

No. of Printed Pages : 5 **MSTL–013(Set-II)**

M. SC. (APPLIED STATISTICS)
(MSCAST)

Term-End Practical Examination

December, 2024

MSTL–013(Set-II) : STATISTICAL COMPUTING
USING R—III

Time : $2\frac{1}{2}$ Hours

Maximum Marks : 50

Note : (i) Attempt any *two* questions.

(ii) Solve the questions using R-software and create a script file.

(iii) Mention necessary steps, hypotheses interpretation, etc.

(iv) Symbols have their usual meanings.

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1. A population consisting of 6 clusters, each containing 6 units. The value of the study variable Y, observed for each unit within each cluster, are given as follows : 7+6+6+6

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Cluster	Values of Y
1	2, 4, 6, 1, 3, 5
2	2, 5, 3, 4, 7, 4
3	4, 3, 6, 2, 1, 5
4	3, 2, 5, 1, 6, 4
5	2, 4, 6, 8, 3, 5
6	4, 1, 2, 7, 5, 3

A random sample of three clusters was selected from the population (first-stage sampling) and 3 units were randomly chosen from each of the selected clusters (second-stage sampling). The selected clusters and corresponding units are as follows :

- (i) Cluster 2 : The Y-values 2, 7 and 3 were selected.
- (ii) Cluster 4 : The Y-values 6, 3 and 1 were selected.
- (iii) Cluster 6 : The Y-values 7, 4 and 3 were selected.

Answer the following questions :

- (a) Write R-code to define the population data as a list of clusters.
- (b) Using R, extract the selected clusters (2, 4 and 6) from the population.

- (c) Extract the second-stage samples (specified Y-values) from the selected clusters.
- (d) Calculate the sample mean of Y for the second-stage sample and print the results.
2. (a) An economist believes that the median starting salary for a computer programmer in a certain city is ₹ 12,000. To verify this claim, 12 computer programmers with similar backgrounds who recently got the jobs were randomly selected. Their starting salaries (in ₹) were as follows :

Salaries (in ₹)				
18,000	15,000	10,000	13,000	12,000
10,000	16,000	9,000	10,000	9,000

Write an R-script to test the economist belief using the sign test at 1% level of significance.

- (b) The following are the grades in Mathematics of High School students

taken randomly from two schools : School-I
and School-II :

Grades	No. of Students in School-I	No. of Students in School-II
A	2	1
A ⁺	2	1
B	4	2
B ⁺	6	3
C	3	4
C ⁺	3	2
D	0	4
D ⁺	0	3

Write an R-code to apply Kolmogorov-Smirnov test to examine the performance in Mathematics of High School students in School-I and School-II is same at 5% level of significance.

- (c) Generate 50 random numbers from a Poisson distribution with $\lambda = 3.5$ using R. Match the result using the direct function of R.

10+7+8

3. (a) Let :

$$x = \begin{bmatrix} 1 \\ -2 \\ 3 \end{bmatrix} \text{ and } A = \begin{bmatrix} 2 & 1 & 0 \\ 1 & 3 & 1 \\ 0 & 1 & 4 \end{bmatrix}$$

Write R-script to compute the quadratic form $Q(x) = x'Ax$.

(b) Given matrix :

$$A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \\ 1 & 0 \end{bmatrix}$$

Write a R-script to apply the Gram-Schmidt process to make the vectors orthogonal, then normalize each resulting vector to create an orthonormal matrix.

10+15

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