IE 306.02 Assignment 1

Due: May 4 2020

(May the force be with you!)

In this Assignment you are going to work on a call center simulation.

- The inter-arrival times of calls are exponentially distributed with mean 6 min.
- Incoming calls are first processed by an automated answering mechanism with a voice recognition system that records the personal details of the caller and routes the call based on the nature of the caller's request either to operator one with probability 0.3 or to operator 2 with probability 0.7.
- The voice recognition system is not perfect and makes a mistake with a 0.1 probability by routing the call to the wrong operator. A caller that is routed to the wrong operator hangs up immediately.
- The time it takes to collect and record the details of a caller is also independently exponentially distributed with mean 5 minutes.
- The answering system can serve 100 callers simultaneously (100 parallel channels). When all channels are busy it drops any incoming call without answering.
- Once this process is completed, the caller is directed to operator 1 or 2, who tries to help the caller with his/her problem. If the operator is busy the customers are put on hold (they wait in a FCFS queue).
- The service time of operator 1 is LogNormally distributed with mean 12 minutes and standard deviation 6 minutes while the service time of operator 2 is uniformly distributed between 1 and 7 minutes.
- An arriving customer that has been waiting on hold for 10 minutes hangs up and leaves the system (reneging).
- Each operator takes 3-min breaks randomly through out the day. When an operator decides to take a break, he/she waits until completing all the customers already waiting for her/him. If new customers arrive during operators break, they wait in the FCFS queue until the operator serves them. The operator resumes service after the break.
- The number of breaks an operator wishes to take during an 8-hour shift is known to be distributed according to a Poisson distribution with a mean of 8 breaks per shift.
- Simulate this system for 1000 and 5000 answered calls separately for 10 runs with 10 different random number seeds each (simulate for 1000 calls with 10 different seeds then simulate for 5000 with the same random number seed set you have used for 1000 calls) and analyze the results from this data.
- For the automated answering system you may either model 100 parallel answering channels as stated in the system description or you may assume infinite capacity. Yet if you choose to make this assumption you have to mathematically show why it is not likely to affect the results.
- Collect and report statistics on:
    - Utilization of the answering system.
    - Utilization of the operators,
    - Average Total Waiting Time
    - Maximum *Total Waiting Time* to *Total System Time* Ratio,
    - Average number of people waiting to be served by each operator.
    - Average number of customers leaving the system unsatisfied either due to incorrect routing or due to long waiting times.
- You should base your code on the SimPy pseudocode provided in the Jupyter notebook. Please use Python 3.0

Clarification:

Total Waiting Time: Total time a caller waits for both operators

Total System Time: The total time a caller spends in the system

Requirements for your program are:

- You should submit a single zipped file that contains:
  - A well written report about your definition of events, simulation logic, simulation outputs, your observations and interpretation of results (pdf files only),
  - Your well documented SimPy code. (Alternatively you can submit a Jupyter file that contains your code and your documentation.)
- The file should not be larger than 1 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-1-Lastname1-Lastname2-Lastname3.zip" with names in alphabetical order.