

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

Term-End Examination

December, 2022

MST-005 : STATISTICAL TECHNIQUES

Time : 3 hours

Maximum Marks : 50

Note : *Question no. 1 is **compulsory**. Attempt any **four** questions from the remaining questions no. 2 to 7. Use of scientific (Non-programmable) calculator is allowed. Use of Formulae and Statistical Tables Booklet for PGDAST is allowed. Symbols have their usual meanings.*

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

(a) In cluster sampling, $s_w^2 > s_b^2$, where s_w^2 represents the variance within clusters and s_b^2 between clusters.

(b) Consecutive 3 random numbers starting from 8937 by 'middle square method' are 8937, 8699 and 6726.

- (c) If the sum of squares of errors in a two-way ANOVA having 4 rows and 5 columns is given as 48, the mean sum of squares will be 4 for the same.
- (d) If we draw all possible samples of size 2 from the population $\{2, 3, 4\}$, then $E(\bar{x}) = \bar{X}$.
- (e) In 2^3 factorial design, the number of factors are two each at three levels.

2. The table given below presents the summary of data of complete census of all the 450 farms of wheat in a region. The farms were stratified according to farm size (in acres) into 2 strata. The population values of strata means (\bar{X}_i) and standard deviation (σ_i) for the area under wheat are given as follows :

Strata No.	Farm size (in Acres)	No. of Farms	Strata Means	Standard Deviation
1.	0 – 100	300	45	15
2.	100 – 200	150	90	60

How would you draw the sample of size 45 using

- (i) Proportional allocation,
- (ii) Neyman allocation ?

Also, obtain the variance of the estimate of the population mean for the proportional allocation and compare its efficiency with SRSWOR.

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3. 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 and after 15 days, increase in weight is noted as given in the following table :

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

Perform a two-way ANOVA to test whether the data indicates any significant difference between

- (i) four diets,
(ii) three blocks. 10
4. Identify the design given in the following table and then carry out the analysis : 10

Column Row	I	II	III	IV
I	A 8	C 18	B 11	D 8
II	C 16	B 10	D 7	A 4
III	B 12	D 10	A 6	C 20
IV	D 10	A 9	C 28	B 16

5. The following table gives the frequency distribution of 100 random numbers generated from $N(0, 1)$ distribution :

Class Interval	Frequency
$\leq (-2.5)$	02
$(-2.5) - (-1.5)$	04
$(-1.5) - (-1.0)$	08
$(-1.0) - (-0.5)$	18
$(-0.5) - 0$	19
$0 - 0.5$	12
$0.5 - 1.0$	14
$1.0 - 1.5$	14
$1.5 - 2.0$	05
$2.0 - 2.5$	02
$2.5 - 3.0$	02

Use chi-square test of randomness to determine whether the fit of distribution is satisfactory or not.

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6. (a) (i) Distinguish between linear and circular systematic sampling, with an example.
- (ii) The data for production of wheat (in thousand kg) in 25 districts is given by 23, 20, 30, 37, 76, 36, 13, 36, 16, 58, 53, 83, 10, 15, 13, 17, 12, 16, 17, 21, 20, 13, 61, 31, 71.
- Select all possible systematic random samples of 7 units.

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- (b) The following data is related to the production (in kg) of 3 varieties of wheat :

P	14	16	18		
Q	14	13	15	22	
R	18	16	19	15	20

Is there any significant difference among the three varieties at 5% level of significance ?

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7. (a) For the data given below, the yield of treatment C in the second block is missing. Estimate the missing value and analyse the data.

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Block	Treatment			
	A	B	C	D
I	105	114	108	109
II	112	113	X	112
III	106	114	105	109

- (b) The distribution function of Pareto distribution is given by

$$f(x) = 1 - \left(\frac{k}{x}\right)^a ; a > 0, 0 < k < x.$$

Given a $U \sim U(0, 1)$, generate a random number from the above distribution, when $a = 2$ and $k = 1$. Suppose $U = 0.5$, then find x .

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