Ollscoil na hÉireann, Gaillimh GX 738
National University of Ireland, Galway

Semester II Examinations, 2002/2003
Front Page Template

Exam Code(s)	3BI1, 3BI2, 1EM1, 3CS2
Exam(s)	3rd Engineering, 3rd Computer Science
Module Code(s)	IE 324
Module(s)	Systems Simulation
Paper No.	1
Repeat Paper	_____ Special Paper _____
External Examiner(s)	Dr. E. J. Wright
Internal Examiner(s)	Professor J. Sheil
	Mr. G. Lupton
	Mr. E. Fallon
Instructions:	Attempt: 3 Questions. All questions carry equal marks. Show all your work clearly. Random variates from the Uniform Distribution on [0,1] included. Cambridge Elementary Statistical Tables supplied.
Duration	2 hours
No. of Answer books	1
Requirements:	
Handout	
MCQ	
Statistical Tables	Yes
Graph Paper	
Log Graph Paper	
Other Material	
No. of Pages	
Department(s)	

Q1 **(33.33*marks)**

A mobile phone shop receives on average 10 customers per hour. Service time is normally distributed with a mean of 5 minutes and a standard deviation of 1 minute. Currently 1 sales person is working in the center. If the sales person is busy customers wait in a queue. The queue has a maximum capacity of 1 place. If the queue is full on arrival then customers depart the system, with the associated potential loss of sale. Based on historic data the manager gives you estimated sale probabilities and associated values as follows:

Probability of customer buying	Value of sale (Euro)
20%	0
50%	20
30%	50

The manager wants to know whether it is viable to increase staffing levels to 2 people. The cost of a sales person is 10 euro/hour.

Manually simulate the above system for 1 hour with 1 sales person. Calculate any loss of sale(s) from customer that balk from the system. Based on these initial results do you recommend further investigation or not, comment.

Select appropriate distributions for inter-arrival times and service times. Use random numbers for estimating sale value probabilities of customers. **Note:** Clearly identify the sequence of selections of the random numbers uniformly distributed on [0,1] from the table included.

Q2 **(5x 6.66*marks)**

Write **short notes on five** of the following:

- Deterministic vs. Stochastic simulation models
- Ways to study a system
- Discrete vs. Continuous event simulation models
- Properties of Pseudorandom Number Generators
- Briefly outline mid square method for generating random numbers. Generate 2 random numbers using the technique
- Generate the equation for the random variable R from equation $f(x) = 3x^2$; $1 \leq x$,0 elsewhere; using inverse transformation technique
- Outline what the Central Limit Theorem states

Q3

(a) **(10marks)**

Outline (flowchart) the steps/stages involved in a computer simulation study

(b) **(2 x 5marks)**

Write short notes on the following steps in simulation involved

- Validation
- Verification

(c) **(13.33*marks)**

Following data is the output from a random number generator. Use the Chi-Square test to check the fit, comment on result. Use a 5% significance level.

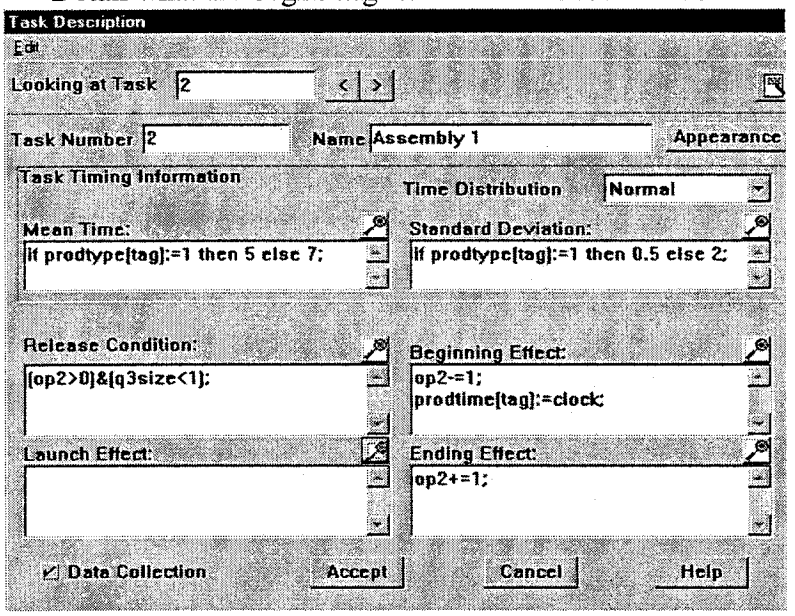
Digit	Observed Digit
0	30
0.1	20
0.2	35
0.3	36
0.4	17
0.5	14
0.6	29
0.7	20
0.8	18
0.9	31

Q 4

(a) **(5x 2marks)**

Review Micro-Saint task description below. Outline:

- What a task is in Micro-Saint
- What the system variable tag in Micro-Saint
- What is required for the task below to start
- How is the mean time calculated below
- Detail what the beginning effect conditions mean for the task below



(b) **(23.33*marks)**

A company has the basic manufacturing process as follows.
Initially an order is generated. It is then released to the 1st assembly station. Here the part waits for a free machine and then are processed. Parts go from this station to assembly 2 for further processing, this station works on JIT process and pulls a part from assembly 1 as required. At all stations work is carried out on a FCFS (first come first served) basis. After this station parts are sent to testing, parts can be queued for testing if required. Parts that pass testing are sent to shipping, parts that fail have to go back to assembly 1, on average 20% parts fail. Shipping is the last operation. A waiting area for parts exists at shipping where parts can be stored until a shipper is free.

Draw the Micro-Saint Network diagram for this manufacturing process. Clearly indicate all tasks, queues, paths and decision conditions.

Q 5

(a) **(6marks)**

Distinguish between the Independent Replication and One Long Run data-collection and analysis methods for steady state simulations.

(b) **(9.33*marks)**

Use the method of antithetic sampling to estimate the mean of a uniform distribution in the interval 8-12. Use the first 10 random numbers in column 1 of the table of random numbers from the uniform distribution on [0,1], given in Table 1.

(c) **(18marks)**

Following are the processing times for two machines working on the same product. Use the Mann-Whitney test to see if there is a difference, choose significance level of 10%.

Processing times

Replication	Machine 1	Machine 2
1	102	102
2	107	102
3	99	104
4	112	105
5	111	101
6	105	100
7	106	95
8	107	104
9	110	107
10	98	108