	3.00	3.00	3.82							3.00 7.22	7.22 7.34													4		
14	729	Kerala	786	103	95	102	3.30	6.30	3.14							7.34 10.48	10.48 10.51													1.04		
15	615	Thirupathy	374	145	190	61	1.30	6.30	3.62					20.17 0.19	24.19 5.57														13.47 (84)			
16	164	Chennai	780	675	56	320	3.30	24.00	2.93	0.45 4.19	4.19 7.44																0.46 (355)					
17	997	Nagarkoil	953	105	920	106	4.00	4.00	2.03											4.00	6.03					v						
18	893	Trichy	169	153	181	149	1.30	43.00	4.87									11.39 17.06	17.06 18.11												7.09 (20)	
19	539	Thirupathy	407	145	380	8	1.30	8.00	5.81					5.57 12.18	12.18 15.36														21.57 (47)			
20	747	Kerala	182	98	199	227	1.00	7.30	3.02							10.51	13.53								v				3.21			
21	198	Chennai	617	427	592	419	3.00	3.00	3.81			3.00 7.21	7.21 7.28															8				
22	557	Thirupathy	811	98	673	187	3.00	11.00	11.10					15.36 2.46	2.46 3.51														28.26 (11)			
23	669	Kerala	29	56	479	227	3.00	8.00	1.73							13.53	16.06												5.53			
24	398	Chennai	169	365	905	320	1.30	4.30	2.93			7.28 10.61	10.61 11.42															2.98 (45)				
25	833	Kerala	161	98	725	124	1.00	9.00	3.02							16.06	19.08												7.06			

										Chennai S1		Chennai S2		Thirupathy		Kerala		Trichy		Nagar Coil		Waiting for Servers						No. of Customers					
Tr. No.	R.No. Pattern	Pattern	R.N. Arrival	Arrival	R.N. Service	Service	Inter Arrival Time	Clock Arrival Time	Service Time	Ser. Beg.	Ser end	Ser. Beg.	Ser end	Ser Beg.	Ser end	Ser Beg.	Ser end	Ser Beg.	Ser end	Ser Beg.	Ser end	S1	S2	S3	S4	S5	S6	P1	P2	P3	P4	P5	P 6
26	689	Kerala	865	127	901	115	4.00	13.00	3.55							19.08 23.08	23.08 23.45												6.08 (12)				
27	741	Kerala	48	56	118	102	3.00	3.30	1.73							23.45	1.58								v				10.25				
28	736	Kerala	932	127	446	227	4.00	1733.00	3.92							1.48	6.30												8.28				
29	273	Chennai	290	416	680	643	2.00	6.30	3.81	7.44	12.05												v					1.14					
30	656	Kerala	110	98	545	63	1.00	18.30	1.94							6.30	9.04												12.00 (35)				
31	537	Thirupathy	353	145	130	61	1.30	12.30	3.62					3.51 7.53	7.53 13.31	9.04	10.11												39.21 (84)				
32	3	Chennai	0.86	158	982	320	1.00	7.30	1.45			11.42	13.27										v						4.12				
33	607	Thirupathy	981	40	570	187	4.00	16.30	2.37					13.31	16.08									v					11.01				
34	116	Chennai	687	675	811	643	3.30	11.00	5.89	12.05 18.34	18.34 19.03																	1.05 (32)					
35	673	Kerala	483	248	120	102	1.30	20.00	3.15							10.11 13.25	13.25 18.15												14.11 (146)				
36	776	Kerala	864	127	880	115	4.00	24.00	3.55							18.15 22.10	22.10												18.15				
37	241	Chennai	552	427	702	643	3.00	14.00	3.91			14.00	18.31										v										
38	164	Chennai	781	675	978	320	3.30	17.30	2.93			18.31 22.04	22.04 1.29																1.01 (3.55)				
39	945	Trichy	749	245	244	149	3.00	7.30	4.87									18.11 23.38	23.38 2.51												10.41 (96)		
40	617	Thirupathy	204	145	700	187	1.30	18.00	9.00					16.08	1.08									v					22.08				
41	107	Chennai	473	312	891	320	2.30	20.00	2.86	20.00	23.26											v											
42	510	Chennai	738	675	981	320	3.30	23.30	2.86	23.26 2.46	2.46 6.11																0.04 (355)						
43	580	Thirupathy	376	145	978	18	1.30	19.30	1.06					1.08 2.14	2.14 10.07														29.38 (127)				
44	506	Chennai	645	675	850	643	3.30	3.00	5.81			3.00 9.21	9.21 9.5															32					
45	562	Thirupathy	945	40	754	187	4.00	23.30	2.37					10.07	12.44									v					34.37				
46	758	Kerala	451	248	395	227	1.30	1.30	3.21							22.47 2.08	2.08 3.12													21.17 (21)			
47	98	Chennai	271	416	251	395	2.00	5.00	3.62	6.11 10.13	10.13 10.32																	1.11 (21)					
48	789	Kerala	149	98	435	227	1.00	2.30	3.02							3.12	6.14								v					23.02			
49	24	Chennai	565	427	14	56	3.00	8.00	0.50			9.50 10.41	10.41 14.21															1.50 (371)					
50	329	Chennai	581	427	368	286	3.00	11.00	2.62	11.00 14.02	14.02 15.31																	141					
																											Total	1153	571	557	25	125	–

S-1 Server 1(Chennai) S-2 server 2(Chennai) S-3 Server 3 S-5 Server 5 S-4 Server 4 S-6 Server 6
P-1 passenger on counter 1(Chennai) P-2 Passenger on counter 2(Chennai) P-3 passenger on counter 3(Thirupathy)
P-4 passenger on counter 4(Kerala) P-5 Passenger on counter 5(Trichy) P-6 Passenger on counter 6(N.Koil)

Average Queue length of the system (single Channel model):

Chennai= 44.7600, Thirupathy=6.640, Kerala=17.8800, Trichy=2.300, Nagarkoil=nil

Average Queue length of the system (Multi-Channel model):

Chennai (Server 1) =23.060, Chennai (Server 2) =11.420

Thirupathy=11.140, Kerala=0.500, Trichy=2.500, Nagarkoil=nil

CONCLUSION

From the Simulation table when comparing with single and multi-channels, the results of the waiting time of the customers are marginally reduced in the multi channels rather than the single channels. Therefore preferably multi channels would be the right choice in place. Also it shows that the few channels where waiting time so less hence to advise the southern railway management those channels should be merged together so that the managerial costing also reduced significantly.

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