Section 1: Definition of Events

In this simulation, there are 6 types of events:

1. Arrival of a call to front desk: new call arriving to system and coming to the front desk operator
2. Departure of call from front desk (same as arrival of call to expert): front desk serves the call and the call is forwarded to the expert operator
3. Departure of call from expert: call is served by the expert operator and leaves the system
4. Reneging: if call waits to be served by the expert operator for a certain amount of time, it leaves the system without getting served
5. Expert operator starting his break: expert operator decides to take a break, serves the calls that arrived to him before he decided to take the break and stops operating
6. Expert operator returning from break: expert operator starts serving calls again

Section 2: Simulation Logic

The logic of our simulation is as follows:

Once a call is initiated, this is registered as a request to the front desk operator resource. The customer is put on hold until the front desk resource activates it back. When the front desk resource is available, the customer is activated and it then initiates the serve_frontdesk process. The duration of a serve_frontdesk session is determined randomly according to a LogNormal distribution. Then, a request to the expert operator resource is registered for the same call. The customer is put on hold until the expert resource activates it back. When the expert resource is available, the customer is activated and it then initiates the serve_expert process. The duration of a serve_expert session is determined randomly according to an exponential distribution. Customers in the expert resource's queue leave the system without getting service when they wait for a random time according to an exponential distribution. Expert resource stops operating for 3 minutes at random times according to a Poisson distribution. When it decides to stop, it serves all customers in its queue before stopping. New calls made when the expert resource stops are put on hold until the resource starts.

Section 3: Simulation Outputs

Outputs of our simulation are as follows:

1. **Simulation for 1000 customers**

   Utilization of frontdesk: 0.510645

   Utilization of expert (including breaks): 0.624112

   Utilization of expert (excluding breaks): 0.650412

   Average Total Waiting Time: 11.1983

   Maximum Total Waiting Time to Total System Time Ratio: 0.917661

   Average number of people waiting to be served by expert: 0.523443

2. **Simulation for 5000 customers**

   Utilization of frontdesk: 0.497092

   Utilization of expert (including breaks): 0.609585

   Utilization of expert (excluding breaks): 0.636116

   Average Total Waiting Time: 11.7349

   Maximum Total Waiting Time to Total System Time Ratio: 0.952532

   Average number of people waiting to be served by expert: 0.564514

Section 4: Observations & Interpretation of Results

The most visible observation between 1000 and 5000 customers is that utilizations decrease and wait times increase. What we can say by looking at this data is that with 5000 customers, we are closer to long run results than 1000 customers. In the long run, utilization would be lower and wait times would be higher. We can conclude this because if we think about the case where there is only 1 customer, for a single operator, utilization would be 1 and wait time would be 0. As we have more customers, utilization decreases and wait times increase.