IE306.02 Assignment 1

Event in SimPy are very similar to deferred, future or promises in other languages and libraries.

Process is responsible for creating and yielding events in order to wait for them to be triggered.

Simulation Logic

We start our simulation by generating customers with the given interarrival times and the distribution. When a customer object is created, it automatically calls its “call” function to simulate the calling action.

When the call starts, the customer tries to get the front desk operator which is defined as a SimPy resource. The customer starts to talk with the front desk operator, in other words, this resource is hold by the customer if it is available which means no other customer uses the resource. If there is a customer who makes the resource busy, then all the incoming customers put in first in first out queue. Service time of the front desk operator is determined by the given distribution.

After the customer finishes talking with the front desk operator, s/he tries to get the expert operator. The customer starts talk with the expert operator, in other words, this resource is hold by the customer if it is available which means no other customer uses the resource. If there is a customer who make the resource busy, then all the incoming customer put in a first in first out queue. The behavior of customers is different than the previous queue. Now, customers renege after a certain amount of time which is determined by the given parameters and the distribution. When they renege, they leave the system without getting service by the expert operator. Again, service time of the expert operator is determined by the given parameters and the distribution.

The behavior of the expert operator is different that the behavior of the front desk operator. Expert operators take breaks randomly determined by the given parameters and the distribution in a shift which is 8 hours. When an expert operator decides to take a break, s/he give service to the customers who are already in the queue. After the operator serves all the people in the queue right before the decision, the operator takes 3 minutes break and no service given in this time interval even if a customer arrives.

We simulate the system until all the customers are served and the current shift of the expert operator is completed. To do that we keep count of the customers incoming and outgoing, when the last customer is served, we stop generating shifts. When the shift is no longer generated, the break process is interrupted. No more break is generated, and the simulation is completed. Even a shift has just started, if the last customer is served, we add this shift to the total system time for our calculations.

We keep track of the busyness of the front desk operator and the expert operator, waiting times of the customer both in the queue belongs to the front desk operator and the expert operator, total system times and the number of shifts. Then using this statistic obtained via simulation, we calculate the resource utilization and the average waiting time and queue lengths.

Outputs

For N = 1000

Utilization of the front-desk operator: 0.486940818195674

Utilization of the expert operator: 0.5933788971591788

Average Total Waiting Time: 12.845824747475167

Maximum Total Waiting Time to Total System Time Ratio: 0.9282867413634713

Average number of people waiting to be served by the expert operator: 0.5898956149000809

For N = 5000

Utilization of the front-desk operator: 0.4966107850267728

Utilization of the expert operator: 0.6015383653824602

Average Total Waiting Time: 11.793885443019992

Maximum Total Waiting Time to Total System Time Ratio: 0.9602102468975032

Average number of people waiting to be served by the expert operator: 0.5339972837078848

Another Run for the Interpretation for N = 100000

Utilization of the front-desk operator: 0.5030629171246281

Utilization of the expert operator: 0.612345537786618

Average Total Waiting Time: 12.597437538977044

Maximum Total Waiting Time to Total System Time Ratio: 0.978665421386166

Average number of people waiting to be served by the expert operator: 0.5825624198890776

Observations & Interpretations

Utilization of the expert operator is more than the utilization of the front desk operator. In other words, expert operator is busier than the front desk operator. This is because service time of the front desk operator is much less than the service time of the expert operator. I want to emphasize that some customers renege from the queue of the expert operator without getting service. Even in this situation, as we observe in the outputs, utilization of the expert operator is a little bit more.

Ratio of the total waiting time to total system time is close to 1. It can never be 1. If it would be possible, it would mean that customers just wait and get their service in instantaneously which is not possible in the practical. In our system, however, this ratio is close to 1. This shows that our customers wait 9 unit of time to get a service of 1 unit of time. Briefly, customers wait long times to get a service of short amount of time.

In the long run, we see that the utilization of the front desk operator is almost equal to 0.5 which means that the front desk operator is idle, sits without doing anything, half of the time s/he works. The situation is not much different for the expert operator.

Briefly, our operators are not busy half of the time they work, and our customers wait so long to get a short amount of service. Even they sometimes leave the queue without getting any service.