KUMARAGURU college of technology
character is life

Register Number:…….

M.E/M.TECH/MCA DEGREE EXAMINATIONS: NOV/DEC 2024

(Regulation 2018)

First Semester

CONSTRUCTION MANAGEMENT

P18MAT1001**:** Statistical Methods for Management

COURSE OUTCOMES

CO1: Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood. estimation and Central Limit Theorem.

CO2: Use statistical tests in testing hypotheses on data.

CO3: Concept of linear regression, correlation, and its applications.

CO4: List the guidelines for designing experiments and recognize the key historical figures in Design of Experiments.

CO5: Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. If T is the MLE of θ and $\psi(\theta)$ is one to one function of θ, then $\psi(T)$ is the MLE of $\psi(\theta)$, This is known as CO1 [K_1]

   a) Unbiased b) Consistent

   c) Invariant d) efficient

2. The equation of Maximum Likelihood Estimator (MLE) is given by CO1 [K_1]

   a) $\frac{\partial logL}{\partial \theta} = 0$ b) $\frac{\partial logL}{\partial \theta} < 0$

   c) $\frac{\partial L}{\partial \theta} < 0$ d) $\frac{\partial logL}{\partial \theta} > 0$

3. The steps involved in testing of hypothesis is CO2 [K_1]
   1. Null hypothesis is defined.
   2. Level of significance is fixed.
   3. The test statistics are computed.
   4. Based on the nature of the test alternative hypothesis is defined.

   a) 2-3-4-1 b) 1-4-2-3

c) 3-4-2-1 d) 4-1-3-2

4. The small sample test used for testing the equality of two variances is CO2 [K_1]

a) t – test b) normal test

c) χ^2– test d) F – test

5. If Cov (x, y) = 3 and v(x) = 4.5, v(y) = 5.5 then the correlation co-efficient is ____._ CO3 [K_2]

a) 0.62 b) 0.86

c) 0.60 d) 0.76

6. The correlation and regression between any two variables eliminating the linear effect of other is called as CO3 [K_1]

a) Karl-Pesrson's correlation b) Partial correlation

c) Multiple correlation d) Joint correlation

7. Assertion (A): 2 x 2 LSD is not possible. CO4 [K_2]

Reason (R): For LSD of order n, degrees of freedom of residual is $n^2 - 1$.

a) Both A and R are Individually true and R is the correct explanation of A b) Both A and R are Individually true but R is not the correct explanation of A

c) A is true but R is false d) A is false but R is true

8. Matching type item with multiple choice code CO4 [K_2]

List I (ANOVA Type)	List II (Total d.f)
A. CRD	i. rc-1
B. RBD	ii. 4r-1
C. LSD	iii. N-1
D. 2^2 Factorial design	iv. $n^2 - 1$

a) A -iii, B-iv, C -i, D-ii b) A -iv, B-iii, C -ii, D-i

c) A -ii, B-iii, C -iv, D-i d) A -iii, B-i, C -iv, D-ii

9. An eigenvector of a covariance matrix tells about CO5 [K_1]

a) The direction of variability in multivariate space b) Whether the data point is an outlier

c) The magnitude of variability in multivariate space d) Whether the data point is normally distributed

10. Which of the following are true for a normal vector X having a multivariate normal distribution? CO5 [K_2]

1. Linear combination of the components of X are normally distributed.

2. All subsets of the components of X have a (multivariate) normal distribution.
3. Zero covariance implies that the corresponding components are independently distributed.
4. The conditional distributions of the components are normal.

a) 1,3. 4 b) 1,2, 3, 4

c) 1,2 d) 2, 3,4

PART B (10 x 2 = 20 Marks)

11.	Define an unbiased estimator and provide an example	CO1	[K_1]
12.	For a sample $X_1, X_2, \ldots, X_n$ from a distribution with unknown mean μ and variance σ^2, prove that the sample mean $\overline{X}$ is an unbiased estimator of μ.	CO1	[K_3]
13.	What is the difference between a Type I and a Type II error in hypothesis testing?	CO2	[K_1]
14.	Write down any two properties of χ^2 - distribution.	CO2	[K_1]
15.	Explain the concept of multiple correlation coefficient and its interpretation.	CO3	[K_2]
16.	In a regression analysis, the regression line of Y on X is given by Y = 3+2X. Find the predicted value of Y when X = 5.	CO3	[K_3]
17.	In a one-way ANOVA test, the total sum of squares (SST) is 100, and the sum of squares for treatments (SSTR) is 40. Find the sum of squares for error (SSE).	CO4	[K_3]
18.	Describe the purpose of a randomized block design in experiments.	CO4	[K_2]
19.	Consider the following covariance matrix for two variables: $\sum = \begin{pmatrix} 5 & 3 \\ 3 & 4 \end{pmatrix}$, Calculate the correlation coefficient between the two variables.	CO5	[K_3]
20.	What is a principal component, and why is it useful in multivariate analysis?	CO5	[K_2]

PART C (6 x 5 = 30 Marks)

21.	Let $x_1, x_2, \ldots \ldots x_n$ be a random sample from a Poisson population with parameter λ. Estimate λ by the method of moments.	CO1	[K_3]
22.	Test the significance of the difference between the means of the samples, drawn from two normal populations with the same SD using the following data:	CO2	[K_3]

	Size	Mean	SD
Sample 1	100	61	4
Sample 2	200	63	6

23.	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: $r_{12} = 0.77, r_{13} = 0.72, r_{23} = 0.52$.	CO3	[K_3]

Determine the value of multiple correlation coefficient.

24. Suppose that an experiment comparing treatments A, B, and C yields the data shown below. CO4 [K_4]

A	B	C
12	13	18
10	17	16
13	20	21
9	14	17

Analyze the significance difference between the treatments.

25. Let $\sum = \begin{bmatrix} 4 & 1 & 2 \\ 1 & 9 & -3 \\ 2 & -3 & 25 \end{bmatrix}$, Obtain $V^{1/2}$ and ρ. CO5 [K_3]

26. Two samples of 6 and 7 items respectively have the following values for a variable CO2 [K_3]

Sample 1	39	41	42	42	44	40	
Sample 2	40	42	39	45	38	39	40

Do the sample variances differ significantly?

Answer any FOUR Questions
PART D (4 x 10 = 40 Marks)

27. Prove the Maximum Likelihood Estimator of the parameter α of a population having density function $\frac{2(\alpha-x)}{\alpha^2}, 0 < x < \alpha$, for a sample of unit size is 2x, x being the sample value. Show that the above estimate is biased. CO1 [K_3]

28. A total number of 3759 individuals were interviewed in a public opinion survey on a political proposal. Of them, 1872 were men and the rest women. A total of 2257 individuals were in favour of the proposal and 917 were opposed to it . A total of 243 men were undecided and 442 women were opposed to the proposal. Do you justify or contradict the hypothesis that there is no association between sex and attitude? CO2 [K_4]

29. Determine the regression equation of X_1 on X_2 and X_3 given the following results: CO3 [$K3_L$]

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

30. Analyse the variance in the following Latin square of yields (in kgs) of paddy where A, B, C, D denote the different methods of cultivation CO4 [K_4]

D122	A121	C123	B122
B124	C123	A122	D125
A120	B119	D120	C121
C122	D123	B121	A122

Examine whether the different methods of cultivation have given significantly different yields.

31. If the covariance matrix of $X = [X_1, X_2]^T$ is $\sum = \begin{pmatrix} 1 & 4 \\ 4 & 100 \end{pmatrix}$. Obtain the principal components of X_1, X_2. CO5 [K_3]

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