GX579

OLLSCOIL NA hÉIREANN, GAILLIMH

NATIONAL UNIVERSITY OF IRELAND, GALWAY

SEMESTER II EXAMINATIONS 1998-1999

3rd INDUSTRIAL ENGINEERING AND INFORMATION SYSTEMS

SYSTEMS SIMULATION IE 324

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Instructions:

Time Allowed: 2 Hours.
Attempt: 3 Questions.
Show all your work clearly.
All Questions carry equal marks.
Random Variates from the Uniform Distribution on [0,1] included.
Maths Tables and Cambridge Elementary Statistical Tables Supplied.

Question 1. The Harassed Booking Clerk **Marks 33.33***

A theatre employs a booking clerk during the day. The clerk is employed to sell tickets and to answer any queries that may arise. Seat bookings are accepted only if the customer turns up in person at the theatre and pays for the tickets. Enquiries can come either from someone there in person or from someone phoning the theatre. The clerk is instructed to give priority to personal customers – after all, they may hand over some cash. Thus if the phone rings just as a customer arrives in person, then the personal enquirer is served first. Thanks to a sophisticated phone system, incoming calls can queue on a FIFO basis until answered. Phone callers never ring off in frustration.

Develop an event-based model of this scenario. Use verbal descriptions (pseudocode) and flowcharts where appropriate to illustrate your answer.

Question 2. **Marks**

Consider a banking system involving two inside tellers and two drive-in tellers. Arrivals to the banking system are either for the drive-in tellers or the inside tellers. The time between arrivals to the drive-in tellers is exponentially distributed with a mean of 0.75 minutes. The drive-in tellers have limited waiting space. Queuing space is available for only three cars waiting for the first teller and four cars waiting for the second teller. The first drive-in teller service is normally distributed with a mean of 0.5 minutes and standard deviation of 0.25 minutes. The second drive-in teller service is uniformly distributed between 0.2 and 1.0 minutes. If a car arrives when the queues of both drive-in tellers are full, the customer balks and seeks service from one of the inside bank-tellers. However, the inside bank system opens one hour after the drive-in bank. **33.33***

Customers who directly seek the services of the inside tellers arrive through a different arrival process with the time between arrivals exponentially distributed with a mean of 0.5 minutes. However, they join the same queue as the balkers from the drive-in portion. A single queue is used for both inside tellers. A maximum of seven customers can wait in the single queue. Customers who arrive when there are seven in the inside queue balk (go elsewhere) and do not seek banking service. The service times for the two inside tellers are triangularly distributed between 0.1 and 1.2 minutes with a mode of 0.4 minutes.

Draw a MicroSaint Network for the above system clearly indicating the presence of queues and decision points. List and define Variables, Functions and Scenario events as appropriate. Include information on Task, Job and Decision descriptions in your answer.

Question 3. **Marks**

(a) Explain the meaning of the following terms in MicroSaint: **8**

- Release Condition
- Ending Effect
- Departing Effect
- Launch Effect

(b) A simulation study was performed to see whether the choice of scheduling rule affects the mean time in system. Twelve long simulation runs of each alternative were performed. The following results were obtained:

Repetition	Rule 1.	Rule 2.
1	54.5	54.9
2	59.2	59.7
3	61.0	61.2
4	60.1	60.9
5	60.1	61.0
6	58.4	58.6
7	58.3	58.5
8	58.7	59.0
9	52.9	53.4
10	62.9	63.5
11	65.0	65.3
12	58.8	59.0

1) Plot the data from Rule 1 against the data from Rule 2. Do you think that the technique of random numbers was used to generate these data points? Why or why not? **10.66***
2) Does the choice of scheduling affect the mean time in the system? **15**

Question 4.

Marks

Write short notes on **four** of the following: **8.33*x4**

- The major steps in computer simulation
- Verification and validation of computer simulation models
- Possible sources of error when simulation output are analysed
- The role of computer simulation in manufacturing systems design
- The desirable features of simulation software pertinent to the manufacturing environment
- Categories of simulation modelling packages

Question 5.

Marks

(a) Use the antithetic technique to estimate the mean of a uniform distribution in the interval 3-10. **8**

(b) Use the inverse probability method to convert the uniform variate U=.8759 into a random variate from each of the following distributions: **11.33***

- Uniform on [3,6]
- Exponential with a mean of 8
- Normal with a mean of 0 and a standard deviation of 1

(c) The following data are given: **14**

0.031	0.212	0.296	0.449	0.706
0.117	0.232	0.331	0.543	0.744
0.152	0.237	0.396	0.595	0.774
0.210	0.265	0.406	0.625	1.244

Draw a histogram of this data. What distribution is this data set likely to have been drawn from? Support your statement with the appropriate statistical test.