Register No : ____________________

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

UG/PG DEGREE END SEMESTER THEORY EXAMINATIONS, APRIL-MAY 2026

First Semester

Common to Construction Engineering & Environmental Engineering

PSMT2401 -STATISTICAL METHODS FOR ENGINEERS

Statistical Tables book to be Permitted

Regulations - 2024

Duration : 3 Hrs ***Maximum : 100 Marks***

*PART – A(ANSWER ALL QUESTIONS) (Marks 10*2=20)*

Q.No	Questions	BTL	CO	Marks
1.	If T is unbiased estimator for θ then Prove that T^2 is biased estimator for θ^2.	L1	1	2
2.	Find the method of moments estimator for the mean of a Poisson distribution given the sample values: 2, 3, 0, 1, 4.	L2	1	2
3.	A quality control engineer suspects that the proportion of defective units among certain manufactured items has increased from the set limit of 0.01. To test his claim, he randomly selected 100 of these items and found that the proportion of defective units in the sample was 0.02. Find the test statistic for the proportion.	L2	2	2
4.	What is meant by the goodness of fit test?	L1	2	2
5.	Distinguish between simple and partial correlation.	L2	3	2
6.	Express the first-order partial correlation r_{XYZ} in terms of r_{XY},$r_{YZ,}$ r_{XZ},	L1	3	2
7.	List two differences between CRD and RBD.	L2	4	2
8.	Define a 2^2 factorial design with an example.	L1	4	2
9.	Write down the mean vector for the bivariate data: (2,3), (4,5), (6,7).	L2	5	2
10.	What is the significance of principal component analysis?	L1	5	2

*PART – B (ANSWER ALL QUESTIONS) (Marks 5*16 = 80)*

Q.No			Questions	BLT	CO	Marks
11.	a	i	Let $x_1, x_2, x_3 \ldots\ldots x_n$ be a random sample from the uniform distribution with p.d.f $f(x,\theta) = \begin{cases} \frac{1}{\theta}, & 0 < x < \infty,\ \theta > 0 \\ 0, & elsewhere \end{cases}$. Obtain the maximum likelihood estimator for θ.	L3	1	8
		ii	Consider a population having the density function $\frac{2}{\alpha^2}(\alpha - x), 0 < x < \alpha$, Obtain Maximum Likelihood Estimator (MLE) of the parameter α.Show that the above estimator is biased.	L3	1	8
			Or			
	b	i	For the double Poisson distribution, $p(x) = \frac{1}{2}\frac{e^{-m_1} m_1^x}{x!} + \frac{1}{2}\frac{e^{-m_2} m_2^x}{x!}, x = 0,1,2\ldots$ Show that the estimates m_1 and m_2 by the method of moments are $\mu_1' = \pm\sqrt{\mu_2' - \mu_1' - (\mu_1')^2}$	L3	1	10
		ii	In random Sampling from Normal population $N(\mu, \sigma^2)$, find the maximum likelihood estimator for μ and σ^2.	L3	1	6

12. a i Two random samples gave the following results: L3 2 10

Sample	Size	Sample mean	Sum of the square of deviations from the mean
1	10	15	90
2	12	14	108

Examine whether the samples come from the same normal population at 5% level of significance.

ii Two plants produce the same metal rods. From the first plant, 50 rods are sampled with an average length of 505 millimeters. From the second plant, 60 rods are sampled with an average length of 500 millimeters. The population standard deviation is known to be 12 millimeters for the first plant and 15 millimeters for the second plant. At the 5% level, test whether the average lengths are different and construct a 95% confidence interval. L4 2 6

Or

b i Two researchers adopted different sampling techniques while investigating the same group of students to find the number of students falling into different intelligence level. The results are as follows: L4 2 8

Research	Below average	Average	Above average	Excellent	Total
X	86	60	44	10	200
Y	40	33	25	2	100
Total	126	93	69	12	300

Would you say that the sampling techniques adopted by the two researchers are significantly different ?

ii A time-management workshop is expected to reduce task completion times (in minutes). For ten students, times are recorded before and after the workshop: Before: 62, 58, 55, 60, 64, 59, 57, 61, 63, 56 After: 59, 57, 54, 58, 62, 58, 55, 60, 60, 55. Use a 5% level to test whether the average time decreases after the workshop. L4 2 8

13. a i Fit a regression line of Y on X for the given data: L4 3 8
X: 2, 4, 6, 8, 10 ; Y: 5, 7, 9, 10, 15

ii From the data relating to the yield of dry bark(X1), height (X2) and girth (X3) for 18 cinchona plants, the following correlation coefficients were obtained: r_{12}=0.77, r_{13}=0.72, r_{23}=0.52 . Determine the value of multiple correlation coefficient. L4 3 8

Or

b i Compute Karl Pearson's correlation coefficient for the following data: L4 3 8
X: 10 12 13 16 17 18 19 20
Y: 20 22 23 27 26 29 30 32

ii Determine the regression equation of X_1 on X_2 for the following results: L4 3 8

Trait	Mean	S.D	r_{12}	r_{23}	r_{31}
X_1	28.02	4.42	0.80	-	-
X_2	4.91	1.10	-	-0.56	-
X_3	594	85	-	-	-0.40

Where X_1= seeds per acre
X_2= Rain fall in inches
X_3= Accumulated temperature above 42 degree .

14.	a	i	A farmer wishes to test the effects of four different fertilizers. A, B, C, D on yield of wheat. In order to eliminate sources of error due to variability in soil fertility, he uses the fertilizers in a Latin Square arrangement as indicated in the following table, where the numbers indicate yields in bushels per unit area.	L4	4	16

A18	C21	D25	B11
D22	B12	A15	C19
B15	A20	C23	D24
C22	D21	B10	A17

Perform an analysis of variance to determine if there is a significant difference between the fertilizers at $\alpha = 0.05$ levels of significance.

Or

	b	i	A chemical engineer wants to study the effects of Temperature (Factor A) and Pressure (Factor B) on the yield of a chemical process. Two levels are used for each factor:	L4	4	16

- Temperature: Low (-1), High (+1)
- Pressure: Low (-1), High (+1)

Temperature	Pressure	Replicate1	Replicate 2	Replicate 3	Total
Low (-1)	Low (-1)	20	22	21	63
Low (-1)	High (+1)	25	26	24	75
High (+1)	Low (-1)	30	29	31	90
High (+1)	High (+1)	35	36	34	105

Analyse the given data and give your interpretation about their significance using 2^2 Factorial Design.

15.	a	i	Let the random variables X_1, X_2, X_3 have the covariance matrix $\Sigma = \begin{pmatrix} 1 & -2 & 0 \\ -2 & 5 & 0 \\ 0 & 0 & 2 \end{pmatrix}$. Determine the principal Components Y_1, Y_2, Y_3.	L3	5	9
		ii	Derive the mean vector and covariance matrix for a bivariate normal distribution.	L3	5	7

Or

	b	i	For the covariance matrix $\Sigma = \begin{pmatrix} 1 & 4 \\ 4 & 100 \end{pmatrix}$ the derived correlation matrix $P = \begin{pmatrix} 1 & 0.4 \\ 0.4 & 1 \end{pmatrix}$, show that the principal components obtained from covariance and correlation matrices are different.	L4	5	16

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