IE 306 Group Assignment 1

Call center Simulation

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In this assignment, we are going to work on a call center simulation with some specific charasteristics which are pre-defined.

We will simulate the system for 1000 and 5000 answered calls separately. Then we will collect and report the statistics on;

*Utilization of the front-desk operator.
*Utilization of the expert operators.
*Average Total Waiting Time.
*Maximum Total Waiting Time to Total System Time ratio.
*Average number of people waiting to be served by the expert operator.

First of all; we create some global variables to define the characteristics of the model instance to be simulated. This includes the seed (RANDOM_SEED) for the random number generators and key parameters for the interrarrival rates (exponentially distributed with mean 14.3min.).

As mentioned before, we will simulate the system for 1000 and 5000 customers. Therefore at first we define NUMBER_OF_CUSTOMERS as 1000. We will simulate for 5000 later.

The time it takes to collect and record the details of a caller is given as LogNormal distributed with mean 7.2 and standart deviation of 2.7 minutes in assignment. So we created a code that gives us the values according to LogNormal distribution.

As we need to store our values, we define some necessarry arrays. Such as service1_times, service2_times, queue1_w_times, queue2_w_times.

The class definition for the customers arriving at the modeled system. When they are created, they immediatelly initiate a call (i.e. activate the call process).

Once a call is initiated, this is registered as a request to the operator1 resource. The customer is put on hold until the resource activates it back.

When the resource is available, the customer is activated and it then initiates the ask_question process. The duration of a question-answer session is determined randomly according to a logNormal and exponential distribution.

Incoming calls are first processed by the unskilled front-desk operator who records the personal details of the caller and the nature of the caller's request. When the operator is busy the customers are put on hold (they wait in a FCFS queue). Once this process is completed, the caller is directed to the expert operator, who tries to help the caller with his/her problem. As in the previous case, if the expert is busy the customers are put on hold (they wait in a FCFS queue).

In class Customer, we defined service operation for operator1 and operator2.

For operator1; the time it takes to collect and record the details of a caller is assumed to be LogNormal distributed with mean 7.2 and standard deviation of 2.7 minutes.

For operator2; the service time of the expert is Exponentially distributed with mean 10.2 minutes.

Then we took into account that the expert operator gives break as explained. The expert operator takes 3-min breaks randomly through out the day. When the 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.

In our code we have some print functions in comment lines. If we want to see the expert operators break times; we simply remove the # in front of #print("expert took a break at %g" % (self.env.now)) line.
Then we can see the break times of expert operator.
This function also works in other commented print functions in our code.

Then we have a code segment that creates our customers. The inter-arrival times of calls are exponentially distributed with mean 14.3 min.

*After completing the simulation with given parameters with 1000 customers and gathering the statistics we get the final result as;

*Utilization of the front-desk operator : 0.4855349213071269
*Utilization of the expert operators : 0.6201067112751932
*Average Total Waiting Time : 10.98836915923675
*Maximum Total Waiting Time to Total System Time ratio : 0.9618395727619385
*Average number of people waiting to be served by the expert operator : 0.5153175239653773

*After completing the simulation with given parameters with 5000 customers and gathering the statistics we get the final result as;

*Utilization of the front-desk operator : 0.494385955779248
*Utilization of the expert operators : 0.6121770949790821
*Average Total Waiting Time : 11.597779500532873
*Maximum Total Waiting Time to Total System Time ratio : 0.9618395727619385
*Average number of people waiting to be served by the expert operator : 0.5415170180098235

With increasing number of customers the utilization of front-desk operator slightly increases while the expert's utilization decreases. Also, average total waiting time increases with more customers in the system.