Output Data Analysis

CSE412 : Simulation and Modeling Sessional

Assignment 4

Specifications

A spreadsheet simulation for single-server queueing system is to be done for output data analysis.

1. Consider rho is 0.9 and interarrival times has a mean of 60 seconds. Create a simulation of the attributes **Interarrival Time (s), Arrival Time, Service Time(s), Time Service Begins, Time Service Ends, Waiting Time in Queue (Delay)** - with at least m = 500 customers. Example shown in figure 1 for m=10.
2. Then, simulate only the **Delay** value for m = 500 customers, for at least n = 1000 replications (runs) for each customer, using what-if analysis. Example shown in figure 2 for n=9.
3. The simulation described in step 1 and 2 should be repeated for different starting conditions. The starting conditions should be varied with the number of customers, s = 0, 5, 10, 12, 15. Here s represents the number in system at time zero. (For example, s=5 means 5 customers will arrive at the system at time zero, so their interarrival time, arrival time these attributes should be set to zero.)
4. For each starting condition, show the plot of convergence of the transient mean, E(Di) for n = 250, 500, 750, 1000 replications in a single graph considering m = 500 customers.
5. Finally, show the plot of E(Di) for n = 1000 replications and m = 500 customers for different starting conditions s in a single graph.

Submission Guidelines

- Create a folder having the same name as your 7-digit student id. Put one or all your xlsx files inside the folder.
- Zip the folder and submit it in Moodle.

Please note that usage of any unfair means will be duly punished and will result in a -100% mark.

Submission Deadline : Sunday, 4 February, 2024 11:55 PM

Supporting Materials

Customer	Interarrival Time (s)	Arrival Time	Service Time(s)	Time Service Begins	Time Service Ends	Waiting Time in Queue (Delay)
1	0	0	18.63771942	0	18.63771942	0
2	87.64442919	87.64442919	10.77137776	87.64442919	98.41580695	0
3	34.43899181	122.083421	10.98666426	122.083421	133.0700853	0
4	54.62989214	176.7133131	18.63375516	176.7133131	195.3470683	0
5	74.10155804	250.8148712	56.67932749	250.8148712	307.4941987	0
6	59.82834223	310.6432134	61.93744377	172.3456476	189.2001506	0
7	12.64091766	133.4465674	52.42933114	189.2001506	263.3783982	49.29653
8	3.496819565	146.552305	2.302728667	292.3654911	308.8395911	98.22904
9	24.15448219	223.1105927	18.29472809	308.8395911	335.414369	76.37728
10	9.26892908	303.7875778	11.55947254	335.414369	352.0794096	85.40308

Figure 1: Example simulation shown for 10 customers

Customer	Interarrival Time (s)	Arrival Time	Service Time(s)	Time Service Begins	Time Service Ends	Waiting Time in Queue (Delay)
1	0	0	18.63771942	0	18.63771942	0
2	87.64442919	87.64442919	10.77137776	87.64442919	98.41580695	0
3	34.43899181	122.083421	10.98666426	122.083421	133.0700853	0
4	54.62989214	176.7133131	18.63375516	176.7133131	195.3470683	0
5	74.10155804	250.8148712	56.67932749	250.8148712	307.4941987	0
6	59.82834223	310.6432134	61.93744377	172.3456476	189.2001506	0
7	12.64091766	133.4465674	52.42933114	189.2001506	263.3783982	49.29653
8	3.496819565	146.552305	2.302728667	292.3654911	308.8395911	98.22904
9	24.15448219	223.1105927	18.29472809	308.8395911	335.414369	76.37728
10	9.26892908	303.7875778	11.55947254	335.414369	352.0794096	85.40308

=TRANSPOSE(START:END)

Simulation for n = 1000 replications (runs)										
	0	0	0	0	0	0	49.29653	98.22904	76.37728	85.40308
1	0	0	0	0	45.97512028	111.8291	164.5433	169.0669	157.4146	183.4674
2	0	0	10.70024835	90.47842177	97.10025445	136.9838	83.40516	100.333	84.56233	92.10658
3	0	33.53191441	42.06781724	46.81163042	94.31203552	128.6136	96.94488	100.4194	44.78224	53.78425
4	0	24.22189821	26.73627139	4.948254263	0	20.88702	10.3364	9.304269	10.00745	0
5	0	0	14.01834348	18.73239467	0	5.574983	6.051762	0	2.937162	0
6	0	4.97921082	1.523312553	0	3.461132567	16.05186	0	16.52605	12.00215	11.63473
7	0	26.0825248	68.34993944	93.81521183	70.53414938	23.33237	80.81838	32.32882	6.32048	50.35289
8	0	7.673121692	10.52449188	19.55477701	16.16991546	10.3689	11.19267	0	0	11.27988
9	0	0	0	44.28230317	54.29615059	85.40979	53.75164	150.4397	224.9615	158.2968

Use what-if analysis to generate n simulations

Figure 2: Example delay simulation shown for n=9

Refer to chapter 4 and 9 of the textbook (Law). (Specifically, Example 4.19, Example 4.22, Example 9.2)

- $InterArrivalRate(\lambda) = \frac{1}{Inter\ Arrival\ Time\ (Mean)}$ [Inter Arrival Time (Mean) is given here, which is 60 seconds]
- $\rho = \frac{\lambda}{\omega}$ [Rho = 0.9 is given]
- $InterServiceRate(\omega) = \frac{1}{Inter\ Service\ Time\ (Mean)}$. It should now be clear how to calculate the Inter Service Time (Mean).
- To generate values from a given mean, we have previously used the formula $-mean * ln(U)$. You can use this idea for both the interarrival time and service time attributes in the simulation.
- To calculate the **Delay** values, utilize the formula explained in Example 4.19.
- To create a graph in Excel, first select the data, then go to **Insert**, and then **Recommended Charts**.