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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February 2025 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Chemical Engineering **Duration: 3 hrs.**
Course Code: 23MA4BSSAP / 22MA4BSSAP **Max Marks: 100**
Course: Statistics and Probability

Instructions: 1. All units have internal choice, answer one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of Statistical tables are permitted.

			UNIT - 1	CO	PO	Marks
1	a)	The following data are chloride concentration y (in milligrams per litre) and roadway area in the water shed x (in percentage) gathered from 6 homes of an apartment in Bengaluru: x: 0.19, 0.15, 0.57, 0.70, 0.67, 0.63 y: 4.4, 6.6, 9.7, 10.6, 10.8, 10.9 Fit a relation of the form $y = a + bx$ by applying the principle of least squares method.	1	1	**6**
	b)	The following table gives the stopping distance y in meters of a motor bike moving at a speed of x km/hour when the breaks are applied x: 16, 24, 32, 40, 48, 56 y: 0.39, 0.75, 1.23, 1.91, 2.77, 3.81 Find the correlation coefficient between the speed and the stopping distance.	1	1	**7**
	c)	If the heights of 300 students are normally distributed with mean 68.0 inches and standard deviation 3.0 inches, how many students have heights (i) greater than 72 inches, (ii) between 65 and 71 inches inclusive? Assume the measurements to be recorded to the nearest inch.	1	1	**7**
		OR			
2	a)	The number y of bacteria per unit volume present in a culture after x hours is given by the following table: x: 0, 1, 2, 3, 4, 5, 6 y: 32, 47, 65, 92, 132, 190, 275 Fit a curve of the form $y = ab^x$ to the data and hence estimate the value of y when $x = 7$.	1	1	**6**
	b)	In the following table data is showing the test scores made by sales man on an intelligent test and their weekly sales. Test scores(x): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 Sales(y): 2.5, 6, 4.5, 5, 4.5, 2, 5.5, 3, 4.5, 3 Calculate the regression line of sales on test scores and also, estimate the most possible weekly volume if a sales man score is 70.	1	1	**7**

		c)	If the probability that an individual will suffer a bad reaction from injection of a given serum is 0.001, determine the probability that out of 2000 individuals, (i) exactly 3 (ii) between 2 and 3 (iii) more than 2, individuals will suffer a bad reaction by applying Poisson distribution.	*1*	*1*	**7**
			UNIT – 2			
	3	a)	The joint probability function of two discrete random variables X and Y is given by $f(x,y)=c(2x+y)$, where x and y can assume all integers such that $0 \le x \le 2$, $0 \le y \le 3$, and $f(x,y)=0$ otherwise. (i) Find the constant c. (ii) Calculate the marginal distribution of X and Y. (iii) Check whether X and Y are stochastically independent or not.	*1*	*1*	**6**
		b)	Two flashcards are selected at random from a box which contains five cards numbered 1, 2, 2, 3, 3. Find the joint distributions of X and Y where X denotes the sum of two numbers and Y denote the minimum of two numbers drawn. Also, determine $Cov(X, Y)$.	*1*	*1*	**7**
		c)	A salesman's territory consists of 3 cities A, B and C. He never sells in the same city on successive days. If he sells in city A, then the next day he sells in city B. However, if he sells in either B or C, then the next day he is twice as likely to sell in city A as in other city. In the long run, how often does he sell in each of the cities?	*1*	*1*	**7**
			OR			
	4	a)	Prove that the Markov Chain whose transition probability matrix is $P=\begin{bmatrix} 0 & 2/3 & 1/3 \\ 1/2 & 0 & 1/2 \\ 1/2 & 1/2 & 0 \end{bmatrix}$ is irreducible.	*1*	*1*	**6**
		b)	In a certain city, the weather on a day is reported as sunny, cloudy or rainy. If a day is sunny, the probability that the next day is sunny is 70%, cloudy is 20% and rainy is 10%. If a day is cloudy, the probability that the next day is sunny is 30%, cloudy is 20% and rainy is 50%. If a day is rainy, the probability that the next day is sunny is 30%, cloudy is 30% and rainy is 40%. If a Sunday is sunny, find the probability that the (i) Tuesday is cloudy and (ii) Wednesday is rainy.	*1*	*1*	**7**
		c)	A coin is tossed three times. Let X denote 0 or 1 according as tail or head occurs on the first toss. Let Y denote the total number of tails which occur. Determine i) the marginal distributions of X and Y, and ii) the joint distributions of X and Y. Also find the expected values of $X+Y$.	*1*	*1*	**7**
			UNIT – 3			
	5	a)	A commonly prescribed drug for relieving nervous tension is believed to be only 60% effective. Experimental results with a new drug administered to a random sample of 100 adults who were suffering from nervous tension show that 70 received relief. Is this sufficient evidence to conclude that the new drug is superior to the one commonly prescribed? Use 5% level of significance.	*2*	*1*	**6**

		b)	A nutritionist is interested in whether two proposed diets, ***A*** and ***B*** work equally well in providing weight-loss for customers. In order to assess a difference between the two diets, she puts 50 customers on ***Diet A*** and 60 other customers on the ***Diet B*** for two weeks. Those on the former had weight losses with an average of 11 pounds and a standard deviation of 3 pounds, while those on the latter lost an average of 8 pounds with a standard deviation of 2 pounds. Do the average diets differ in terms of their weight loss? Use 1% level of significance.	*2*	*1*	**7**
		c)	The standard deviation of the height of Honor students of a college is 4 inches. Two samples are taken. The standard deviation of the height of 100 B. Com Honor students is 3.5 inches and 50 B.A. Honor students is 4.5 inches. Test the significance of the difference of standard deviations of the samples. Use 5% level of significance.	*2*	*1*	**7**
			OR			
	6	a)	A survey of 100 similar-sized hospitals revealed a mean daily census in the paediatrics service of 27 with a standard deviation of 6.5. Do these data provide sufficient evidence to indicate that the population mean is greater than 25? Level of significance 0.05	*2*	*1*	**6**
		b)	In a winter of an epidemic flu, 2000 babies were surveyed by a well-known pharmaceutical company to determine if the company's new medicine was effective after 2 days. Among 120 babies who had the flu & were given the medicine, 29 were cured within two days. Among 280 babies who had the flu but were not given the medicine, 56 were cured within 2 days. Is there any significant indication that supports the company's claim of the effectiveness of the medicine?	*2*	*1*	**7**
		c)	In an elementary school examination, the mean grade of 32 boys was 72 with a standard deviation of 8, while the mean grade of 36 girls was 75 with a standard deviation of 6. Test the hypothesis that the average performance of girls is better than boys.	*2*	*1*	**7**
			UNIT – 4			
	7	a)	The marks attained by a class of six students on two assignments were as follows. Student | 1 | 2 | 3 | 4 | 5 | 6 Assignment 1 | 50 | 70 | 69 | 64 | 63 | 64 Assignment 2 | 61 | 62 | 54 | 61 | 61 | 6 Is there a significant difference between the means of the marks from which the two samples were selected? Use 5% level of significance.	*2*	*1*	**6**
		b)	The following table lists the 4 special tourist places *X*, *Y*, *Z* and *W* in a city and the number of places visited by each other in a poll of 600 tourists. Number of places | 0 | 1 | 2 | 3 | 4 Number of tourists | 110 | 260 | 150 | 72 | 8 Fit a Poisson distribution to the following data and test for the goodness of fit at α =5%.	*2*	*1*	**7**

		c)	The following figures relate to production in kg. of three varieties P, Q, R of wheat shown in 12 plots P 14 16 18 - - Q 14 13 15 22 - R 18 16 19 15 20 Is there any significant difference in the production of these varieties? Apply one-way ANOVA at 0.01 level of significance.	*2*	*1*	**7**
			OR			
	8	a)	Five pre-school children were given a supplement of multi-purpose food for a period of four months. Their skin-fold thickness (in mm) was measured before the commencement of the programme and also at the end. Apply the parametric test to check if there is any change in their skin- fold thickness for the following data. Child 1 2 3 4 5 At the beginning of the program 6 8 8 6 9 At the end of the training program 8 8 10 7 10	*2*	*1*	**6**
		b)	500 school boys and girls are asked about their favorite color: blue, green or pink. Results are shown below: Blue Green Pink Boys 100 150 20 Girls 20 30 180 At $\alpha = 5\%$, would you conclude that there is a relationship between gender and favorite color? Apply chi-square test.	*2*	*1*	**7**
		c)	Two random samples from two normal populations are given below: Sample I: 16 26 27 23 24 22 Sample II: 33 42 35 32 28 31 At 5% level of significance, do the estimates of population variances differ significantly?	*2*	*1*	**7**
			UNIT – 5			
	9	a)	Data recorded on yield of four varieties in an experiment with four replications for which one value is missing. Estimate the missing value and analyse the data. P-5.52 R-5.57 Q-5.071 S-9.16 S-6.69 R-5.14 Q-? P-6.09 S-2.89 P-6.02 Q-6.53 R-2.83 R-9.76 Q-6.25 S-8.9 P-9.77	*1*	*1*	**10**
		b)	An oil company tested 4 different blends - A, B, C and D of gasoline for fuel efficiency accordind to a Latin Square Design in order to control for the variability of 4 different drivers and 4 different models of cars. Fuel efficiency was measured in miles per gallon after driving the cars over a standard course. The data are presented below. Analyse the data. Driver | Car Model: I, II, III, IV 1 D-15.5 B-33.9 C-13.2 A-29.1 2 B-16.3 C-26.6 A-19.4 D-22.8 3 C-10.8 A-31.8 D-17.1 B-30.3 4 A-14.7 D-34 B-19.7 C-21.6	*1*	*1*	**10**

OR

10 a) A company wants to produce cars for its own use. It has to select the make of the car out of the four makes A, B, C and D available in the market. For this they try four cars of each make by assigning the cars to four drivers to run on four different routes. The efficiency of car is measured in terms of time in hours. The layout and the time consumed is as given below: *1* *1* **10**

Routes	Drivers			
	1	2	3	4
1	18 (C)	12 (D)	16 (A)	20 (B)
2	26 (D)	34 (A)	25 (B)	31 (C)
3	15 (B)	22 (C)	10 (D)	28 (A)
4	30 (A)	20 (B)	15 (C)	9 (D)

Analyze the experimental data and draw conclusion. Use 5% level of significance.

b) Carryout the analysis of the following randomized block design. Use 1% level of significance. *1* *1* **10**

Varieties	Blocks			
	I	**II**	**III**	**IV**
A	7	16	10	11
B	14	15	15	14
C	8	16	7	11

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