

2020

STATISTICS — HONOURS

Sixth Paper

(Group - A)

Full Marks : 50

*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.*Answer **any two** questions from **question nos. 1 to 8** and **any one** question from **question nos. 9 to 12**.

1. Give a real life example of designing an experiment mentioning clearly your choice of treatments, experimental units, the method of allocation of treatments over experimental units and the appropriate model for analysis. 10
2. With reference to a Randomized Block Design (RBD), define block contrast and treatment contrast. Show that they are mutually orthogonal. 10
3. Give the model with assumptions of a Latin square design. Suppose in a Latin square design the MSE is larger than mean sum of squares due to rows (MSR) but is significantly smaller than that due to columns (MSC). What would be your recommendations and why? 10
4. Derive an expression for the efficiency of LSD with that of a comparable RBD. 10
5. In a $(2^5, 2^2)$ factorial experiment give the layout of a single replicate confounding the factorial effects ABC and DE. 10
6. With reference to a $(2^n, 2^2)$ factorial design, prove that if any two factorial effects are confounded, then their generalized interaction effect is also confounded. 10
7. Write a short note on different types of biases in survey sampling. 10
8. Consider a fictitious population comprising of 3 units namely U_1, U_2 and U_3 with variate values Y_1, Y_2 and Y_3 respectively. Sample of 2 units is selected to estimate the population mean. Two estimators are proposed. Under what condition would you recommend the estimator T? 10

Sample (S)	T	T*
First and second unit	$(Y_1+Y_2)/2$	$(Y_1+Y_2)/2$
Second and third unit	$(Y_2/2)+Y_3/3$	$(Y_2+Y_3)/2$
First and third unit	$Y_1/2+2Y_3/3$	$(Y_1+Y_3)/2$

9. (a) Derive an estimate of the missing value of a Latin Square design with a single missing observation.
- (b) With reference to a LSD of order v , define an elementary treatment contrast. Compute an estimate of the average variance of the estimates of all possible elementary treatment contrasts involving the missing value. 14+16

Please Turn Over

10. (a) With reference to an ANCOVA model in RBD, give a point estimate of the regression coefficient. Also set up a 100 (1 – α)% confidence interval for the true regression coefficient.

(b) Suppose an experiment is conducted over b blocks with two treatments A and B each at 2 levels.

PLAN 1: All possible level combinations are allocated randomly over the plots of a block. Fresh randomization is done for each of the b blocks.

PLAN 2: The levels of ‘A’ are first randomized over the plots of a block. Levels of B are then randomly allocated within each plot. It is repeated for b blocks.

PLAN 3: A block is divided into as many rows and columns as the levels of A and B respectively. The levels of A are randomized over the rows of a block and the levels of B are randomized over the columns of a block. Fresh randomization is done for each of the b blocks.

Identify the experimental designs in each case. Analyse the data in **PLAN 1** for testing the significance of the treatment ‘A’. 10+20

11. (a) Consider a finite population of size N, in which M individuals are smokers. Based on a simple random sample of size n drawn without replacement from the population, obtain an unbiased estimator of the proportion of smokers in the population. Derive an unbiased estimator of the variance of the estimator.

(b) A simple random sample of size 3 is drawn from a population of size N with replacement. Show that the probabilities that the sample contains 1, 2 and 3 different units are given by,

$$P_1 = \frac{1}{N^2}; P_2 = \frac{3(N-1)}{N^2}; P_3 = \frac{(N-1)(N-2)}{N^2} \quad 18+12$$

12. (a) A simple random sample of n households was drawn without replacement from a city containing N households. The number of persons in each of the selected households was then noted. Obtain an unbiased estimator of the total number of persons in the city. Derive the standard error of the estimator.

(b) Discuss briefly the steps involved in the planning and execution of a survey. 18+12
