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

M. SC. (APPLIED STATISTICS)

(MSCAST)

Term-End Practical Examination

December, 2024

MSTL–013(Set-I) : 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, hypothesis 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 Z, observed for each unit within each cluster, are given as follows :

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

A random sample of 3 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 3 : The Z-values 6, 4 and 5 were selected.

(ii) Cluster 4 : The Z-values 4, 6 and 2 were selected.

(iii) Cluster 5 : The Z-values 7, 5 and 4 were selected.

Answer the following questions : 7+6+6+6

(a) Write R-code to define the population data as a list of clusters.

(b) Using R, extract the selected clusters (3, 4 and 5) from the population.

(c) Extract the second-stage samples specified (Z-values) from the selected clusters.

(d) Calculate the sample mean and sample variance of Z for the second-stage sample and print the results.

2. (a) A machine produces several defective items per day. To check the randomness of the defective items, a sample of defective items produced per day over a period of 20 days is taken and found the following results :

13	17	14	20	18	17	16	14	19	21
18	20	17	13	14	19	20	15	19	17

Write R-code to test that the machine produced defective items in random order at 5% level of significance.

(b) A researcher was interested in correlating ranks in languages and ranks in Mathematics. The collected data on 12 students. Their ranks are given below :

Students	**Rank in Language**	**Rank in Science**
A	3	11
B	2	8

C	5	6
D	6	9
E	7	12
F	9	1
G	10	2
H	8	5
I	1	10
J	4	7
K	12	3
L	11	4

Write an R-script to apply Kendall's Tau test to interpret the output.

(c) Generate 20 random numbers from negative binomial distribution X ~ Neg Bin ($r = 4$, $p = 0.3$) using R.

(i) Calculate sample mean and sample variance of the generated random numbers.

(ii) Also compare the results obtained in part (i) with the results obtained using the direct function of R. 10+7+8

3. (a) Write an R-script to compute the eigen decomposition for the given matrix : 15

$$D = \begin{bmatrix} 2.3 & 1.2 & 0.9 \\ 1.2 & 2.0 & 1.1 \\ 0.9 & 1.1 & 1.8 \end{bmatrix}.$$

(b) Define the matrix A and compute the singular value decomposition in R for the following matrix : 10

$$A = \begin{bmatrix} 3 & 1 \\ 1 & 3 \end{bmatrix}$$

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