

### **Effect of changing service time distribution**

I conducted 5 times simulation for initial distribution which was given in example of queuing system and also conducted for changing service time distribution according to the assignment problem of that queuing system. For both cases, assigned service time for each range was same. For better understand, I am giving the service time distribution for initial example and assignment problem below—

Example problem (initial distribution)	assignment problem (changed distribution)	Service time (for both cases)
1-10	1-5	1
11-30	6-15	2
31-60	16-35	3
61-85	36-65	4
86-95	66-90	5
96-100	91-100	6

now I am giving the results which I found from simulation for initial case is given below—

	1 <sup>st</sup> simulation	2 <sup>nd</sup> simulation	3rd simulation	4 <sup>th</sup> simulation	5th simulation	Average
Avg waiting time	0.5	1.15	0.45	1.05	1.35	0.9
Probability of wait in queue	0.15	0.4	0.15	0.35	0.5	0.31
Proportion of idle time in server	0.4018	0.2874	0.3789	0.3258	0.1899	0.32
Avg service time	3.35	3.10	2.95	3	3.2	3.12
Avg interarrival time	5.5789	4.4737	4.8421	4.2105	3.7378	4.57
Average time those who wait	3.33	2.8750	3	3	2.7	2.98
Avg time spent in system	3.85	4.25	3.4	4.05	4.55	4.02

now I am giving the results which I found from simulation for assignment problem (changed distribution) case is given below—

	1 <sup>st</sup> simulation	2 <sup>nd</sup> simulation	3rd simulation	4 <sup>th</sup> simulation	5th simulation	Average
Avg waiting time	0.65	4.85	1.25	2.4	1.3	2.09
Probability of wait in queue	0.25	0.8	0.35	0.65	0.45	0.5
Proportion of idle time in server	0.2427	0.037	0.2885	0.1684	0.1868	0.19
Avg service time	3.9	3.9	3.7	3.95	3.7	3.83
Avg interarrival time	4.9474	4.0526	5.1053	4.6316	4.6842	4.68
Average time those who wait	2.6	6.0625	3.5714	3.6923	2.89	3.76
Avg time spent in system	4.55	8.75	4.95	6.35	5	5.92

now I am giving the comparison which I found from the two tables given below—

	Initial example problem (initial distribution)	Assignment problem (changed distribution)
Avg waiting time	0.9	2.09
Probability of wait in queue	0.31	0.5
Proportion of idle time in server	0.32	0.19
Avg service time	3.12	3.83
Avg interarrival time	4.57	4.68
Average time those who wait	2.98	3.76
Avg time spent in system	4.02	5.92

## Conclusion

- 1) **Average waiting time will be higher in assignment problem** distribution in comparison to the example problem distribution. Because assignment problem distribution has higher service time which causes bottlenecks and customer has to wait in the queue.
- 2) **Probability of wait in queue will be higher in assignment problem** distribution in comparison to the example problem distribution. Because higher service time in assignment problem distribution comparison to the example problem lead to server keeping busy and in maximum time customers which already arrives will have to be wait.
- 3) **Proportion of idle time in server will be lower in assignment problem distribution.** Because higher service time is assignment problem distribution means that the server will give service for comparatively higher periods, the customer meanwhile already will arrive and wait. So, there will be lower chance for the server to be idle because maximum time customer will already be arrived before the service time ends of their immediate previous customer.
- 4) **Avg service time will be obviously higher in assignment problem distribution** than the example problem.Because the probabilities have given in assignment problem distribution higher in comparison to the example problem.
- 5) **Avg interarrival time will be higher in assignment problem distribution** in comparison to the example problem if the arrival process remains same in both cases. Higher service time means that the system is busy longer, so if the system wants to be fully utilized, the customers will have to arrive less frequently which results in higher interarrival time.
- 6) **Average time those who wait will be higher in assignment problem distribution** in comparison to the example problem distribution because higher service time in assignment problem will create a longer significant waiting line. The customers will have to wait significantly longer in the line.
- 7) **Avg time spent in system must be higher in assignment problem distribution** because waiting time and service time both are higher in the assignment case. As we know the time spent in the system is the sum of waiting time in the queue and the service time.so obviously the average time spent in the system will be higher in the assignment case.