

(3 hours)

(Total marks 80)

- N.B. (1) Question No. 1 is compulsory and carries 20 marks.  
 (2) Attempt any four questions out of remaining six questions.  
 (3) Use of calculator is allowed

- 1) a) Discuss simulation application in any one of the following system [10]  
 i) Takeaway Food Delivery  
 ii) Cash Counter analysis in Bank  
 iii) Passenger flow analysis in an airport terminal

b) The highway between Mumbai and Pune has a high incidence of accidents along its 150 Km. Public safety officers say that the occurrence of accidents along the highway is randomly (uniformly) distributed, but the news media says otherwise. The public safety department published records for the month of March. These records indicated the point at which 15 accidents occurred, as follows:

88.3	40.7	36.3	27.3	36.3
91.7	67.3	7.0	45.2	23.3
98.8	90.1	17.2	23.7	97.4

Use Kolmogrov-Smirnov test to determine whether the distribution is uniformly distributed (Given  $D_{0.05,15} = 0.338$ ) [10]

- 2) a) Consider a drive in restaurant where carhops take order and bring food to the car. Cars arrive according to the interarrival distribution of cars. There are two carhops, Able and Baker. Able is better in doing the job and works a little bit faster than Baker. When a customer arrives, if he finds Able free, the customer starts service immediately with Able. If able is not free but Baker is, then the customer starts service immediately with Baker. If both are busy, the customer starts service immediately with Baker. The distribution of their service time is also given: [8]

Interarrival time of cars, (min)	1	2	3	4	5
Probability	0.18	0.25	0.27	0.17	0.13

Able's Service Time (min)	2	3	4	5
Probability	0.17	0.24	0.29	0.30

Baker's Service Time (min)	3	4	5	6
Probability	0.18	0.22	0.30	0.30

- i) Develop the simulation table and analyze the system by simulating the arrival and service of 10 customers.  
 ii) How many minutes Able as well as Baker were busy?  
 iii) How many customers had to wait?  
 iv) What is the average waiting time?  
 Assume that the first customer is arriving to system at 0<sup>th</sup> time random digits for interarrival time and service are given below:

Customer	1	2	3	4	5	6	7	8	9	10
R.D. for Interarrival time	—	32	66	41	21	37	79	18	60	98
R.D. for Service Time	49	53	34	17	30	57	22	62	56	73

b) Explain Naylor and Finger validation approach. [7]

- 3) a) A baker is trying to determine how many dozens of bagels to bake each day. Their probability distribution of the number of customers/day is given in table. [8]

Probability distribution of number of customers/day

Number of customers/day	8	10	12	14
Probability	0.35	0.30	0.25	0.10

Customers order 1,2,3,4 dozen bagels according to probability distribution given in table.

Probability distribution of bagels ordered by customer

No. of dozen ordered / customer	1	2	3	4
Probability	0.4	0.3	0.2	0.1

Bagels sell for Rs.54 per dozen. They cost Rs. 38 per dozen to make. All bagels not sold at the end of the day are sold at half price to local grocery store. Assume that the baker baked 30 dozens every day. Make a simulation table and find out the total profit.

Random digits for bagel customer/day

R.D. for customer/day	44	63	83
-----------------------	----	----	----

Random digits for dozens ordered / customer

RD for dozens orderd/customer	1	0	0	2	0	9	6	3	2	9	8	7	5	3	6	3	4	9	6
	3	1	0	7	2	8	7	4	8	5	1	7	1						

b) Discuss multivariate and Time-Series Input Models [7]

- 4) a) What do you mean by simulation? Write down the steps in simulation study. [8]

b) A college professor is leaving home for summer but would like to have a light bulb burning at all times to discourage burglars. The professor rigs up a device that will hold two light bulbs. The device will switch the current to the second bulb if the first bulb fails. The box in which the light bulbs are packaged says "Average life 1000 hours, exponentially distributed." The professor will be gone 90 days (2160 hours). What is the probability that a light will be burning when the summer is over and the professor returns? [7]

- 5) a) How would you collect data to be used as input to simulation model? In case there is no data, then how would you generate samples to be used as input to simulation study? [8]

b) Write down the inverse transformation of Weibull Distribution.

The life time of a computer chip measured in hours is Weibull distributed with parameters  $\alpha = 0.2$ ,  $\beta = 0.5$  and  $v = 0$ . Generate two random life time of computer chip from this distribution? Use  $R_1 = 0.6173$  and  $R_2 = 0.4829$  [7]

6) a) What are the properties of random Number? What are the methods used to generate random numbers? Explain with the help of example. [8]

b) The following data were available for the past 10 years on demand and lead time. Estimate correlation and covariance. [7]

Lead Time	6.5	4.3	6.9	6.0	6.9	6.9	5.8	7.3	4.5	6.3
Demand	103	83	116	97	112	104	106	109	92	96

7) a) Explain output analysis of Terminating Simulation and Steady State Simulation [8]

b) Consider the following sequence of 30 numbers [7]

0.12	0.01	0.23	0.28	0.89	0.31	0.64	0.28	0.83	0.93
0.99	0.15	0.33	0.35	0.91	0.41	0.60	0.27	0.75	0.88
0.68	0.49	0.05	0.43	0.95	0.58	0.19	0.36	0.69	0.87

Test whether the 3<sup>rd</sup>, 8<sup>th</sup>, 13<sup>th</sup>, .....numbers in the sequence are autocorrelated where  $\alpha = 0.05$ . (Given  $Z_{0.025} = 1.96$ )