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MST-005

**POST GRADUATE DIPLOMA IN
APPLIED STATISTICS /
CERTIFICATE IN CONDITION
MONITORING
(PGDAST/CCOMO)**

Term-End Examination

June, 2026

MST-005 : STATISTICAL TECHNIQUES

Time : 3 Hours

Maximum Marks : 50

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

(ii) *Attempt any **four** questions from the remaining question No. 2 to 7.*

(iii) *Use of Formulae and Statistical Tables Booklet for PGDAST is allowed.*

(iv) *Use of scientific (non-programmable) calculator is allowed.*

(v) *Symbols have their usual meanings.*

1. State whether the following statements are True or False. Give reasons in support of your answers. 5×2=10

(a) The probability of selection of units from a population using SRSWOR remains same.

(b) If linear congruential generator is :

$$Z_i = (245 Z_{i-1} + 752) \bmod (1000)$$

where $Z_0 = 145$

then first three random numbers will be

$$Z_1 = 277, Z_2 = 617 \text{ and } Z_3 = 917.$$

(c) In an examination hall, there are 10 rows and each row has 20 students. A research scholar selects 3 rows randomly and then includes all students of these selected rows in his study. Then the research scholar is using the two-stage sampling technique.

- (d) The CRD is based on all three principles, i.e., randomization, replication and local control.
- (e) If the sum of squares of errors in a two-way ANOVA, having 4 rows and 3 columns is 45, then the mean sum of squares will be 7.5.
2. (a) The marks of 25 students in MST-005 course are given as follows :
- 23, 20, 30, 37, 40, 32, 38, 42, 48
36, 05, 08, 15, 45, 40, 25, 17, 06
42, 30, 32, 24, 30, 12, 40.
- Select all possible systematic samples of size 7 using linear systematic sampling. What problem will you face using this sampling ? How to resolve it ? After resolving the problem, again draw first 4 samples. 6
- (b) Describe the two stage sampling with an example. 4

3. A sample of 50 students of PGDAST is to be drawn from two study centres, namely, A and B. The following information about the centres is given :

Study Centre	No. of PGDAST students	Average Marks	Mean Squares
A	150	70	10
B	100	75	5

How many students are selected using proportional and Neyman's allocation methods. Also, calculate the variance of sample mean under both the allocation methods. Compare these with variance under SRSWOR and show that :

$$\text{Var}(\bar{x})_{\text{SRSWOR}} \geq \text{Var}(\bar{x})_{\text{prop}} \geq \bar{x}_{\text{Ney}}$$

4. (a) A rental car company wants to investigate whether the type of car rented affects the length of the rental period. An experiment is run for one week at a particular location and 7 rental contracts are selected at random for each car type. The obtained results are shown in the following table :

Type of Car	Observations (in months)						
SUV	3	5	3	7	6	5	3
Hatchback	1	3	4	7	5	6	3
Sedan	4	1	3	5	7	1	2
Sports	3	5	7	5	10	3	4

Is there any evidence to support a claim that the type of car rented affects the length of the rental contract at 5% level of significance

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- (b) Explain fixed and random effects models with examples.

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5. An industrial engineer is investigating the effect of four assembly methods (A, B, C and D) on the assembly time for a laptop. Four operators are selected for the study and observed data are given as follows :

Order of Assembly	Operator			
	1	2	3	4
1	10(C)	14(D)	7(A)	8(B)
2	7(B)	18(C)	11(D)	8(A)
3	5(A)	10(B)	11(C)	9(D)
4	10(D)	10(A)	12(B)	14(C)

Test at 5% level of significance, whether the effect of the :

- (i) Orders of assembly
- (ii) Operators, and
- (iii) Methods of assembly

are significantly different under the normality assumption.

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6. (i) Generate ten random numbers from $U(0, 1)$ using middle square method taking first number as 8737.
- (ii) A student tosses an unbiased coin ten times. Using the random numbers generated in part (i), obtain a sequence of heads and tails.
- (iii) Using the sequence of heads and tails generated in part (ii) obtain the number of heads assuming two games of 5 trials. 10
7. (a) A student of PGDAST programme generates 40 $U(0, 1)$ random numbers using LCG and then classified the generated numbers into 5 class as follows :

Class	Frequency
0–0.2	5
0.2–0.4	14
0.4–0.6	7
0.6–0.8	4
0.8–1.0	10

Apply Chi-square goodness of fit test to test that the generated random numbers follows $U(0, 1)$ distribution ($\alpha = 0.05$). 6

(b) Discuss principles of design of experiments. 4

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