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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: Industrial Engineering & Management **Duration: 3 hrs.**

Course Code: 23IM4BSSFE / 22IM4BSSFE **Max Marks: 100**

Course: Statistics for Engineers

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

		UNIT - I	CO	PO	Marks
1	a)	An engineer is someone who solves problems of interest to society by the efficient application of scientific principles. Justify the statement.	CO1	PO1	**06**
	b)	The ages of a sample of the students attending college this semester are: 19 17 15 20 23 41 33 21 18 20 18 33 32 29 24 19 18 20 17 22 55 19 22 25 28 30 44 19 20 39 i. Construct a frequency distribution with intervals 15-19, 20-24, 25-29, 30-34, and 35 and older. ii. Estimate the modal value iii. Now compute the mean for raw data.	CO2	PO1	**08**
	c)	Construct the Pareto Chart to identify the vital few factors affecting discharge delay from Emergency Department **Causes of discharge delay from Emergency Department (Audit in May & June)** / **Frequency** Review by team: 16 Bed shortage on ward: 21 Patient complications: 4 Doctor busy: 11 X-rays: 52 Other: 3	CO2	PO1	**06**
		OR			

	2	a)	The compressive strengths (in kgf) of 45 specimens are given below. 190 218 208 181 228 176 165 157 201 193 154 245 163 142 146 178 131 229 110 97 76 149 183 156 168 105 207 186 169 237 200 196 194 151 87 180 134 123 221 121 199 160 141 174 143 i) Construct frequency distribution using the lowest limit of lower class as 75kgf. ii) Find the mean, median, mode and standard deviation of the above specimens. iii) Construct a histogram for the frequency.	*CO3*	*PO2*	**15**
		b)	The following table gives the index numbers of industrial production for India. INDEX NUMBER OF INDUSTRIAL PRODUCTION Item | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 Cement | 107.0 | 113.1 | 107.6 | 102.6 | 116.7 | 133.9 Iron & steel | 100.6 | 112.0 | 96.1 | 100.2 | 121.3 | 145.0 General index | 104.2 | 110.2 | 112.0 | 114.3 | 119.3 | 131.2 Represent them using line graph. Comment on the representation.	*CO3*	*PO2*	**05**
			UNIT - II			
	3	a)	The probability that a visitor to a Web site provides contact data for additional information is 0.01. Assume that 1000 visitors to the site behave independently. Determine the following probabilities: i. No visitor provides contact data. ii. Exactly 10 visitors provide contact data. iii. More than 3 visitors provide contact data.	*CO3*	*PO2*	**06**
		b)	A research study uses 800 men under the age of 55. Suppose that 30% carry a marker on the male chromosome that indicates an increased risk for high blood pressure. i. If 10 men are selected randomly and tested for the marker, what is the probability that exactly 1 man has the marker? ii. If 10 men are selected randomly and tested for the marker, what is the probability that more than 1 has the marker?	*CO3*	*PO2*	**06**

		c)	The number of flaws in bolts of cloth in textile manufacturing is assumed to be Poisson distributed with a mean of 0.1 flaw per square meter. i. What is the probability that there are two flaws in one square meter of cloth? ii. What is the probability that there is one flaw in 10 square meters of cloth? iii. What is the probability that there are no flaws in 20 square meters of cloth? iv. What is the probability that there are at least two flaws in 10 square meters of cloth?	*CO3*	*PO2*	**08**
			OR			
	4	a)	The thickness of a flange on an aircraft component is uniformly distributed between 0.95 and 1.05 millimeters. Determine the following: i. Cumulative distribution function of flange thickness ii. Proportion of flanges that exceeds 1.02 millimeters iii. Thickness exceeded by 90% of the flanges iv. Mean and variance of flange thickness	*CO3*	*PO2*	**08**
		b)	The fill volume of an automated filling machine used for filling cans of carbonated beverage is normally distributed with a mean of 12.4 fluid ounces and a standard deviation of 0.1 fluid ounce. i. What is the probability that a fill volume is less than 12 fluid ounces? ii. If all cans less than 12.1 or more than 12.6 ounces are scrapped, what proportion of cans is scrapped? iii. Determine specifications that are symmetric about the mean that include 99% of all cans.	*CO3*	*PO2*	**06**
		c)	Cabs pass your workplace according to a Poisson process with a mean of five cabs per hour. i. Determine the mean and standard deviation of the number of cabs per 10-hour day. ii. Approximate the probability that more than 65 cabs pass within a 10-hour day. iii. Approximate the probability that between 50 and 65 cabs pass in a 10-hour day.	*CO3*	*PO2*	**06**
			UNIT - III			
	5	a)	The compressive strength of concrete is being tested by a civil engineer who tests 12 specimens and obtains the following data: 2216 2237 2249 2204 2225 2301 2281 2263 2318 2255 2275 2295 i. Construct a 95% two-sided confidence interval on the mean strength. ii. Construct a 95% lower confidence bound on the mean strength. Compare this bound with the lower bound of the	*CO3*	*PO2*	**08**

			two-sided confidence interval and discuss why they are different.			
		b)	An article in the Journal of the American Statistical Association (1990, Vol. 85, pp. 972–985) measured the weight of 30 rats under experiment controls. Suppose that 12 were underweight rats. i. Calculate a 95% two-sided confidence interval on the true proportion of rats that would show underweight from the experiment. ii. Using the point estimate of p obtained from the preliminary sample, what sample size is needed to be 95% confident that the error in estimating the true value of p is less than 0.02? iii. How large must the sample be if you wish to be at least 95% confident that the error in estimating p is less than 0.02, regardless of the true value of p?	*CO3*	*PO2*	**12**
			OR			
	6	a)	The overall distance traveled by a golf ball is tested by hitting the ball with Iron Byron, a mechanical golfer with a swing that is said to emulate the distance hit by the legendary champion, Byron Nelson. Ten randomly selected balls of two different brands are tested and the overall distance measured. The data follow: Brand 1: 275, 286, 287, 271, 283, 271, 279, 275, 263, 267 Brand 2: 258, 244, 260, 265, 273, 281, 271, 270, 263, 268 Construct a 95% two-sided CI on the mean difference in overall distance for the two brands of golf balls.	*CO3*	*PO2*	**06**
		b)	A random sample of 500 adult residents of Maricopa County indicated that 385 were in favor of increasing the highway speed limit to 75 mph, and another sample of 400 adult residents of Pima County indicated that 267 were in favor of the increased speed limit. Construct a 95% confidence interval on the difference in the two proportions. Provide a practical interpretation of this interval.	*CO3*	*PO2*	**06**
		c)	An article in Fire Technology investigated two different foam-expanding agents that can be used in the nozzles of fi refighting spray equipment. A random sample of five observations with an aqueous film-forming foam (AFFF) had a sample mean of 4.7 and a standard deviation of 0.6. A random sample of five observations with alcohol-type concentrates (ATC) had a sample mean of 6.9 and a standard deviation 0.8. i. A 90% two-sided confidence interval on σ_1^2 / σ_2^2 ii. 95% two-sided confidence interval on σ_1^2 / σ_2^2 . Comment on the comparison of the width of this interval with the width of the interval in part (a).	*CO3*	*PO2*	**08**

			UNIT - IV			
	7	a)	A melting point test of n = 10 samples of a binder used in manufacturing a rocket propellant resulted in $\bar{x}$ = 154.2°F. Assume that the melting point is normally distributed with σ = 1.5°F. i. Test H_0: μ = 155 versus H_1: μ ≠ 155 using α = 0.01. ii. What is the P-value for this test? iii. What is the β-error if the true mean is μ = 150? iv. What value of n would be required if we want β < 0.1 when μ = 150? Assume that α = 0.01.	*CO3*	*PO2*	**12**
		b)	Let X denote the number of flaws observed on a large coil of galvanized steel. Of 75 coils inspected, the following data were observed for the values of X: Values 1 2 3 4 5 6 7 8 Observed frequency 1 11 8 13 11 12 10 9 i. Does the assumption of the Poisson distribution seem appropriate as a probability model for these data? Use α = 0.01. ii. Calculate the P-value for this test.	*CO3*	*PO2*	**08**
			OR			
	8	a)	Two chemical companies can supply a raw material. The concentration of a particular element in this material is important. The mean concentration for both suppliers is the same, but you suspect that the variability in concentration may differ for the two companies. The standard deviation of concentration in a random sample of n_1 = 10 batches produced by company 1 is s_1 = 4.7 grams per liter, and for company 2, a random sample of n_2 = 16 batches yields s_2 = 5.8 grams per liter. Is there sufficient evidence to conclude that the two population variances differ? Use α = 0.05			**10**
		b)	Two types of plastic are suitable for electronics component manufacturer to use. The breaking strength of this plastic is important. It is known that $\sigma_1 = \sigma_2$ = 1.0 psi. From a random sample of size n_1 = 10 and n_2 = 12, you obtain x_1 = 162.5 and x_2 = 155.0. The company will not adopt plastic 1 unless its mean breaking strength exceeds that of plastic 2 by at least 10 psi. i. Based on the sample information, should it use plastic 1? Use α = 0.05 in reaching a decision. Find the P-value.			**10**
			UNIT - V			
	9	a)	A study was made to model the relation between weekly advertising expenditures and sales. During the study following data were recorded:	*CO4*	*PO3*	**16**

Advertising cost (Rs)	20	25	30	35	40	45	50	55	60
Weekly sales	400	420	405	480	475	490	525	560	515

			i. Plot a scatter diagram ii. Find the equation of the regression line to predict weekly sales from advertising expenditures. iii. Compute Coefficient of determination R^2 and interpret about model. iv. Test the hypothesis for Slope using $\alpha = 0.05$			
		b)	Discuss briefly the multi linear regression. With its applications.	*CO1*	*PO1*	**04**
			OR			
	10	a)	Regression methods were used to analyze the data from a study investigating the relationship between roadway surface temperature (x) and pavement deflection (y). Summary quantities were n = 20, Σy_i = 12.75, Σy_1^2 = 8.86, Σx_i = 1478, $\Sigma\ x_i^2$= 143,215.8, and $\Sigma x_i y_i$ = 1083.67. i) Calculate the least squares estimates of the slope and intercept. Graph the regression line. Estimate σ^2. ii) Use the equation of the fitted line to predict what pavement deflection would be observed when the surface temperature is 85°F. iii) What is the mean pavement deflection when the surface temperature is 90°F? iv) What change in mean pavement deflection would be expected for a 1°F change in surface temperature?	*CO4*	*PO3*	**15**
		b)	Define data analytics. Mention the types of data analytics with its applications	*CO1*	*PO1*	**05**

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