SOMAIYA VIDYAVIHAR UNIVERSITY
K. J. Somaiya College of Engineering, Mumbai -77
(A Constituent College of Somaiya Vidyavihar University)

Batch: CSM-1	**Roll No.: 16010121045**
Experiment / Assignment / Tutorial No: 1	

Experiment: 1

Title: Simulation of Multi Server System: Able – Baker Carhop Problem.

Problem Statement: Consider a drive in restaurant where carhops take order and bring food to the cars. Cars arrive in manner as shown:

Time between Arrival(minutes)	1	2	3	4
Probability	0.25	0.4	0.2	0.15

There are 2 carhops Able & Baker. Able is better to do the job and works a bit faster than Baker. Their service distribution is as follows:

Service Time(minutes)	2	3	4	5
Probability	0.3	0.28	0.25	0.17

Service Distribution time of Baker:

Service time(minutes)	3	4	5	6
Probability	0.35	0.25	0.2	0.2

Able gets the customer if both carhops are idle. The problem is to find how well the current arrangement is working.

Expected Outcome of Experiment:

Index	**Outcome**

CO1	Understand the concepts of discrete event simulation and its importance in business, science, engineering, industry and other services.

Books/ Journals/ Websites referred:

1. Jerry Banks, John Carson, Barry Nelson, and David M. Nicol, "Discrete Event System Simulation,; Fifth Edition, Prentice-Hall.
2. Averill M Law, "System Modeling & Analysis"; 4th Edition TMH.
3. Banks C M, Sokolowski J A, "Principles of Modeling and Simulation", Wiley

Pre Lab/ Prior Concepts:

Theory:

Conceptual Model:

I. Discrete event model of system used for multichannel queuing. E.g. of Able & baker problem.
II. This problem is simulated using an event scheduling simulation.
III. A simulation table is used to record the excessive system snapshot as time proceeds.
IV. The simulation requires mainly an activity table representing a service time distribution of able & baker & inters arrival of customers.
V. Activity duration is specified by a modeller.

Characteristics of System:

I) Calling Population: Infinite in nature.
II) System capacity: Infinite.
III) Nature of Arrival: Random arrival nature.
IV) Service Mechanism: At a time maximum two customers can be served one by Able & other by Baker. If able & baker both are busy, the customer has to wait. If both servers are free, priority goes to Able.
V) Queuing Discipline: Customers are chosen in FIFO manners.

System State:

System state for Able or Baker indicating Able being Idle or Busy at given instant.

Entities:

Neither the customers nor the server needs to be explicitly represented except in

terms of state variable unless customer averages are desired.

Events:

I. Arrival Event
II. Service Completion by Able
III. Service completion by Baker.

Delay:

A customer waits in queue until Able or Baker becomes free.

Use of Random Numbers:

I. To generate random nos. in simulation packages, RAND ( ) of function is used.
II. In Able & Baker problem random nos. are used for arranging inter arrival timer & service required for customers.

Real time example:

I. Public Telephone Booth with Two Telephones
II. Customer is chosen in FIFO manner.

Result: (Performance Measures):

Average Waiting Time = **1.35**
(Total time customers wait in queue) / (Total no. of Customers)

Prob. of Customers waiting = **0.24**
(No. of Customers who waits) / (Total no. of Customers)

Prob. of Idle Server = **0.457**
(Total Idle Time of Server) / (Total runtime of simulation)

Average Service Time = **3.61**
(Total Service Time) / (Total no. of Customers)

Average Time between Arrival = **2.34**
(Total Time between arrivals) / (No. of arrivals)

Average Waiting Time of Those Who Wait = **5.625**
(Total Time Customer waits in system) / (Total no. of Customers)

Average Time Customers Spends in System = **4.96**
(Total Time Customer spends in system) / (Total no. of Customers)

Conclusion: Successfully simulated the Able Baker Experiment with 100 samples.

Post Lab Questions:

Plot the frequency of caller delay & average caller delay for 30 trials.

Post Lab			
Trial Number	Caller Delay	Cumilative Caller Delay	Average Caller Delay
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	2	2	0.4
6	0	2	0.333333333
7	5	7	1
8	7	14	1.75
9	0	14	1.555555556
10	5	19	1.9
11	0	19	1.727272727
12	8	27	2.25
13	10	37	2.846153846
14	15	52	3.714285714
15	0	52	3.466666667
16	0	52	3.25
17	13	65	3.823529412
18	0	65	3.611111111
19	16	81	4.263157895
20	0	81	4.05
21	14	95	4.523809524
22	18	113	5.136363636
23	0	113	4.913043478
24	17	130	5.416666667
25	22	152	6.08
26	0	152	5.846153846
27	21	173	6.407407407
28	25	198	7.071428571
29	0	198	6.827586207
30	24	222	7.4