AM3911G: Modelling and Simulation **(Due: 03/24/2020)**

Assignment #4

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Problem 1 – Points

Description of Environment
The environment consists of the teller and the customers. customers arrive and depart at discrete times – they are also serviced over fixed times. The status of the teller either idle or busy. The change of the environment from one state to the next depends on arrival and departure events occurring. The logic associated with processing the arrival and departure events depends on the state of the system at the time of the event.

1. In the case of an arrival, the disposition of the arrival customer is dependent on the status of the teller.
    - If the teller is idle, the status of the teller is changed to busy and the departure event is scheduled for the customer by adding his service time to the current time.
    - If the teller is busy at the time of an arrival, the customer cannot begin service at the current time and, therefore, he enters the queue (the queue length is increased by one).
2. For the departure event, the logic associated with processing the event is based on queue length.
    - If a customer is waiting in the queue, the teller status remains busy, the queue length is reduced by one, and the departure event for the first waiting customer is scheduled.
    - If the queue is empty, the status of the teller is set to idle.
3. To place the arrival and departure events in their proper chronological order, it is necessary to maintain a record calendar of future events to be processed. This is done by maintaining the times of the next arrival event and the next departure event. The next event to be processed is then selected by comparing these event times.

Customer Number (1)	Arrival Time (2)	Start Service Time (3)	Departure Time (4)	Time in Queue (5)=(3)-(2)	Time in Bank (6)=(4)-(2)
1	3.2	3.2	7.0	0.0	3.8
2	10.9	10.9	14.4	0.0	3.5
3	13.2	14.4	18.6	1.2	5.4
4	14.8	18.6	21.7	3.8	6.9
5	17.7	21.7	24.1	4.0	6.4
6	19.8	24.1	28.4	4.3	8.6
7	21.5	28.4	31.1	6.9	9.6
8	26.3	31.1	33.2	4.8	6.9
9	32.1	33.2	35.7	1.1	3.6
10	36.6	36.6	40.0	0.0	3.4
11	40.0	40.0	42.0	0.0	2.0
12	41.0	42.0	47.0	1.0	6.0
13	41.3	47.0	50.0	5.7	8.7

The average time spent in queue per customer is: 2.52308 minutes
The average time spent in the bank per customer is: 5.75385 minutes

We conduct a bank teller simulation with two tellers. There are a total of 9 customers which enter the bank (chosen arbitrarily). The arrival time and required service time of each customer results from small arbitrary deviation from the original set of customers. Each teller has their own line, and a customer enters the line which is shortest. Under no circumstance can a customer switch teller lines once they have initially chosen one. Below are the results from the simulation.

Customer Number (1)	Arrival Time (2)	Required Service Time (3)	Start Service Time (4)	Departure Time (5)	Time in Queue (6)=(4)-(2)	Time in Bank (7)=(5)-(2)
1	3.2	2.8	3.2	6.0	0.0	2.8
2	5.5	3.1	6.0	9.1	0.5	3.6
3	11.4	5.2	11.4	16.6	0.0	5.2
4	14.8	1.6	16.6	18.2	1.8	3.4
5	17.7	3.4	18.2	21.6	0.5	3.9
6	18.5	3.5	21.6	25.1	3.1	6.6
7	22.7	2.9	25.1	28	2.4	5.3
8	24.3	1.8	24.3	26.1	0.0	1.8
9	32.2	2.1	32.2	34.3	0.0	2.1

The average time spent in queue per customer is: 0.922222 minutes
The average time spent in the bank per customer is: 3.85556 minutes

In comparison, the first 9 customers in the discrete event simulation with only one bank teller had an average time in queue of 2.9 minutes and an average time in bank of 6.07778 minutes. By increasing the number of tellers available to deal with customers, the average time in the queue

and the average time spent in the bank per customer is decreased by a significant amount. As a bank owner, we should be able to identify time periods during operating hours in which the inflow of customers is high. With this data, we can adjust the work schedule of our tellers such that more tellers are working during these times, which should act to decrease the average time a customer spends both in the bank and waiting in the queue.