

Digital Systems Simulation

Homework 1 Solutions

Problem 1

1. Discuss possible objectives and performance measures for this model

Objective of this model is to test the efficiency of the teller scheduling policy. This system simulation has to determine the percent of time tellers are busy. Also, the objectives could be to study the average waiting time by customer in line, time spent at the bank, etc. The concept can be extended to study the time spent on each type of transaction so improvements can be made in the processing of those transactions.

Performance measures for this model could be:

- Proportion of time the teller is busy
- Teller utilization
- Average length of queue, average time spent in queue, average time spent in the bank, maximum time spent by a customer in the system

2. What is the environment of the bank?

Environment of the bank is “Business Environment” where monetary transactions take place with the customer population.

3. What are the entities in this model? Name some attributes of each entity type which might be important in this study.

Entities are customers. Associated attributes are:

- a. Time of arrival
- b. Number of customers in queue
- c. Type of transaction
- d. Idle / Busy (waits in queue or being served)

Note: Tellers and Reception Secretary are NOT entities. They are resources.

4. What are the events? Give a brief description of each.

Events are defined as instantaneous occurrence that may change the state of the system. Following are some of the events:

- Arrival of a customer
- Service by receptionist
- Branching of customer to service window or desk area

- Service by teller

5. Identify the system resources and possible state variables

ResourcesState -----	Variables -----
Secretary	Busy / Idle
Window Teller	Busy / Idle
Desk Teller	Busy / Idle
Queue	Length

Problem 2

Manual simulation of bank teller:

Customer Number (1)	Arrival Time (2)	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	3.8	3.2	7.0	0.0	3.8
2	10.9	3.5	10.9	14.4	0.0	3.5
3	13.2	4.2	14.4	18.6	1.2	5.4
4	14.8	3.1	18.6	21.7	3.8	6.9
5	17.7	2.4	21.7	24.1	4.0	6.4
6	19.8	4.3	24.1	28.4	4.3	8.6
7	21.5	2.7	28.4	31.1	6.9	9.6
8	26.3	2.1	31.1	33.2	4.8	6.9
9	32.1	2.5	33.2	35.7	1.1	3.6
10	36.6	3.4	36.6	40.0	0.0	3.4

Event Time	Customer Number	Event Type	Number In Queue	Number In Bank	Teller Status	Teller Idle time
0.0	--	Start	0	0	Idle	-
3.2	1	Arrive	0	1	Busy	3.2
7.0	1	Depart	0	0	Idle	
10.9	2	Arrive	0	1	Busy	3.9
13.2	3	Arrive	1	2	Busy	
14.4	2	Depart	0	1	Busy	
14.8	4	Arrive	1	2	Busy	
17.7	5	Arrive	2	3	Busy	
18.6	3	Depart	1	2	Busy	
19.8	6	Arrive	2	3	Busy	
21.5	7	Arrive	3	4	Busy	
21.7	4	Depart	2	3	Busy	
24.1	5	Depart	1	2	Busy	
26.3	8	Arrive	2	3	Busy	
28.4	6	Depart	1	2	Busy	
31.1	7	Depart	0	1	Busy	
32.1	9	Arrive	1	2	Busy	
33.2	8	Depart	0	1	Busy	
35.7	9	Depart	0	0	Idle	
36.6	10	Arrive	0	1	Busy	0.9
40.0	10	Depart	0	0	Idle	

- Average number of customers in the system: 1.4525
- Teller is idle 20% of the time:
- Average time in the bank: 5.81