Monte-Carlo Simulation Study on the Queueing Model of Kanchi Kamakshi Temple

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ABSTRACT

In this paper, we discuss the application of Monte-Carlo Simulation technique in the queueing model of Kanchipuram Sri Kamakshi Temple during Fridays. The simulation table provides a systematic method of studying the future behaviour of the system over time. The queueing pattern of the temple has been studied for a period of time and the same is simulated for the next one 20 weeks period using Monte-Carlo simulation technique. The results are discussed in detail of different timing levels, peak and non-peak timings. The aim is to find the best possible time to get the darshan of the principal deity Goddess Kamakshi and make sure that the pilgrims flow in visiting the temples without much delay.

Keywords: Waiting time, M/M/1 queueing model, Simulation, Monte-Carlo, Temple.

MSC2010 subject classification: 90B22, 65CXX

1. Introduction

As it is witnessed in the queueing model in temples, all the pilgrims who come to get the darshan of the God will be allowed to get into a queue. There will be one server engaged to serve the pilgrims in giving parasadam while getting the darshan of the principal deity. Here pilgrims are assumed to be the customers while getting the darshan of God is assumed to be the service. This model is assumed to a single server model. The aim is to find the best possible time of some selected temples and make sure that the pilgrims flow in visiting the temples without much delay.

Not all temples follow the same pattern. Each temple has its own tradition and follows its practice as no one cannot disturb this setup. As it has been discussed earlier, for getting the service, the pilgrims choose a method based on their desire, but of course getting the darshan of the principal deity in person become the most wanted service. Also, all the temples perform some daily rituals for God which may lead to 20 to 30 minutes of time. During the time, temple priests cover the entrance of the principal deity with a screen, and this is the time where a group

of pilgrims standing in the waiting line are stopped being served (getting the darshan of God). This makes the waiting time for the pilgrims who join at last a bit longer.

1.1 Queue Pattern in Temples

Queues in temples certainly differ from any other form of queues as in this, all the pilgrims who have come to see the darshan of God will not leave the queue in the middle because of the purpose of their visit not being served. Hence once they start to join the waiting line, they will definitely finish darshan and come out of the server irrespective of the time taken to finish. This shows the uniqueness and importance of studying the queueing model in temples. It is also considered that the pilgrims are following M/M/1/∞/FCFS queueing system. i.e.

- The arrivals of pilgrims to the temples follow Poisson process
- The service time is exponentially distributed
- Only one server is existent. Pilgrims are served on a First-come-first-serve basis.
- There is no limit on the arrival of pilgrims.

1.3 Peak and Non-Peak Darshan Timings

According to the temple routines, at least three times a day the priests offer worship to the principal deity, during that time they would screen the entrance of sanctum sanctorum for some duration that usually varies from 15 to 20 minutes of time. At this time, the people who come and stand in the queue will remain static and this makes the waiting line lengthier. The time which the temple priest performs the daily rituals for the principal deity will come in the peak hour. Apart from this time, more people will come and organise in the temple after the regular working hours, for example, morning after 10:00 a.m and evening after 5:00 p.m. Each temple has a different peak and non-peak timings found after the arrival of devotees over a particular time period.

2. Methods

Based on the different timing levels and considering the queue pattern in the temples, the queue data can be collected in accordance with the entry of a pilgrim and the time taken to service them. With the help of this data one can perform simulation study to find the average waiting time of a pilgrim in the system, inter arrival time of pilgrims and the time of queue build-up.

2.1 Steps in Monte-Carlo Simulation

- Identify the measure of effectiveness

- Decide the variable which influences the measure of effectiveness

- Determine the probability distribution for each variable in step (2) and construct the cumulative probability distribution

- Choose an appropriate set of random numbers

- Consider each random number as the decimal value of the cumulative probability distribution

Use the simulated values so generated into the formula derived from the measure of effectiveness.

2.4 Queueing Study on Sri Kamakshi Temple

The study is done on Friday at Sri Kamakshi Temple, the temple of Goddess Parvathi for 15 weeks to know the pattern of queue build up. This temple is the only lone famous Goddess temple situated in the city. Hence people will converge here hugely during Fridays. Also, during every Friday Golden Chariot for Goddess Kamakshi exclusively runs inside the temple, all the devotees visit to see on this day. This made the study done on the particular day at this temple.

Fig. 2.1 Model sheet

2.5 Data Collection

The data such collected are modelled in the form of table to find the average waiting time in both the line and the system for separated one hour time block with the preference of peak and non-peak timings are tabulated below:

Blocks	Week 1			Week 2			Week 3		
	Average Waiting Time in Line (in sec.)	Average Waiting Time in System (in sec.)	Average Darshan Time	Average Waiting Time in Line (in sec.)	Average Waiting Time in System (in sec.)	Average Darshan Time	Average Waiting Time in Line (in sec.)	Average Waiting Time in System (in sec.)	Average Darshan Time
9.00 - 10.00	210	358	09:28	210	362	09:32	214	361	09:35
10.00 - 11.00	250	477	12:07	249	471	12:00	252	479	12:11
11.00 - 12.00	1024	480	25:04	1016	319	22:15	1025	485	25:10
12.00 - 1.00	582	387	16:09	589	396	16:25	583	395	16:18
5.00 - 6.00	760	307	17:47	762	301	17:43	760	305	17:45
6.00 - 7.00	357	578	15:35	360	580	15:40	351	571	15:22
7.00 - 8.00	315	690	16:45	320	691	16:51	325	678	16:43
8.00 - 9.00	248	243	08:11	249	241	08:10	253	235	08:08

Blocks	Week 4			Week 5			Week 6		
	Average Waiting Time in Line (in sec.)	Average Waiting Time in System (in sec.)	Average Darshan Time	Average Waiting Time in Line (in sec.)	Average Waiting Time in System (in sec.)	Average Darshan Time	Average Waiting Time in Line (in sec.)	Average Waiting Time in System (in sec.)	Average Darshan Time
9.00 - 10.00	215	366	09:41	215	363	09:38	209	368	09:37
10.00 - 11.00	252	471	12:03	255	474	12:09	249	471	12:00
11.00 - 12.00	1018	344	22:42	1016	393	23:29	1015	412	23:47
12.00 - 1.00	584	315	14:59	583	392	16:15	583	412	16:35
5.00 - 6.00	764	307	17:51	768	307	17:55	769	303	17:52
6.00 - 7.00	357	579	15:36	356	577	15:33	354	577	15:31
7.00 - 8.00	318	659	16:17	324	735	17:39	324	672	16:36
8.00 - 9.00	251	244	08:15	249	242	08:11	255	236	08:11

Blocks	Week 7			Week 8			Week 9		
	Average Waiting Time in Line (in sec.)	Average Waiting Time in System (in sec.)	Average Darshan Time	Average Waiting Time in Line (in sec.)	Average Waiting Time in System (in sec.)	Average Darshan Time	Average Waiting Time in Line (in sec.)	Average Waiting Time in System (in sec.)	Average Darshan Time
9.00 - 10.00	214	361	09:35	206	367	09:33	205	360	09:25
10.00 - 11.00	247	479	12:06	245	479	12:04	254	471	12:05
11.00 - 12.00	1023	394	23:37	1023	320	22:23	1021	347	22:48
12.00 - 1.00	586	350	15:36	586	314	15:00	586	394	16:20
5.00 - 6.00	762	307	17:49	768	310	17:58	766	301	17:47
6.00 - 7.00	356	578	15:34	356	580	15:36	353	575	15:28
7.00 - 8.00	315	682	16:37	358	735	18:13	321	742	17:43
8.00 - 9.00	249	237	08:06	252	235	08:07	246	245	08:11

Blocks	Week 10			Week 11			Week 12		
	Average Waiting Time in Line (in sec.)	Average Waiting Time in System (in sec.)	Average Darshan Time	Average Waiting Time in Line (in sec.)	Average Waiting Time in System (in sec.)	Average Darshan Time	Average Waiting Time in Line (in sec.)	Average Waiting Time in System (in sec.)	Average Darshan Time
9.00 - 10.00	208	364	09:32	206	368	09:34	205	360	09:25
10.00 - 11.00	253	471	12:04	247	476	12:03	252	475	12:07
11.00 - 12.00	1022	320	22:22	1022	380	23:22	1018	399	23:37
12.00 - 1.00	580	324	15:04	586	539	18:45	587	346	15:33
5.00 - 6.00	760	390	19:10	770	305	17:55	768	305	17:53
6.00 - 7.00	355	575	15:30	355	576	15:31	359	576	15:35
7.00 - 8.00	317	741	17:38	321	690	16:51	315	679	16:34
8.00 - 9.00	253	241	08:14	252	243	08:15	246	236	08:02

Blocks	Week 13			Week 14			Week 15		
	Average Waiting Time in Line (in sec.)	Average Waiting Time in System (in sec.)	Average Darshan Time	Average Waiting Time in Line (in sec.)	Average Waiting Time in System (in sec.)	Average Darshan Time	Average Waiting Time in Line (in sec.)	Average Waiting Time in System (in sec.)	Average Darshan Time
9.00 - 10.00	209	360	09:29	205	362	09:27	202	364	09:26
10.00 - 11.00	252	478	12:10	246	475	12:01	249	474	12:03
11.00 - 12.00	1016	413	23:49	1009	432	24:01	1019	425	24:04
12.00 - 1.00	590	521	18:31	587	319	15:06	582	381	16:03
5.00 - 6.00	768	307	17:55	768	309	17:57	769	308	17:57
6.00 - 7.00	355	575	15:30	353	573	15:26	351	572	15:23
7.00 - 8.00	321	682	16:43	321	692	16:53	326	692	16:58
8.00 - 9.00	246	245	08:11	249	243	08:12	248	231	07:59

3. Results

The resulted table values are incorporated to find the probability distributions among the peak and non-peak timings for various minutes differences in getting the darshan of the principal deity and it is listed below:

Non-Peak Timings			
Minutes	Frequency	Probability	Cumulative
7	0	0	0
8	15	0.16666667	0.16666667
9	6	0.06666667	0.23333333
10	9	0.1	0.33333333
11	0	0	0.33333333
12	15	0.16666667	0.5
13	0	0	0.5

Peak Timings			
Minutes	Frequency	Probability	Cumulative
14	0	0	0
15	8	0.10666667	0.10666667
16	20	0.26666667	0.37333333
17	11	0.14666667	0.52
18	18	0.24	0.76
19	3	0.04	0.8
20	0	0	0.8
21	0	0	0.8
22	3	0.04	0.84
23	4	0.05333333	0.89333333
24	6	0.08	0.97333333
25	2	0.02666667	1
26	0	0	1

3.1 Simulated Data for Peak and Non-Peak Timings

The following table shows the simulated values using Monte-Carlo simulation technique for peak and non-peak timings for the next 20 weeks period.

For Peak Timings:

Week	1	2	3	4	5
Random	0.381398	0.145248	0.929567	0.665539	0.816153
Minutes	17	16	24	18	22

Week	6	7	8	9	10
Random	0.016434	0.428382	0.840224	0.300377	0.118219
Minutes	15	17	23	16	16

Week	11	12	13	14	15
Random	0.380144	0.653593	0.805597	0.886403	0.277883
Minutes	17	18	22	23	16

Week	16	17	18	19	20
Random	0.970173	0.530962	0.148969	0.91158	0.050155
Minutes	24	18	16	24	15

For Non-Peak Timings:

Week	1	2	3	4	5
Random	0.72298	0.79714	0.56308	0.94126	0.42691
Minutes	13	13	13	13	12
Week	6	7	8	9	10
Random	0.53956	0.55608	0.34316	0.28435	0.318
Minutes	13	13	12	10	10

Week	11	12	13	14	15
Random	0.45837	0.53805	0.07992	0.39921	0.32062
Minutes	12	13	8	12	10

Week	16	17	18	19	20
Random	0.59312	0.75641	0.87351	0.01066	0.52896
Minutes	13	13	13	8	13

Finally, the difference between the observed value and simulated values are:

Over all	Peak			Non-Peak		
	Min.	Avg.	Max.	Min.	Avg.	Max.
Observed	10:16	18:01	29:27:00	07:13	09:55	12:14
Simulated	15:00	18:00	24:00	8:00	11:00	13:00

4. Conclusion

In this paper, the queue model in temples and the study of its importance have been discussed in detail with considering different timings. This study helps the pilgrims to know

the best possible time to visit a particular temple to get the darshan of the principal deity without getting much delay.

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