

**M. SC. (APPLIED STATISTICS)
(MSCAST)**

Term-End Examination

December, 2024

**MST-020 : SURVEY SAMPLING AND DESIGN OF
EXPERIMENTS-II**

Time : 3 Hours

Maximum Marks : 50

Note : (i) *Question No. 1 is compulsory.*

(ii) *Attempt any **four** questions from the remaining question nos. 2 to 6.*

(iii) *Use of Scientific calculator (non-programmable) is allowed.*

(iv) *Symbols have their usual meanings.*

1. State whether the following statements are **True** or **False**. Give reasons in support of your answers :

$$5 \times 2 = 10$$

(a) The estimator $\hat{R}$ becomes approximately unbiased for R when R takes value equal to β .

- (b) The product estimator $\hat{\bar{Y}}_p$ over sample mean estimator $\bar{y}$ when ρ takes value in the range of $\left(-\frac{1}{2}, 0\right)$.
- (c) In two-stage sampling, if $m = M$, then two-stage sampling reduces to the stratified random sampling.
- (d) Factorial experiment in which the number of levels are different for each of n factors, is symmetrical factorial experiment.
- (e) In a Balanced Incomplete Block Design, the relation $r(\theta - 1) = \lambda(k - 1)$ holds, where θ is number of treatments, k is block size, r is number of replications and λ is a fixed integer.
2. (a) Obtain the expression for measuring the variability of the Ratio estimator of the Population Mean. 6
- (b) In a population of size 500, the population mean of the auxiliary variable X was observed to be 10. On the basis of a sample

of size 20, the following sample values were obtained : 6

$$\bar{y} = 19.55, \bar{x} = 18.2, s_y^2 = 50.79, s_x^2 = 56.16, s_{xy} = 52.57, \hat{\rho} = 0.98.$$

Obtain the value of Ratio estimate of Population Mean. Also find the estimate of the MSE ($\hat{\bar{Y}}_R$). 4

3. (a) Obtain the expression of sampling variance of the estimator of population mean in cluster sampling with equal clusters in size. 5
- (b) The age of dwellers (in years) residing in 8 households in a building are given as follows :

1	22, 36, 56, 14, 05	5	14, 19, 58, 38
2	71, 66, 40	6	08, 45, 22
3	45, 33, 22, 17	7	22, 17, 12, 28
4	44, 40, 56, 22, 13, 10	8	37, 33, 34, 06, 13, 05

Selecting a random sample of size 3 households, find an estimate of the average age of dwellers in the building using the values of selected cluster means. 5

4. (a) What is a 3^3 -factorial experiment ? How many treatment combinations would be there in such an experiment ? List all the treatment combinations in the form of a table. 5
- (b) Classify the treatment combinations of 3^3 -factorial experiment into : 5
 - (i) Main effects of the factors.
 - (ii) 2-factor interaction effects of factors.
 - (iii) 3-factor interaction effects of factors.
5. Give the concept of 'Partial Confounding'. How is it different from the 'Complete Confounding' ? On the basis of 2^3 -factorial design with four replicates, how would you partially confound the 3 two-factor interactions and the three-factor interaction effects ? 10
6. (a) What is the Randomised Response Technique (RRT) and under what situations this technique is used for getting the truthful answer of the respondents ? How is this technique comparable with Direct Response Query (DRQ) ? 6
- (b) Explain the following terms : 4
 - (i) Contrasts
 - (ii) Orthogonal Contrasts in detail

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