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Question Paper Code : 10863

M.E./M.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

First Semester

Construction Engineering and Management

MA 5165 — STATISTICAL METHODS FOR ENGINEERS

(Common to M.E. Environmental Engineering/M.Tech. Remote Sensing)

(Regulation 2017)

Time : Three hours

Maximum : 100 marks

Statistical tables are permitted.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define and distinguish between estimator and estimate.
2. How efficiency is identified in the criteria of estimation?
3. What are the two types of errors in testing of hypothesis? Define them.
4. What are the assumptions underlying the *t*-test?
5. Define partial correlation with an example.
6. What are the properties of regression coefficient?
7. Write down the linear model of analysis of variance of one way classification.
8. Define factor and level in factorial design with an example.
9. Give an example of a tri-variate data in engineering applications.
10. Give an example of a covariance matrix and identify the variances in it.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Define unbiasedness in estimators. Show that in sampling from a population with mean μ and variance σ^2 , sample mean \bar{x} is an unbiased estimator of μ , but the sample variance s^2 is not unbiased to σ^2 . (9)

- (ii) A random sample of n observations by drawn from $N(\mu, 1)$. Show

that the statistic $t = \frac{\sum_{i=1}^n x_i^2}{n}$ is an unbiased estimator of $\mu^2 + 1$. (4)

Or

- (b) (i) A random sample of five observations X_1, X_2, X_3, X_4, X_5 be drawn from a normal population with unknown mean μ . Let $t_1 = \bar{X}$, $t_2 = \frac{X_1 + X_2}{2} + X_3$ and $t_3 = \frac{2X_1 + X_2}{3}$. From the above the statistics, which are unbiased to μ ? And which one is the best among three?

- (ii) If X_1, X_2, \dots, X_n are the values of a random sample from an exponential population, find the maximum likelihood estimator of its parameter θ .

12. (a) (i) Explain the test procedure for testing the equality of two means in large samples with an example in industrial applications. (6)

- (ii) In a manufacturing industry, there a two independent process producing the same item of steel roads. The average length in a sample of 200 items by process-A is found to be 120 cms with a standard deviation of 10 cms. By process-B based on a sample of 300 items, the average length is 125 cms with a standard deviation of 15 cms. Test whether the difference between the processes are significant by their average at 5% level of significance. (7)

Or

- (b) (i) Explain the steps involved in testing the $r \times c$ contingency table using chi-square test with its practical applications. (6)

- (ii) The following table shows the flooring type of their houses and the income level of a sample of 200 households are given below. Test whether the two attributes are independent or not at 5% level of significance. (7)

Income Level	Floor type		
	Cement	Tiles	Granite
Low	18	7	5
Middle	10	43	17
High	12	30	58

13. (a) The following bivariate data shows the length, X (in inches) and weight, Y (in kgs) of a sample of 10 iron rods.

X : 12 18 24 20 17 13 20 24 32 16

Y : 4 7 12 10 13 15 13 14 20 12

- (i) Obtain the Pearson's correlation coefficient of X and interpret the result
(ii) Estimate the weight (Y) of rod when the length is 25 inches
(iii) Predict the length (X) of rod when the weight is 18 kgs. (13)

Or

- (b) (i) Discuss in detail about multiple and partial correlation with their uses. (6)
(ii) The simple correlation coefficient of a sample of 20 manufactured products whose length (X_1), weight (X_2) and life (X_3) are as follows :

$$r_{12} = 0.77 \text{ (i.e., correlation between } X_1 \text{ and } X_2)$$

$$r_{13} = 0.72 \text{ and } r_{23} = 0.52$$

Find the partial correlation coefficient $r_{12.3}$ and $r_{13.2}$ and also find the multiple correlation coefficient $R_{1.23}$. (7)

14. (a) A set of data involving four "tropical feed stuffs A, B, C, D " tried on 20 chicks is given below. All the 20 chicks are treated alike in all respects except the feeding treatments and each feeding treatment is given to 5 chicks. Analyse the data using CRD layout and interpret the result. (13)

Feed	Gain in weight				
A	55	49	42	21	52
B	61	112	30	89	63
C	42	97	81	95	92
D	169	137	169	85	154

Or

- (b) An experiment was carried out to determine the effect concrete mixture in a construction. The mixture type are as follows. A : Normal N : Medium C : High D : Strong. This type is used in concrete beams as follows : (13)

Height \ Length	I	II	III	IV
	I	D 29.1	B 18.9	C 29.4
II	C 16.4	A 10.2	D 21.2	B 19.1
III	A 5.4	D 38.8	B 24	C 37
IV	B 24.9	C 41.7	A 9.5	D 28.9

Analyse the data of LSD layout and draw your results.

15. (a) A random sample of 10 observations be drawn from a trivariate normal population whose data is as follows :
- X_1 : 12 15 17 18 20 16 17 14 13 10
 X_2 : 20 23 21 24 28 23 26 27 20 19
 X_3 : 31 28 32 34 28 27 24 20 32 30
- (i) Obtain the sample mean vector
(ii) Calculate the covariance matrix
(iii) Obtain the sample correlation matrix. (13)

Or

- (b) (i) Discuss in detail about the principal components analysis with its applications. (6)
(ii) Write down the properties of multivariate normal distribution. (7)

PART C — (1 × 15 = 15 marks)

16. (a) To compare two kinds of bumper guards, six of each kind were mounted on a certain make of compact car. Then, each car was run into a concrete wall and the following are the costs of the repairs.
- Bumper guard 1 : 127 168 143 165 122 139
Bumper guard 2 : 154 135 132 171 153 149

Use 0.01 level of significance to test whether the difference in means of the two samples are significant.

Or

- (b) Describe the uses and applications of Correlation and Regression analysis in industrial studies.