Exam Date & Time: 11-Jan-2024 (02:30 PM - 05:30 PM)





MANIPAL ACADEMY OF HIGHER EDUCATION

DEPARTMENT OF MECHANICAL AND INDUSTRIAL ENGINEERING END SEMESTER MAKEUP EXAMINATION- JAN 2024 V SEMESTER B.TECH. (INDUSTRIAL AND PRODUCTION ENGG.) - 2018 CURRICULUM

SIMULATION MODELING AND ANALYSIS [MME 3157]

Marks: 50

Duration: 180 mins.

(5)

Descriptive

Answer all the questions.

1A) A supermarket has one checkout counter. Customers arrive at this checkout counter at random from 1 to 10 minutes apart. Each possible value of inter-arrival time has the same probability of occurrence equal to 0.10. Service time vary from 5 to 10 minutes with probabilities shown below:

Service time	5	6	7	8	9	10
Probability	0.1	.05	0.2	0.25	0.3	0.1

Given random numbers can be used both for arrival and service time computations.

87, 83, 48, 44, 62, 78, 59, 95, 6, 21

Develop the simulation table for 10 customers. Find:

- a) Average waiting time?
- b) Average service time?
- c) Average time customer spends in the system?
- 1B) An agricultural company strongly believes that farm yield in a year is dependent on the rainfall in that year and has maintained the following record. The company wants to develop a model to predict the yield in the next year and it has obtained the likely rainfall next year is 3.9 meters.Perform regression analysis to predict the yield.

Year	1	2	3	4	5	6	(3)
Rainfall in meters	3	3.4	2.8	3.6	3.5	3.3	
Yield (tons)	1.3	1.7	1.2	1.9	1.8	1.4	

1C) Explain the process of selecting the input models for developing a simulation model, when there is no data. (2)

2A)

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A flexible manufacturing system has been simulated to test three different scheduling routines, which appear to be different. For each scheduling routine simulation is run for almost the same time, which results into different replications. The number of units produced for three schedules are given below. Does the hypothesis, that all three schedules are equally sufficient, holds true?

Schedules	Nu	Number of units produced									
1	36	24	28	17	19	23	25	19	26	26	-
2	26	21	22	29	31	26	20	30	-	-	-
3	16	27	30	20	14	17	24	17	27	30	24

(5)

2B)	An electronic sensor evaluates the quality of memory chips, rejecting those that fail.	
	Upon demand, the sensor will give the minimum and maximum number of rejects	
	during each hour of production over the past 24 hours. Without further information, the	
	quality control department has assumed that the number of rejected chips can be	
	approximated by a triangular distribution. The current dump of data indicates that the	(3)
	minimum number of rejected chips during any hour was 0, the maximum was 10, and	
	the mean was 4. Find the value of mode? What is the probability of rejecting 2 chips in a	
	hour. Also find the height of mode.	

2C)	List the steps used in performing the Kolmogorov-Smirnov Test.	(2)
3A)	The time to pass through a queue, to begin self-service at a cafeteria has been found to be $N(16, 9)$. What is the probability that an arriving customer waits?	
	a) Less than 15 minutes.	
	b) Between 15 and 20 minutes.	(4)
	c) Between 20 and 25 minutes.	
	d) More than 25 minutes.	
3B)	List the components of a discrete event system and explain. Give examples.	(3)
3C)	Sketch and explain the process of model building, verification and validation while developing a simulation model of a physical system.	(3)
4A)	The number of vehicles arriving at the southwest corner of an intersection in a 5-minute	(4)
	period between 8:00 A.M. and 8:05 A.M. was monitored for five workdays over a 20-week period. Table below shows the resulting data. The first entry in the table indicates that there were 12 5-minute periods during which zero vehicles arrived, 10 periods during which one	

vehicle arrived, and so on.

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Arrivals per Period	0	1	2	3	4	5
Frequency	12	10	19	17	10	8
Arrivals per Period	6	7	8	9	10	11
Frequency	7	5	5	3	3	1

The distribution appeared to follow a Poisson distribution with mean 4.64. Use chi-square test to verify the hypothesis.

4B)	Explain the different types of variables used in simulation modelling of a physical system.	(3)
4C)	Use the linear congruential method to generate a sequence of six random numbers with	
	$X_0 = 37, a = 27, c = 53, and m = 100.$	(3)
5A)	Earthquakes occurring in a particular country according to the Poisson process is having a rate of 0.15 per day. Suppose we begin counting earthquakes at some point in time, find the following:	
	a. What is the probability that 4 earthquakes will occur in March 2024?	
	b. What is the probability that two or more earthquakes occur over 50 days period?	(4)
	c. What is the probability that it takes more than 90 days until the 3 rd earthquake?	
	d. What is the probability of no earthquakes over 4 separate 1-day periods?	
5B)	How the family of probability distributions is selected while developing an input model for a physical system? Explain with examples.	(4)
5C)	The number of telephone lines busy at a time is a binomial variable with probability 0.18 that a line is busy. If 25 lines are selected at random, what is the probability that:	
	a. At least 4 lines are busy	(2)
	b. At most 8 lines are busy.	

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