

M. SC. (APPLIED STATISTICS)
(MSCAST)

Term-End Examination

December, 2025

**MST-013 : SURVEY SAMPLING AND DESIGN
OF EXPERIMENTS—I**

Time : 3 Hours

Maximum Marks : 50

Note : *Question No. 1 is compulsory. Attempt any **four** questions from the remaining Question Nos. 2 to 6. Use of scientific calculator (non-programmable) is allowed. Symbols have their usual meanings.*

1. State whether the following statements are True or False. Give reasons in support of your answer : 5×2=10
 - (a) If strata are heterogeneous within themselves, then Stratified Random

Sampling scheme provides estimates with greater precision.

- (b) The total number of all possible samples of size 2 using SRS without replacement scheme from a population of size 5 is 25.
 - (c) If the Sum of Squares of Errors in a Two-way Analysis of Variance having 4 rows and 5 columns is given as 48, the Mean Sum of Squares will be 4 for the same.
 - (d) If there is one missing value in a Latin Square Design with 4 treatments, the error degrees of freedom will be 5.
 - (e) When population size N is not a multiple of sample size n , Linear Systematic Sampling is appropriate.
2. Consider a population of 6 units with values : 1, 2, 3, 4, 5 and 6. Write down all possible samples of size 2, drawn by using Simple Random Sampling Without Replacement scheme and verify that sample

mean is an unbiased estimator of the population mean. Also calculate the sample variance and verify that $\text{Var}_{\text{WR}}^{(\bar{y})} > \text{Var}_{\text{WOR}}^{(\bar{y})}$.

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3. One thousand plots in a particular state of India were stratified according to their sizes. The number of plots (N_i), mean production of wheat per plot ($\bar{y}_i$) and Standard Deviation of production of wheat per plot (S_i) for each stratum are given in the following table :

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Stratum	N_i	$\bar{y}_i$	S_i
1	300	15	8
2	500	16	12
3	200	24	18

Then :

- (i) Determine the sample size drawn from each stratum for drawing a sample of 100 plots under Proportional Allocation Scheme without replacement.

- (ii) Also, estimate the sample mean and the variance of sample mean under given sampling scheme.
4. A researcher wants to test four diets A, B, C and D on growth rate in mice. These animals are divided into 3 groups according to their weights. Heaviest 4, next 4 and lightest 4 are put in Block-I, Block-II and Block-III, respectively. Within each block, one of the diets is given at random to the animals. After 15 days, increase in weight (in mg) is noted, which are given in the following table :

Block	Diet			
	A	B	C	D
I	12	8	6	5
II	15	12	9	6
III	14	10	8	5

Perform a Two-way Analysis of Variance to test whether the data indicate any significant difference (i) between the four diets, and (ii) due to different blocks.

5. In an experiment, the yield (in 1000 kg) of 4 varieties of wheat (A, B, C and D) corresponding to 4 different fertilizers and 4 different years, are measured. The data are given in the following table :

Year Fertilizer	2017	2018	2019	2020
1	(A) 70	(B) 75	(C) 68	(D) 81
2	(D) 66	(A) 59	(B) 55	(C) 63
3	(C) 59	(D) 66	(A) 39	(B) 42
4	(B) 41	(C) 57	(D) 39	(A) 55

At $\alpha = 0.05$, test the hypothesis that there is no significant difference among the (i) average yields of the four varieties of wheat, (ii) fertilizers, and (iii) years. 10

6. (a) The information regarding production of wheat (in 1000 kg) in 25 districts are collected, for a particular season. Select

a Systematic Random Sample of 7 units from the given data as follows :

23, 20, 30, 37, 76, 36, 13, 36, 16, 58, 53, 83, 10, 15, 13, 17, 12, 16, 17, 21, 20, 18, 61, 31 and 71

Also calculate mean and variance of the selected sample. 7

- (b) Explain the main principles of design of experiments in brief. 3

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