No. of Printed Pages : 6

MST–005

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

Term-End Examination

December, 2024

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.

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

   (a) If we increase the sample size, then the non-sampling error will decrease.

(b) In a sequence of random numbers generated through LCG :

$x_i = (5x_{i-1} + 8) \bmod (10)$ with $x_0 = 4$, the x_1, x_2 and x_3 will be 8, 8, 8.

(c) Suppose 10 elementary schools are randomly chosen from Delhi and then 20 students from each selected school, then suggested model will be the fixed effect model.

(d) For studying the significance differences among three groups, one learner applied ANOVA technique and another multiple two sample *t*-test then they will get the same result.

(e) The local control principal in design of experiment is used to reduce biasedness.

2. (a) A random number generator produces the following random numbers :

0.24	0.40	0.02	0.76	0.51
0.66	0.22	0.46	0.92	0.16
0.17	0.49	0.36	0.62	0.47
0.23	0.07	0.86	0.78	0.82
0.35	0.05	0.84	0.25	0.33
0.64	0.85	0.92	0.56	0.84
0.75	0.64	0.65	0.48	0.13
0.95	0.04	0.23	0.27	0.16

Apply Chi-square test to test whether the random numbers come from U (0, 1) distribution.

(b) Explain *two* methods of generation of random numbers. 6+4

3. (a) Twenty-eight rats were given one of four different diets at random and the response measure was liver weight as a percentage of body weight. The responses are as follows :

Diet

A	B	C	D
3.52	3.46	3.53	3.74
3.36	3.72	3.51	3.82
3.57	3.37	3.60	3.86
4.18	3.86	3.75	4.07
3.87	3.68	3.64	4.30
3.75	3.51	3.51	3.97
3.93	3.35		3.86
	3.63		

(i) Compute the overall mean and treatment effect.

(ii) Compute the ANOVA table for these data.

(iii) Test whether the effect of diets is same at 5% level of significance.

(b) In a warehouse three trucks arrive per hour to be unloaded. Generate inter-arrival time of ten trucks using U (0, 1) random numbers :

0.579	0.052	0.312	0.307	0.645
0.0945	0.645	0.956	0.394	0.110

In how many cases it exceeds half an hour ? 7+3

4. An experiment is performed to determine the effect of two advertising campaigns on three types of bath soaps (A, B and C). Sales (in dozen) of each bath soap recorded after the first advertising campaign and then after the second advertising campaign. This experiment was

repeated three times for each advertising campaign and got the results as follows :

Bath Soap	Campaign-I			Campaign-II		
A	74	64	50	102	120	110
B	24	73	51	52	90	102
C	76	40	50	105	110	99

Perform an appropriate ANOVA to determine whether there is a significance difference between (i) the bath soaps and (ii) the campaigns at 5% level of significance. 10

5. Following are the yields (in kg) per plot that resulted when all four combinations of 2 levels of nitrogen (N) and 2 levels of phosphate (P) were applied to a grain variety in a randomized block experiment :

Block	Yield			
I	(*l*) 4.3	(*n*) 6.5	(*p*) 6.4	(*np*) 8.8
II	(*p*) 8	(*l*) 4.7	(*n*) 9.3	(*np*) 8
III	(*l*) 5.5	(*n*) 7.9	(*np*) 8.2	(*p*) 6.4
IV	(*np*) 4.8	(*n*) 6.3	(*p*) 5.4	(*l*) 5.5

Perform factorial experiment and draw conclusions. 10

6. The workers of a factory are stratified into three strata on the basis of their wages as follows : 10

Stratum	Wages (in hundreds)
I	3, 4, 5, 3, 4, 4, 5, 4
II	8, 9, 10, 7, 7, 8, 8, 7, 10, 6, 10, 6
III	12, 15, 12, 14, 15, 16

(i) Compute mean and population mean square (S_i^2) of each stratum.

(ii) Determine required stratified random sample size for each stratum using proportional and Neyman allocations.

(iii) Compute variance of sample mean under proportion allocation.

7. Write short notes on the following : $2\frac{1}{2}\times 4=10$

(i) Two-stage random sampling

(ii) Cluster sampling

(iii) Simple random sampling

(iv) Advantages of sampling over census

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