Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 30917

M.E./M.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

First Semester

Construction Engineering and Management

MA 4159 — STATISTICAL METHODS FOR ENGINEERS

(Use of statistical tables may be permitted)

(Common to M.E. Environmental Engineering/ M.E. Industrial Engineering/
M.E. Infrastructure Engineering and Management/
M.Tech. Remote Sensing and GIS)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. If T is an unbiased estimator for θ. show that T^2 is a biased estimator for θ^2.
2. Define 'efficiency of an estimator'.
3. A coin is thrown 400 times and is found to result in "Head" 245 times. Test whether the coin is a fair one.
4. State the important properties of the t-distribution.
5. If X, Y are independent random variable's prove that $r_{XY} = 0$. Is the converse true?
6. Prove that the correlation coefficient is the geometric mean of the regression coefficients.
7. What is the aim of the design of experiments?
8. Name three basic designs of experiment.
9. How to partition the sample mean vector and covariance matrix?
10. What is the relation between the principal component and covariance matrix?

PART B — (5 × 13 = 65 marks)

11. (a) If T_1 is an MVUE of $\gamma(\theta)$ and T_2 is any other unbiased estimator of $\gamma(\theta)$ with efficiency e < 1, then prove that no unbiased linear combination T_1 and T_2 can be an MVUE of $\gamma(\theta)$

Or

(b) In random sampling from normal population $N(\mu, \sigma^2)$. Find the maximum likelihood estimators for

(i) μ when σ^2 is known and

(ii) the simultaneous estimation of μ and σ^2.

12. (a) Before an increase in excise duty on tea, 800 people out of a sample of 1000 were consumers of tea. After the increase in duty, 800 people were consumers of tea in a sample of 1200 persons. Find whether there is significant decrease in the consumption of tea after the increase in duty.

Or

(b)

Day :	Mon	Tues	Wed	Thur	Fri	Sat
No.of accidents	15	19	13	12	16	15

The table above gives the number of air-craft accidents that occurred during the various days of a week. Test whether the accidents are uniformly distributed over the week.

13. (a) Find the coefficient of correlation between X and Y using the following data:

X :	5	10	15	20	25
Y :	16	19	23	26	30

Or

(b) In a particular destroyed laboratory record of an analysis of correlation data, the following results only are legible: Variance of X = 1. The regression equations are $3x + 2y = 26$ and $6x + y = 31$. What were (i) the mean values of X and Y? (ii) the standard deviation of Y? and (iii) the correlation coefficient between X and Y?

14. (a)

	Treatement			
Doctor	1	2	3	4
A	10	14	19	20
B	11	15	17	21
C	9	12	16	19
D	8	13	17	20

Four doctors each test four treatments for a certain disease and observe the number of days each patient takes to recover. The results are mentioned above (recovery time in days). Discuss the difference between (a) doctors and (b) treatments at 5% level of significance.

Or

(b) Determine whether there is significant difference in the durability of 3 makes of computers, samples of size 5 are selected from each make and the frequency of repair during the first year of purchase is observed. The results are as follows:

Makes		
A	B	C
5	8	7
6	10	3
8	11	5
9	12	4
7	4	1

In view of the above data, what conclusion can you draw?

15. (a) Find the covariance martix for the two random variables X_1 and X_2.

x_1	−1	0	1
$P(x_1)$	.3	.3	.4

x_2	0	1
$P(x_2)$	.8	.2

Or

(b) Geneticists are often concerned with the inheritance of characteristics that can be measured several times during an animal lifetime. Body weight (in grams) for n = litters. $\overline{X}'$ = [39.88, 45.08, 48.11, 49.95] and

$$R = \begin{bmatrix} 1 & .7501 & .6329 & .6363 \\ .7501 & 1 & .6925 & .7386 \\ .6329 & .6925 & 1 & .6625 \\ .6363 & .7386 & .6625 & 1 \end{bmatrix}$$

Find the first principal component.

PART C — (1 × 15 = 15 marks)

16. (a) Test made on the breaking strength of 10 pieces of a metal wire gave the results: 578, 572, 570, 568, 572, 570, 570, 572, 596 and 584 kg. Test if the mean breaking strength of the wire can be assumed as 577kg.

Or

(b) The following data resulted from an experiment to compare three burners B_1, B_2 and B_3. A Latin square design was used as the tests were made on 3 engines and were spread over 3 days.

	Engine 1	Engine 2	Engine 3
Day 1	$B_1 - 16$	$B_1 - 17$	$B_1 - 20$
Day 2	$B_2 - 16$	$B_2 - 21$	$B_2 - 15$
Day 3	$B_3 - 15$	$B_3 - 12$	$B_3 - 13$

Test the hypothesis that there is no differences between the burners.