KUMARAGURU
college of technology
character is life

Register Number:……

M.E DEGREE EXAMINATIONS: NOV/DEC 2023

(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. An estimator is said to be the best, if it is…… CO1 [K_1]

   a) Unbiased, consistent, Efficient, Sufficient
   b) Randomization, blocking, biased, Local Control
   c) Biased, inconsistent, efficient, sufficient
   d) Efficient, Sufficient, grouping, variance

2. Examine the following statement and choose the codes given below: CO1 [K_4]
   Assertion (A): A consistent Estimator is unbiased in the limit.
   Reason (R) : An unbiased estimator is may or may not be a consistent estimator.
   a) Both A and R are Individually true and R is the correct explanation of A
   b) A is true but R is false
   c) Both A and R are Individually true but R is not the correct explanation of A
   d) A is false but R is true

3. The steps involved in testing of hypothesis is CO2 [K_4]
   (1) The test statistic is computed.
   (2) Level of significance is fixed.
   (3) The Null hypothesis and Alternative hypothesis is defined.
   (4) Comparing the test statistic, and the table value draw the conclusion.
   a) 3-2-1-4
   b) 2-1-3-4
   c) 1-2-3-4
   d) 3-1-4-2

4. Match the List-I with List-II CO2 [K_3]

List I (Type)	List II (Total Degrees of freedom)
A. CRD	i. rc-1
B. RBD	ii.N-1
C. LSD	iii. 4r-1
D.2×2 factorial	iv. n^2 -1

	A	B	C	D
a)	iv	iii	ii	i
b)	iii	iv	i	ii
c)	ii	i	iv	iii
d)	i	ii	Iii	iv

5. The correlation between only two variables eliminating the linear effect of other variables is called…… CO3 [K_1]

a) Partial regression b) Linear regression

c) Partial correlation d) Linear interpolation

6. The equation of the plane of regression of X_1 on X_2 and X_3 is ……. CO3 [K_1]

a) $X_1 = b_{12.3}X_2 + b_{13.2}X_3$ b) $X_1 = \sigma_{11}X_2 + \sigma_{12}X_3$

c) $X_1 = b_{12.3}X_2 - b_{13.2}X_3$ d) $X_1 = \sigma_{12}X_2 + \sigma_{32}X_3$

7. Consider the following statements and select which of them are correct? CO4 [K_2]
1. Randomized Block Design can be performed only in the square field.
2. Latin Square Design can be performed only in the rectangle field.
3. In Latin Square Design, the number of treatments is equal to the number of replications.
4. Latin Square Design cannot be performed on 2×2 field.

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

c) 3,4 d) 2,4

8. The correction factor for the below data is …… CO4 [K_3]

A	B	C	D
8	6	14	20
9	8	12	22
11	10	18	25
12	4	9	23

a) 1245.33 b) 2782.56

c) 1453.52 d) 4128.69

9. Consider the Matrix $\Sigma = \begin{bmatrix} 2 & 1 \\ 8 & 6 \end{bmatrix}$.The corresponding Characteristic Equation for this Matrix is…….. CO5 [K_2]

a) $\lambda^2 + 8\lambda - 4 = 0$ b) $\lambda^2 - 8\lambda - 4 = 0$

c) $\lambda^2 + 8\lambda + 4 = 0$ d) $\lambda^2 - 8\lambda + 4 = 0$.

10. The steps involved in finding principal component is CO5 [K3]

1. Find the variance of each principal component vectors.
2. Find the principal component vectors.
3. Find the Eigenvalues and eigenvectors of covariance matrix.
4. Obtain variance -covariance matrix

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

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

PART B (10 x 2 = 20 Marks)

11. Define Unbiased estimator. CO1 [K1]

12. List the characteristics of good estimator. CO1 [K1]

13. Find the Chi-square value for the given data: CO2 [K4]

No. of persons	Drug	No drug
Cured	65	55
Not cured	35	45

14. What is Type-I error and Type-II error. CO2 [K2]

15. Write the Normal equations for the second-degree curve $y=ax^2+bx+c$. CO3 [K3]

16. In a tri-variate distribution, it is given that $r_{12}=0.8$, $r_{23}=0.7$, $r_{31}=0.6$. Find the value of $r_{12.3}$. CO3 [K4]

17. What are the basic principles of Experimental design? CO4 [K1]

18. Find the values of A and B in the below ANOVA table. CO4 [K5]

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Sum of Squares	F Ratio
Between Treatments	2	6	A	B
Error	7	34	4.857	

19. Define Random Matrix. CO5 [K1]

20. Find the standard deviation matrix for $\Sigma = \begin{bmatrix} 4 & 1 & 2 \\ 1 & 9 & -3 \\ 2 & -3 & 25 \end{bmatrix}$. CO5 [K4]

PART C (10 x 5 = 50 Marks)

21. If $x_1, x_2, \ldots\ldots, x_n$ is a random sample taken from Poisson distribution (λ), then show that sample mean x is consistent estimator of λ. CO1 [K4]

22. Find the Maximum Likelihood estimator of θ in the pdf of the exponential distribution. CO1 [K5]

23. A simple sample of heights of 6400 Englishmen has a mean of 170 cm and a S.D. of 6.4 cm, while a simple sample of heights of 1600 Americans has a mean of 172 cm CO2 [K5]

and a S.D. of 6.3 cm. Do the data indicate that Americans are, on the average, taller than Englishmen?

24. Samples of two types of electric light bulbs were tested for length of life and the following data were obtained CO2 [K5]

	Type I	Type II
Sample size	8	7
Sample mean	1234 hours	1036 hours
Sample S.D.	36 hours	40 hours

Is the difference in the means sufficient to warrant that type I is superior to type II regarding length of life?

25. Fit a straight line to the data given below. Also estimate the value of y at $x = 2.5$ CO3 [K4]

x:	0	1	2	3	4
y:	1	1.8	3.3	4.5	6.3

26. In a tri-variate distribution $\sigma_1 = 2, \sigma_2 = 3, \sigma_3 = 3, r_{12} = 0.7, r_{23} = r_{31} = 0.5.$ CO3 [K3]

Find the value of $b_{12.3}$.

27. A random sample is selected from each of 3 makes of ropes and their breaking strength are measured with the following results. CO4 [K4]

I	70	72	75	80	83		
II	100	110	108	112	113	120	107
III	60	65	57	84	87	73	

Test whether the breaking strength of the ropes differ significantly.

28. The following data represents the number of units of productions per day turned out by different workers using four different types of machines. CO4 [K5]

		Machine Type			
		A	B	C	D
	1	44	38	47	36
Workers	2	46	40	52	43
	3	34	36	44	32
	4	43	38	46	33
	5	38	42	49	39

Test whether the 5 men differ with respect to mean productivity and test whether the mean productivity is the same for the four different machine types.

29. Find the covariance matrix of the two random variables X_1 & X_2 given that their joint probability mass function is CO5 [K3]

$X_1 \backslash X_2$	0	1	$P(x_1)$
-1	0.24	0.06	0.3
0	0.16	0.14	0.3
1	0.40	0	0.4
$P(X_2)$	0.8	0.2	1

30. Let X_1 *and* X_2 have the joint pmf $P(x_1, x_2) = \frac{x_1+2x_2}{18}, x_1 = 1,2\ x_2 = 1,2.$ CO5 [K4]

Find (i) Marginal pmf 's of x_1 &x_2. (ii) Mean Vector

Answer any TWO Questions

PART D (2 x 10 = 20 Marks)

31. Two random samples gave the following results: 10 CO2 [K5]

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.

32. Analyze the variance in the Latin square of yields (in kgs.) of paddy where P, Q, R, S denote the denote the different methods of cultivation. 10 CO3 [K4]

S122	P121	R123	Q122
Q124	R123	P122	S125
P120	Q119	S120	R121
R122	S123	Q121	P122

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

33. Compute the principal component analysis to the following matrix 10 CO5 [K5]

$$A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$$

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