U.S.N.										

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

Autonomous Institute Affiliated to VTU

October 2024 Supplementary 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. Answer any FIVE full questions, choosing 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)	If X is Poisson variate with probability mass function $P(X)$ then prove that the mean and variance of a Poisson distribution are same.	1	1	**6**
	b)	The velocity v of a liquid is known to vary with temperature according to a quadratic law $v = a + bt + ct^2$. Find the best values of a, b and c for the following table: t: 1, 2, 3, 4, 5 v: 2.31, 2.01, 1.80, 1.66, 1.55	1	1	**7**
	c)	In the following table are recorded dates showing the test scores made by salesman on an intelligence test and their weekly sales. Salesman: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 Test scores: 40, 70, 50, 60, 80, 50, 90, 40, 60, 60 Sales: 2.5, 6.0, 4.5, 5.0, 4.5, 2.0, 5.5, 3.0, 4.5, 3.0 Calculate the regression line of sales on test scores and estimate the most probable weekly sales volume if a salesman makes a score of 70.	1	1	**7**
		OR			
2	a)	Fit a curve of the form $y = ab^x$ for the following data: x: 1, 2, 3, 4 y: 8, 15, 33, 65	1	1	**6**
	b)	The income levels (in thousands of dollars) and percent of income donated to charities for seven families are shown in the following table. Income level (x): 50, 65, 48, 42, 59, 72, 60 Donating percent (y): 4, 8, 5, 5, 10, 7, 6 Obtain the correlation coefficient of x and y.	1	1	**7**
	c)	In a city, water use in the summer is normally distributed with a mean of 310 million gallons per day and a standard deviation of 45 million gallons per day. City reservoirs have a combined storage capacity of nearly 350 million gallons. (i) What is the probability that a day requires more water than is stored in city reservoirs? (ii) What reservoir capacity is needed so that the probability that it is exceeded is 1%?	1	1	**7**

			UNIT – 2			
	3	a)	Find the fixed probability vector $P = \begin{bmatrix} 0.1 & 0.5 & 0.4 \\ 0.6 & 0.2 & 0.2 \\ 0.3 & 0.4 & 0.3 \end{bmatrix}$.	*1*	*1*	**6**
		b)	Let X and Y be the number of apparatus breakages in two chemical labs in a given month. The joint distribution of X and Y is given by $X \downarrow / Y \rightarrow$ | 0 | 1 | 2 0 | 0.52 | 0.20 | 0.04 1 | 0.14 | 0.02 | 0.01 2 | 0.06 | 0.01 | 0 Compute the following: (i) Marginal distributions of X and Y (ii) $\text{cov}(X, Y)$.	*1*	*1*	**7**
		c)	A software engineer goes to his work place every day by a bike or car. He never goes by bike on two consecutive days, but if he goes by car on a day then he is equally likely to go by car or bike on the next day. Find the transition matrix for the chain of the mode of transport he uses. If car is used on first day of a week, find the probability that: (i) bike is used on the third day (ii) car is used on the third day.	*1*	*2*	**7**
			UNIT – 3			
	4	a)	It is hoped that a newly developed pain reliever will more quickly produce perceptible reduction in pain to patients after minor surgeries than a standard pain reliever. The standard pain reliever is known to bring relief in an average of 3.5 minutes. To test whether the new pain reliever works more quickly than the standard one, 50 patients with minor surgeries were given the new pain reliever and their times to relief were recorded. The experiment yielded sample mean $\bar{x} = 3.1$ minutes and sample standard deviation $s = 1.5$ minutes. Is there sufficient evidence in the sample to indicate, at the 5% level of significance, that the newly developed pain reliever does deliver perceptible relief more quickly?	*1*	*2*	**6**
		b)	Intelligence test of two groups of boys and girls gives the following results. | | Girls | Boys Number of students | 121 | 81 Mean (score) | 84 | 81 Standard deviation (score) | 10 | 12 Is the difference between the standard deviations significant? Use 5% level of significance.	*1*	*2*	**7**

		c)	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 and 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. At 1% level of significance, is there any significant indication that supports the company's claim on the effectiveness of the medicine?	*1*	*2*	**7**
			UNIT – 4			
	5	a)	Trace metals in drinking water affect the flavor and an unusually high concentration can pose a health hazard. Ten pairs of data were taken measuring zinc concentration in bottom water and surface water. At 1% level of significance, does the data suggest that the true average concentration in the bottom water exceeds that of surface water?	*1*	*2*	**6**
		b)	A company is considering to manufacture 3 energy drinks in terms of endurance in 18 persons. Each drink was randomly assigned to 6 different persons. The response in time to exhaustion (in seconds) on a treadmill is recorded. At 1% level of significance, test whether there is any significant difference in the mean of three drinks.	*1*	*2*	**7**
		c)	In a cross between rust-resistant and rust-susceptible varieties of oats, the F_3 families were compared for rust reaction in the seedling stage and in the field under ordinary epidemic conditions. The data are as follows:	*1*	*2*	**7**
			OR			
	6	a)	It is believed that the proportion of people with A, B, O and AB blood types in a population are respectively 0.4, 0.2 0.3 and 0.1. When 400 randomly picked people were examined, the number of persons with these types was observed to be 148, 96,106 and 50 respectively. At 5% level of significance, test the hypothesis that these data bear out the stated belief.	*1*	*2*	**6**

Zinc concentration	Location									
bottom water	0.430	0.266	0.567	0.531	0.707	0.716	0.651	0.589	0.469	0.723
surface water	0.415	0.238	0.390	0.410	0.605	0.609	0.632	0.523	0.411	0.612

Drink 1	42	36	54	44	28	45
Drink 2	48	34	56	46	32	50
Drink 3	62	48	75	52	44	65

Field Reaction	Seedling Reaction			Total
	Resisting	Segregating	Susceptible	
Resisting	142	51	7	200
Segregating	13	404	5	422
Susceptible	5	17	176	198
Total	160	472	188	820

Test at 5% level of significance whether the rust reaction is independent in two stages.

	b)	A software company markets a new computer game with two experimental packaging designs. Design 1 is sent to 11 stores; their average sales the first month is 52 units with sample standard deviation 12 units. Design 2 is sent to 6 stores; their average sales the first month is 46 units with sample standard deviation 10 units. Test at the 1% level of significance whether the data provide sufficient evidence to conclude that the mean sales per month of the two designs are different.	*1*	*2*	**7**
	c)	Two independent samples of sizes 7 and 6 have the following values. Sample A: 28 30 32 33 33 29 34 Sample B: 29 30 30 24 27 29 - Examine whether the samples have been drawn from normal populations having the same variance. Use 1% level of significance.	*1*	*2*	**7**
		UNIT – 5			
7	a)	A seed company performs an experiment to compare four varieties of rice. Five fields are available for the study and each field is subdivided into four plots of equal size. Each variety is randomly assigned to a plot, and the yield in bushels is recorded as follows: Blocks (Lands) | Fertilizers: 1 | 2 | 3 | 4 | 5 1 | 82 | 84 | 85 | 87 | 90 2 | 88 | 90 | 92 | 95 | 97 3 | 92 | 96 | 96 | 99 | 101 4 | 94 | 97 | 100 | 102 | 103 At 1% level of significance, test whether there is any significant difference in the yield mean according to variety of rice and fields.	*1*	*2*	**10**
	b)	Four levels of fertilizers were tried in a 4 x 4 Latin square to see its effect on the yield of peanuts. The yield are given below in kg. per plot along with the layout: C(26.7) | A(19.7) | B(29.0) | D(29.8) A(23.1) | B(21.7) | D(24.9) | C(29.0) B(29.3) | D(20.1) | C(29.0) | A(27.3) D(25.1) | C(17.4) | A(28.7) | B(35.1) At 5% level of significance, test whether there is any significant difference in the means due to 3 factors (row, column & treatment (fertilizer)).	*1*	*2*	**10**

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