U.S.N.										

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

Autonomous Institute Affiliated to VTU

August 2024 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Industrial Engineering and Management **Duration: 3 hrs.**
Course Code: 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.

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.

				CO	*PO*	Marks
			UNIT – I			
1	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 and stem and leaf diagram for the frequency.	*CO* 1	*PO1*	**14**
	b)	Mention and explain the collecting engineering data with an example.	*CO* 1	*PO1*	**6**
		UNIT – II			
2	a)	A disk drive manufacturer sells storage devices with capacities of one terabyte, 500 gigabytes, and 100 gigabytes with probabilities 0.5, 0.3, and 0.2, respectively. The revenues associated with the sales in that year are estimated to be INR 50 million, INR 25 million, and INR 10 million, respectively. Let X denote the revenue of storage devices during that year. i) Determine the probability mass function of X. ii) Determine the cumulative distribution function for the random variable	*CO* 1	*PO1*	**6**

		b)	Suppose that scratches are present at 5 places among 50 in a patient. A surgery selects 8 places randomly (without replacement). i) What is the probability that scratches are present in at least one selected place? ii) What is the probability that scratches are present in two or more selected places? iii) Instead of eight places, what is the minimum number of places that need to be selected to meet the following objective? The probability that at least one places has scratches present is greater than or equal to 0.9.	***CO*** 1	***PO1***	**6**
		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?	***CO*** 1	***PO1***	**8**
			OR			
	3	a)	The demand for water uses in Phoenix in 2003 hit a high of about 442 million gallons per day on June 27. 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%? iii) What amount of water use is exceeded with 95% probability? iv) Water is provided to approximately 1.4 million people. What is the mean daily consumption per person at which the probability that the demand exceeds the current reservoir capacity is 1%? Assume that the standard deviation of demand remains the same.	***CO*** 1	***PO1***	**8**
		b)	The number of (large) inclusions in cast iron follows a Poisson distribution with a mean of 2.5 per cubic millimeter. Approximate the following probabilities: i) Determine the mean and standard deviation of the number of inclusions in a cubic centimeter (cc). ii) Approximate the probability that fewer than 2600 inclusions occur in a cc. iii) Approximate the probability that more than 2400 inclusions occur in a cc. iv) Determine the mean number of inclusions per cubic millimeter such that the probability is approximately 0.9 that 500 or fewer inclusions occur in a cc.	***CO*** 1	***PO1***	**8**

		c)	The probability density function of the net weight in pounds of a packaged chemical herbicide is f (x) = 2.0 for 49.75 < x < 50.25 pounds. i) Determine the probability that a package weighs more than 50 pounds. ii) How much chemical is contained in 90% of all packages?	***CO*** 1	***PO1***	**4**
			UNIT - III			
	4	a)	A civil engineer is analyzing the compressive strength of concrete. Compressive strength is normally distributed with $\sigma^2 = 1000(psi)^2$. A random sample of 12 specimens has a mean compressive strength of $\overline{x}$ = 3250 psi. i) Construct a 95% two-sided confidence interval on mean compressive strength. ii) Construct a 99% two-sided confidence interval on mean compressive strength. Compare the width of this confidence interval with the width of the one found in part (i).	***CO*** 2	***PO2***	**6**
		b)	Differentiate between point estimate and interval estimate with an example	***CO*** 1	***PO1***	**6**
		c)	An article in the Australian Journal of Agricultural Research ["Non-Starch Polysaccharides and Broiler Performance on Diets Containing Soyabean Meal as the Sole Protein Concentrate" (1993, Vol. 44(8), pp. 1483–1499)] determined that the essential amino acid (Lysine) composition level of soybean meals is as shown here (g/kg): 22.2 24.7 20.9 27.0 26.0 23.9 25.6 23.8 24.8 26.5 i) Construct a 99% two-sided confidence interval for σ^2. ii) Calculate a 99% lower confidence bound for σ^2. iii) Calculate a 90% lower confidence bound for σ. iv) Compare the intervals that you have computed.	***CO*** 2	***PO2***	**8**
			UNIT – IV			
	5	a)	An article in Growth: A Journal Devoted to Problems of Normal and Abnormal Growth ["Comparison of Measured and Estimated Fat-Free Weight, Fat, Potassium and Nitrogen of Growing Guinea Pigs" (1982, Vol. 46(4), pp. 306–321)] reported the results of a study that measured the body weight (in grams) for guinea pigs at birth. 421.0 452.6 456.1 494.6 373.8 110.7 241.0 290.9 88.8 258.5 90.5 296.0 687.6 296.0 296.0 96.4 317.0 705.7 273.0 279.3 81.7 256.5 879.0 268.0 227.5 102.4 447.8 i) Test the hypothesis that mean body weight is 300 grams. Use α = 0.05. ii) What is the smallest level of significance at which you would be willing to reject the null hypothesis? iii) Explain how you could answer the question in part (I) with a two-sided confidence interval on mean body weight.	***CO*** 2	***PO2***	**12**

	b)	In a random sample of 85 automobile engine crankshaft bearings, 10 have a surface finish roughness that exceeds the specifications. Do these data present strong evidence that the proportion of crankshaft bearings exhibiting excess surface roughness exceeds 0.10? i) State and test the appropriate hypotheses using $\alpha = 0.05$.	***CO*** 2	***PO2***	**8**
		OR			
6	a)	Let X denotes 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: No. of Flaws: 1 2 3 4 5 6 7 8 Observed data: 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 $\alpha = 0.01$. ii) Calculate the P-value for this test.	***CO*** 2	***PO2***	**12**
	b)	Extracts of St. John's Wort are widely used to treat depression. An article in the April 18, 2001, issue of the Journal of the American Medical Association ("Effectiveness of St. John's Wort on Major Depression: A Randomized Controlled Trial") compared the efficacy of a standard extract of St. John's Wort with a placebo in 200 outpatients diagnosed with major depression. Patients were randomly assigned to two groups; one group received the St. John's Wort, and the other received the placebo. After eight weeks, 19 of the placebo-treated patients showed improvement, and 27 of those treated with St. John's Wort improved. Is there any reason to believe that St. John's Wort is effective in treating major depression? Use $\alpha = 0.05$.	***CO*** 2	***PO2***	**8**

			UNIT – V			
	7	a)	An article in the Journal of Sound and Vibration (Vol. 15 1, 199 1, pp. 383-394) described a study investigating the relationship between noise exposure (x) and hypertension (Y). The following data (sorted by sound pressure level) are representative of those reported in the article:	***CO*** 2	***PO2***	**10**
		b)	Discuss briefly the Multi linear Regression. With its application.	***CO*** 1	***PO1***	**6**
		c)	Distinguish between correlation and regression.	***CO*** 1	***PO1***	**4**

No.	Sound Pressure level (x;unit: dB)	Blood Pressure Rise (Y;unit: mmHg)	No.	Sound Pressure level (x;unit: dB)	Blood Pressure Rise (Y;unit: mmHg)
1	60	1	11	85	5
2	63	0	12	89	4
3	65	1	13	90	6
4	70	2	14	90	8
5	70	5	15	90	4
6	70	1	16	90	5
7	80	4	17	94	7
8	80	6	18	100	9
9	80	2	19	100	7
10	80	3	20	100	6

Assume that x and Yare linearly related.
i) Calculate the least squares estimates of the intercept and slope of the linear model for x and Y.
ii) Calculate the residual of y = 5 mmHg at x = 85 dB.
iii) Estimate the error variance σ^2.

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