No. of Printed Pages : 6 **MSTL–011(Set-I)**

M. SC. (APPLIED STATISTICS)
[M. SC. (AST)]
Term-End Practical Examination
June, 2025

MSTL–011(Set-I) : STATISTICAL COMPUTING USING R-I

Time : $2\frac{1}{2}$ *Hours* *Maximum Marks : 50*

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

(ii) Solve the questions using R software.

(iii) Symbols have their meanings.

(iv) Mention necessary formulae, steps, interpretations etc.

1. (a) Evaluate $\int_0^1 \int_0^1 \frac{1}{\sqrt{1-x^2}\sqrt{1-y^2}} dxdy$. 5

(b) Plot the distribution function of Binomial distribution with the following parameters in a single plot only using different colours. Give suitable label to the x-axis and y-axis : 5

(i) $n = 50, p = 0.25$

(ii) $n = 50, p = 0.50$

(iii) $n = 10, p = 0.75$

Also, compute 25th, 50th, 75th and 100th quantiles from Binomial distribution with parameters $n = 100, p = 0.75$.

(c) Given table presents the summary of data for the complete census of all the 2468 farms in a region. The farms were stratified according to farms-size (in acres) into six strata, as given in column 2 of the table. The number of farms in the different strata Ni, are given in the column 3. The population values of the strata means for the area under wheat $\left(\overline{X}_i\right)$ and those of strata standard deviations $\left(S_i\right)$ are given in the subsequent columns :

Stratum No.	Farm size (in Acres)	N_i	$\overline{X}_i$	S_i
1	0—80	494	12.1	9.1
2	81—160	561	14.3	8.3
3	161—240	392	24.3	5.1
4	241—320	564	14.5	6.8
5	321—400	269	4.2	4.3
6	401 and above	188	53.0	5.2

Perform the following :

(i) Create a data frame for the above data set.

(ii) Select a stratified random sample of size 100 by using proportional and Neyman's allocation.

(iii) Append the computed sample size in part (ii) with the data frame of part (i).

(iv) Compute Variance $\overline{X}_{st}$ in both cases.

(v) Compute gain in efficiency in case of proportional allocation and Neyman's allocation with respect to simple random sampling.

2. (a) Create a graph of the following function : 5

$$f(x) = \begin{cases} 0 & ; \quad \text{for } x < -2 \\ 2/4 & ; \quad \text{for } -2 \le x < 0 \\ 3/4 & ; \quad \text{for } 0 \le x < 4 \\ 1 & ; \quad \text{for } x \ge 4 \end{cases}$$

(b) Consider the results in the given table for an experiment involving 6 treatments in 4 randomized blocks : 10

Treatments Blocks	A	B	C	D	E	F
1	24.7	20.6	27.7	16.2	16.2	24.9
2	27.8	28.8	22.7	15.0	17.0	22.5
3	38.5	39.5	36.8	19.6	15.4	26.3
4	28.5	31.0	34.9	14.1	17.7	22.6
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Perform the following tasks using formulae and verify these computed results using aov( ) function :

(i) Identify the design.

(ii) Create a .txt file for saving the above data.

(iii) Test whether the treatments differ significantly.

(iv) Perform the pairwise comparison (if required).

(c) Given data is of manufacturing floppy discs with specified thickness between 0.009″ and 0.018″. 5 samples of size 7 each are drawn every hour and their

thickness in units (1 unit = 0.001″) are noted down and given in the following table :

Sample No.	Thickness of floppy discs (in 1 unit)						
1	16	14	16	14	11	15	15
2	20	25	16	18	25	16	27
3	17	14	14	25	10	11	19
4	18	14	13	14	09	14	12
5	12	14	17	10	14	15	14

for the above data, compute the control limits for the $\overline{X}$ chart and R-chart using formulae as well as quality control package. Also, check whether the process is under control or not. If not, then compute the revised control limits using both the methods. 10

3. (a) Create graphs of the following two functions using plot( ) function and curve( ) function :

(i) $y = 3x^5 - 40x^3 + 3x - 20$ in range $-2 < x < 0$.

(ii) $y = \left(\log x\right)^3$ in the range 0.2 to 1.

Also comment on convexity/concavity of these curves. 10

(b) The failure density function of a random variable T is given by : 10

$$f(t) = \begin{cases} 0.05e^{-0.05t} & ; \quad t \geq 0 \\ 0 & ; \quad \text{otherwise} \end{cases}$$

Plot the failure density function, reliability function, cumulative failure distribution function and hazard rate function of T. Also compute (i) reliability of the component for a 15 hours mission time and (ii) mean time to failure.

(c) Use ratio to trend method to determine the quarterly seasonal indices for the following quarterly data of sales of cars : 10

Year	Q1	Q2	Q3	Q4
2018	11	26	22	41
2019	12	36	30	58
2020	15	52	34	75
2021	20	58	44	79
2022	24	68	47	82

Also compute and plot the deseasonalised data along with the original time series data.

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