Boğaziçi University
Department of
Industrial Engineering

IE 306.02
System Simulation
Homework 3

KORUGAN
Due Date:
June 6^{th} 2022
8:00 AM

Jobs arrive one by one at a queueing network where the first station is a GI/G/1 queueing system and the second station is a GI/G/c/c queueing system. Each arriving job enters the first station. If the server is idle the job is served. If the server is busy the job enters the queue. Each job in queue reneges after an independently distributed exponential time with rate ρ. After a job is served by the first station it enters the second station with c parallel servers if a server is idle. It picks randomly with equal probability among available servers. When all servers of the second station are busy a job that is completed at station one leaves the system immediately (renegs). All queues operate under an FCFS discipline. The necessary parameters for this simulation are:

- Interarrival time distribution of job arrival process defined as Uniform $[a, b]$.
- The service time distribution of the first station defined as Erlang(k, μ_1).
- Reneging time distribution for the jobs waiting in the first station queue defined as Exponential(ρ)
- Service time distribution of each server at the second station defined as Exponential(μ_2)
- Number of parallel servers at the second station given as c.

Using the same parameter values assigned for your group in Homework 1 generate an Arena simulation model of the above system. (Hint: Make sure you discard all entities when their job in the simulation is completed. The student version of Arena has an upper bound for entities in use.). For all experimental settings calculate average sojourn time of a job in the system, average reneging rate, proportion of jobs that completed service. Start all your simulations with an empty system. While calculating reneging rate consider all jobs that enter the system yet leave before entering GI/G/c/c system.

- First run 10 simulations of 500 exiting jobs (reneging jobs included) using different random number seeds. Calculate the warm-up period based on average sojourn times. Calculate the requested outputs including and excluding warm-up periods separately. Compare the results and comment on the impact of the warm-up period.
- Then run one simulation of 5000 exiting jobs. After excluding the warmup period calculate the outputs as discussed in class. Compare the results with the previous analysis that excludes warm-up periods.
- Increase the number of parallel servers by one, run the simulation for 5000 exiting jobs, do the appropriate analysis and compare the results of average sojourn times to the previous analysis. Test if the increase in the number of servers has any effect on sojourn times.

For each step of the simulation an understandable and proper reporting is required. You are also required to compare and discuss the results of your simulations thoroughly with the knowledge you have gathered in the course so far. Upload your report (as a pdf file) and your Arena code as

two separate files. You may compress the files using zip if necessary. The files should not be larger than 2 Mb, it must be submitted through the Moodle website (e-mails and other means will be disregarded) and it should be named as:
IE306- Asn-3-Group-yy-Lastname1-Lastname2-Lastname3.zip(or pdf or doe)
with names in alphabetical order.