Boğaziçi University
Department of
Industrial Engineering

IE 306.02
System Simulation
Homework 3

KORUGAN
Due Date:
June 5^{th} 2023
8:00 AM

Jobs arrive one by one at a GI/G/c queueing system that operates under an FCFS discipline. The interarrival time distribution of job arrivals follows a Uniform $[a, b]$ distribution. The service times of each of c servers at the second station follows an Exponential(μ) distribution, independently. The uniform distribution values and the number of servers for your group are given in the Excel sheet. In the first phase of the homework you are expected to calculate the warmup period length for average server utilizations $\rho = \{0.6, 0.7, 0.8, 0.9\}$. Remember $\rho = \frac{L_s}{c}$. You can calculate the necessary average service rate μ for each case from here. In the second phase for each experiment you will use $\rho = 0.8$ and 10 replications.

First Phase

Determine the warmup period for each utilization value using two responses, the ensemble averages of W_i, the sojourn time of arrival i and the average of cumulative average number of customers in the system $\hat{L} = \frac{\int_0^T L(t)dt}{T}$. For each response calculation use 10 and 30 runs with different random number seeds.Plot and report these values in a suitable graph to see when they converge. For each graph also plot the confidence interval with %95 level of significance. Report the differences you observe with respect to the number of replications for each response of each utilization value. State which response converges to stationary values quicker. Also look at the relation between the utilization values and the warmup period length.

Second Phase

Calculate the average values and the confidence interval of W_i, for 20 departing jobs by using the the following three starting conditions:

- Start the system empty and collect the necessary data.
- Start the system with 4 jobs in the system and collect the necessary data.
- Start the system empty. Run the system for the warmup period length you have calculated for $\rho = 0.8$ earlier, then collect the data for 20 departures.

Compare the results for three experiments. Comment.
Generate a simulation model using Simpy. A generic queueing system model using Simpy is also given as a jupyter file. 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. Upload your report (as a pdf file) and your Python 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.zip(or pdf or doe)
with names in alphabetical order.