U.S.N.										

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

Autonomous Institute Affiliated to VTU

December 2023 Supplementary 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.
3. Statistical tables need to be carried.

		UNIT - I	*CO*	*PO*	Marks
1	a)	Explain in brief the basic methods of collecting engineering data	*CO1*	*PO1*	**04**
	b)	Let us consider the weight of 120 students at a university, as given below;	*CO1,CO2*	*PO1, PO2*	**16**

154	141	122	130	131	174	165	156	168
182	205	171	146	158	143	151	178	147
164	167	138	139	141	176	168	171	192
124	155	158	198	122	120	110	155	166
175	207	162	218	130	133	151	152	175
166	131	141	150	164	139	154	172	133
196	132	183	173	142	144	165	132	191
190	134	150	158	136	169	152	134	159
185	135	168	186	135	140	140	187	188
140	145	146	155	172	140	144	142	150
159	144	163	162	160	157	153	145	154
145	142	148	142	143	154	143	152	165
131	144	142	146	146	150	178	152	161
173	162	171						

i. Construct a grouped frequency distribution table with class size 10 for the data given
ii. Estimate the mean, median and mode for the above data
iii. Estimate the standard deviation, variance
iv. Construct a histogram considering all classes. Comment

			UNIT - II			
	2	a)	Actual lengths of stay at a hospital's emergency department are shown in the following table (rounded to the nearest hour). Length of stay is the total of wait and service times. Some longer stays are also approximated as 15 hours in this table. Hours 1 2 3 4 5 6 Count 19 51 86 102 87 62 Percentage 3.8 10.2 17.2 20.4 17.4 12.4 Hours 7 8 9 10 15 Count 40 18 14 11 10 Percentage 8.0 3.6 2.8 2.2 2.0 i. Calculate the probability mass function of the wait time for service. ii. Determine the cumulative distribution function for the random variable. iii. Calculate the mean and variance for the random variable.	*CO1,CO2*	*PO1, PO2*	**08**
		b)	Assume that the wavelengths of photo synthetically active radiations (PAR) are uniformly distributed at integer nanometers in the red spectrum from 675 to 700 nm. i. What are the mean and variance of the wavelength distribution for this radiation? ii. If the wavelengths are uniformly distributed at integer nanometers from 75 to 100 nanometers, how do the mean and variance of the wavelength distribution compare to the previous part? Explain.	*CO1,CO2*	*PO1, PO2*	**06**
		c)	Samples of 20 parts from a metal punching process are selected every hour. Typically, 1% of the parts require rework. Let X denotes the number of parts in the sample of 20 that require rework. A process problem is suspected if X exceeds its mean by more than 3 standard deviations. i. If the percentage of parts that require rework remains at 1%, what is the probability that X exceeds its mean by more than 3 standard deviations? ii. If the rework percentage increases to 4%, what is the probability that X exceeds 1? iii. If the rework percentage increases to 4%, what is the probability that X exceeds 1 in at least one of the next five hours of samples?	*CO1,CO2*	*PO1, PO2*	**06**
			OR			
	3	a)	The life of a semiconductor laser at a constant power is normally distributed with a mean of 7000 hours and a standard deviation of 600 hours. i. What is the probability that a laser fails before 5000 hours? ii. What is the life in hours that 95% of the lasers exceed? iii. If three lasers are used in a product and they are assumed to fail independently, what is the probability that all three are still operating after 7000 hours?	*CO1,CO2*	*PO1, PO2*	**06**

		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. Such that the probability is approximately 0.9 that 500 or fewer inclusions occur in a cc.	*CO1,CO2*	*PO1, PO2*	**08**
		c)	The time between calls to a corporate office is exponentially distributed with a mean of 10 minutes. i. What is the probability that there are more than three calls in one-half hour? ii. What is the probability that there are no calls within one-half hour? iii. Determine x such that the probability that there are no calls within x hours is 0.01.	*CO1,CO2*	*PO1, PO2*	**06**
			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).	*CO2*	*PO2*	**06**
		b)	Differentiate between point estimate and interval estimate with an example	*CO1*	*PO1*	**06**
		c)	An article in the Agricultural Research 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.	*CO2*	*PO2*	**08**

			UNIT - IV			
	5	a)	An article in Growth: A Journal Devoted to Problems of Normal and Abnormal Growth 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 $\alpha = 0.05$. 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.	*CO1,CO2*	*PO1, 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 $\alpha = 0.05$. ii. If $p = 0.15$, how large would the sample size have to be for us to have a probability of correctly rejecting the null hypothesis of 0.9?	*CO1,CO2*	*PO1, PO2*	**08**
			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.	*CO2*	*PO2*	**12**
		b)	Extracts of Plant X are widely used to treat depression. An article compared the efficacy of a standard extract of Plant X with a placebo in 200 outpatients diagnosed with major depression. Patients were randomly assigned to two groups; one group received the Plant X, and the other received the placebo. After eight weeks, 19 of the placebo-treated patients showed improvement, and 27 of those treated with Plant X improved. Is there any reason to believe that Plant X is effective in treating major depression? Use $\alpha = 0.05$.	*CO2*	*PO2*	**08**

			UNIT - V			
	7	a)	Sound and vibration article 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:	*CO2CO3*	*PO2 PO3*	**16**

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.

		b)	Discuss briefly the Multi linear Regression With its application.			**04**

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