U.S.N.										

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

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Computer Science and Business Systems **Duration: 3 hrs.**
Course Code: 24MA4BSSBS **Max Marks: 100**
Course: Statistical Modeling for Business Systems

Instructions: 1. Each unit has an internal choice; answer one complete question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of statistical tables are permitted.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - 1	*CO*	*PO*	Marks
1	a)	Calculate rank correlation coefficient from the following data: x: 10, 20, 30, 30, 40, 45, 50 y: 15, 20, 25, 30, 40, 40, 40 Hence interpret the nature of association between x and y.		*1*	*1*	**6**
	b)	Fit a parabola of the form $y = a + bx + cx^2$ for the following data: x: 1, 2, 3, 4, 5, 6, 7 y: 2, 6, 7, 8, 10, 11, 11		*1*	*1*	**7**
	c)	Compute the possible multiple correlation coefficients when the following are known: $r_{12} = 0.98$, $r_{13} = 0.44$ and $r_{23} = 0.54$.		*1*	*1*	**7**
		OR				
2	a)	Calculate the Pearson's coefficient of correlation and determine the nature of the correlation from the following data: x: 12, 9, 8, 10, 11, 13, 7 y: 14, 8, 6, 9, 11, 12, 3		*1*	*1*	**6**
	b)	Determine the equation of a straight line of the form $y = a + bx$ which best fits the following data: x: 10, 12, 13, 16, 17, 20, 25 y: 10, 22, 24, 27, 29, 33, 37		*1*	*1*	**7**
	c)	In a partially destroyed laboratory record, the only information available are the equations of the lines of regression of y on x and x on y. The respective equations are $4x - 5y + 33 = 0$ and $20x - 9y = 107$. Calculate: (i) $\bar{x}$ and $\bar{y}$ (ii) the co-efficient of correlation between x and y (iii) interpret the nature of association between x and y.		*1*	*1*	**7**
		UNIT - 2				
3	a)	A random sample of size 50 is taken from a gamma distribution with parameters $\alpha = 5$ and $\beta = 20$. State the approximate sampling distribution of the sample mean and hence calculate approximately the		*1*	*1*	**6**

			probability that the sample mean is greater than 115.			
		b)	Two independent samples are drawn from normal populations with unknown variances. Sample 1 has size 12, sample mean 14.5, and sample standard deviation 4.8. Sample 2 has size 15, sample mean 17.2, and sample standard deviation 5.3. What is the probability that the mean of Sample 1 exceeds that of Sample 2 by at least 1 unit?	*1*	*1*	**7**
		c)	Determine the Maximum Likelihood Estimate of μ from a Poisson distribution with parameter μ, based on the following random sample: x: 0, 1, 2, 3 f: 50, 30, 15, 5	*1*	*1*	**7**
			OR			
	4	a)	If independent random samples of size 8 come from normal populations having the same variance, what is the probability that either sample variance will be at least 7 times as large as the other?	*1*	*1*	**7**
		b)	Two independent random samples of sizes 100 and 120 respectively are drawn from two Poisson populations with parameters 2 and 3 respectively. What is the probability that the sample mean difference lies between -1 and 0?	*1*	*1*	**7**
		c)	A discrete random variable has the following probability distribution: x: 0, 1, 2 $P(X=x)$: 2θ, $\frac{2}{3}-\theta$, $\frac{1}{3}-\theta$ The following sample was drawn from this distribution: $\{0,0,0,1,1,1\ 2\}$. Calculate the method of moments estimate of θ. Hence determine an estimate of the population variance.	*1*	*1*	**7**
			UNIT - 3			
	5	a)	A test is designed to measure the level of anxiety that was administered to a sample of male and female patients just prior to undergoing the same surgical procedure. The sample sizes and the variances computed from the scores were as follows: Male: $n_1 = 16$, $s^2_1 = 150$ Female: $n_2 = 21$, $s^2_2 = 275$ Do these data provide sufficient evidence to indicate that in the represented populations the scores made by the males and females are same?	*2*	*1*	**7**
		b)	Two salesmen, A and B, are employed by a company. Recently, it conducted a sample survey yielding the following data: *No. of sales*: *Salesman A* 20, *Salesman B* 22 *Average weekly sales (Rs in Lakhs)*: 30, 25 *Standard Deviation (Rs in Lakhs)*: 10, 7 Use a suitable t-test to check if there is any significant difference between the average sales of the two salesmen.	*2*	*1*	**7**

		c)	A farmer applied 3 types of fertilizers on 4 separate plots. The figure of yield per acre is tabulated below: | | *A* | *B* | *C* | *D* | | *Nitrogen* | 6 | 4 | 8 | 6 | | *Potash* | 7 | 6 | 6 | 9 | | *Phosphate* | 8 | 5 | 10 | 9 | Find out if the plots are materially different in fertility, as also, if the three fertilizers make any significant difference in the yield.	*2*	*1*	**7**
			OR			
	6	a)	It has previously been recorded that the average depth of ocean at a particular region is 67.4 fathoms. Is there reason to believe this at 0.01 level of significance if the readings at 40 random locations in that particular region showed a mean of 69.3 with standard deviation of 5.4 fathoms?	*2*	*1*	**6**
		b)	A researcher wants to compare the effectiveness of three different diets on weight loss. The weight loss (in kg) for participants in each group after 4 weeks is recorded as follows: | *Diet A* | *Diet B* | *Diet C* | | 4 | 6 | 8 | | 5 | 7 | 7 | | 6 | 5 | 9 | | 5 | 6 | 8 | Using a One -Way ANOVA, test at 5% significance level to determine whether there is a significant difference in mean weight loss between the three diets.	*2*	*1*	**7**
		c)	The average weekly losses of man-hours due to strikes in an institute before and after a disciplinary program was implemented are as follows: Is there reason to believe that the disciplinary program is effective at 5% level of significance? | Before | 45 | 73 | 46 | 124 | 33 | 57 | 83 | 34 | | After | 36 | 60 | 44 | 119 | 35 | 51 | 77 | 29 |	*2*	*1*	**7**
			UNIT - 4			
	7	a)	A food inspector examines 16 jars of a certain brand of jam to determine the present of foreign impurities. The following data were recorded: 2.4, 2.3, 3.1, 2.2, 2.3, 1.2, 1.0, 2.4, 1.7, 1.1, 4.2, 1.9, 1.7, 3.6, 1.6, 2.3. At the 5% level of significance, apply a Wilcoxon signed rank test to examine the null hypothesis that the median present of impurities in this brand of jam is 2.5.	*2*	*1*	**6**
		b)	The lengths of the femur, in mm, in samples of a mouse from Britain and North Africa are given below: | Britain | 12.3 | 12.7 | 13.1 | 10.8 | 11.3 | 11.8 | 12.4 | 13.2 | | North Africa | 10.6 | 9.8 | 11.5 | 10.0 | 11.1 | - | - | - | Conduct a non-parametric test at the 5% level to test whether the data are consistent with the assumption that the mice in Britain and North Africa are the same breed.	*2*	*1*	**7**
		c)	Fit a Poisson distribution to the following data and test for the goodness of fit at α =5%. | x | 0 | 1 | 2 | 3 | 4 | | f | 419 | 352 | 154 | 56 | 19 |	*1*	*1*	**7**
			OR			

	8	a)	A sample analysis of examination results of 200 MBAs was made. It was found that 46 students had failed, 68 had secured a second division and the rest were placed in the first division. Do these figures commensurate with the general examination result which is in the ratio of 4:3:2:1 for various categories respectively?	*2*	*1*	**6**
		b)	The following data indicate the lifetime (in hours) of samples of two brands of light bulbs, brands A and B, in continuous use: *A* 603 625 641 622 585 593 660 600 633 580 *B* 620 640 646 620 652 639 590 646 631 669 Use the Mann- Whitney test to compare the lifetime of brands A and B of light bulbs.	*2*	*1*	**7**
		c)	The following data represent the number of hours that a rechargeable hedge trimmer operates before a recharge is required: 1.5, 2.2, 0.9, 1.3, 2.0, 1.6, 1.8, 1.5, 2.0, 1.2, and 1.7. Test the hypothesis at the 0.05 level of significance that this particular trimmer operates with a median of 1.8 hours requiring a recharge.	*2*	*1*	**7**
			UNIT - 5			
	9	a)	Apply the technique of semi-averages to fit a straight line for the trend corresponding to the following time series data. *Year* 2014 2015 2016 2017 2018 2019 2020 *Sales* 80 90 92 83 94 99 92 Provide a free-hand diagram representing the trend in each case.	*1*	*1*	**10**
		b)	Consider the following chronological data: *Year* 2015 2016 2017 2018 2019 *Sales* 25 28 35 40 52 (i) Construct a suitable mathematical model to predict trend values for sales by assuming a linear trend. (ii) Estimate the sales for the year 2026. (iii) Determine the rate of change in the sales per month.	*1*	*1*	**10**
			OR			
	10	a)	The following are the annual profits in millions of rupees in a certain business: *Year* 2015 2016 2017 2018 2019 *Profits* 60 72 75 65 80 Apply the method of least squares to fit a suitable trend line. Hence estimate the profit for the year 2030.	*1*	*1*	**10**
		b)	Compute the 4-yearly moving averages to analyze the trend for the following time series data pertaining to production in thousands of units manufactured: *Year* 2013 2014 2015 2016 2017 2018 2019 2020 *Production* 21 22 23 24 25 26 27 26 Indicate the approximate error in prediction.	*1*	*1*	**10**

****