MST–005

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination
December, 2023

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 nos. **2** to **7**.*

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

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

(v) *Symbols have their usual meanings.*

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

    (a) Sampling error occurs in both census and sample survey.

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(b) In a cluster sampling, the elements within a cluster should be as homogeneous as possible.

(c) The error degrees of freedom in an one-way analysis of variance of population means at 4 levels of a factor with total 20 observations will be 16.

(d) If there is one missing value in a Latin Square Design with 4 treatments, the error degrees of freedom will be 5.

(e) In a middle square method, the next generated random number using random number 15, will be 22.

2. (a) 30 books of Statistics are arranged in serial numbers 1 to 30 in a library. Select all possible systematic random samples of 10 books.   4

(b) One thousand plots in a state of India were stratified according to their sizes. The number of plots (N_i), mean production of wheat per plot $(\overline{Y}_i)$ and standard deviation of production of wheat per plot

(S_i) for each stratum are given as follows : 6

Stratum	N_i	$\overline{Y}_i$	S_i
1	300	15	8
2	500	16	12
3	200	24	18

(i) Determine the sample size drawn from each stratum for drawing a sample of 100 plots under proportional allocation without replacement.

(ii) Also, estimate the sample mean and the variance of sample mean under given sampling scheme.

3. (a) Explain two stage sampling with an example. 3

(b) A company has three manufacturing units. The data of the number of produced items in five randomly selected shifts at each manufacturing unit are given in the table ahead :

Unit 1	Unit 2	Unit 3
29	32	25
27	33	24
30	31	24
27	34	25
28	30	26

Test whether there is a significant difference between the average number of items at three manufacturing units at 5% level of significance.   7

4. In an experiment, the yield of 4 varieties of wheat (A, B, C and D) corresponding to 4 different fertilizers and 4 different years, are measured. The data are given in the following table :

Years / Fertilizers	2017	2018	2019	2020
1	(A) 70	(B) 75	(C) 68	(D) 81
2	(D) 66	(A) 59	(B) 55	(C) 63
3	(C) 59	(D) 66	(A) 39	(B) 42
4	(B) 41	(C) 57	(D) 39	(A) 55

Test at $\alpha = 0.05$, the hypothesis that there is no significance difference among the (i) average yields of the four varieties of wheat, (ii) fertilizers, and (iii) years.   10

5. (a) Explain middle square method of generation of random numbers with an example.   2

(b) The following table provides the frequency distribution of 40 random numbers following U (0, 1). Apply Chi-square goodness of fit test to test the fitting of the distribution as follows :   4

Class Interval	Class Frequency (n_i)
0.0 – 0.2	5
0.2 – 0.4	14
0.4 – 0.6	7
0.6 – 0.8	4
0.8 – 1.0	10

(c) Describe any **two** applications of simulation.   4

6. (a) Describe the assumptions of Analysis of Variance (ANOVA).   3

(b) Simulate a M/M/1 process with $\lambda = 0.6$ and $\mu = 1.0$ and find out average waiting time W_i by taking N = 10.   7

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7. A z^2-experiment was conducted in order to obtain an idea of the interaction between spacing (s) and number of seedlings per hole (n) along with the effects of different types of spacing and seedling per hole. The levels of two factors are : s (8" and 10" spacing in between) and n (3 and 4 seedlings per hole).

The field plan and yield of dry Aman paddy (in kg) for each plot are given as follows :

Block	Yield			
1	(l) 117	(s) 106	(ns) 109	(n) 114
2	(ns) 114	(l) 120	(s) 117	(n) 114
3	(l) 111	(n) 117	(s) 114	(ns) 106
4	(ns) 93	(n) 121	(s) 112	(l) 108
5	(ns) 75	(s) 97	(l) 73	(n) 38
6	(n) 58	(l) 81	(ns) 105	(s) 117

Analyse the gives design.   10