

**POST GRADUATE DIPLOMA IN  
APPLIED STATISTICS (PGDAST)**

**Term-End Examination**

**December, 2017**

01951

**MST-005 : STATISTICAL TECHNIQUES**

*Time : 3 hours*

*Maximum Marks : 50*

**Note :**

- (i) *Question no. 1 is compulsory. Questions no. 2 to 5 have internal choices.*
- (ii) *Use of scientific calculator is allowed.*
- (iii) *Use of Formulae and Statistical Tables Booklet for PGDAST is allowed.*
- (iv) *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) Population of the number of heads or tails based on the tossings of a coin is an example of real population.
- (b) Suppose the null hypothesis  $H_0 : \mu_1 = \mu_2 = \mu_3$  is rejected. It only means that  $\mu_1 \neq \mu_2$ ,  $\mu_2 \neq \mu_3$ ,  $\mu_1 \neq \mu_3$ .

- (c) Precision of an experiment is directly proportional to the variance of mean.
- (d) We want to draw 10 two-digit random numbers using middle square method. At one place we have a random number 14, then the next random number will be 25.
- (e) In  $2^3$  factorial experiment, we have two factors each at three levels.
2. (a) Draw all possible samples of size 2 from the population {8, 12, 16} and verify that sample mean is an unbiased estimator of population mean. Also find the variance of estimate of the population mean.
- (b) Distinguish between Sampling errors and Non-sampling errors. 6+4

**OR**

- (a) A random sample of 100 employees is to be drawn from a population of 500 employees in colleges A and B. The population means and population mean squares of their monthly wages are given below :

	$N_i$	$\bar{X}_i$	$S_i^2$
College A	300	25	25
College B	200	50	100

Calculate the sizes of random samples using Proportional and Neyman allocation techniques.

- (b) In a Statistics class, total number of students is 30. Select a systematic random sample of 10 students. The ages (in years) of the 30 students is given below :

22 25 22 21 22 25 24 23 22 21  
 20 21 22 23 25 23 24 22 24 24  
 21 20 23 21 22 20 20 21 22 25

- (c) To determine the yield rate of wheat in a district of Punjab, 6 groups were constructed of 6 plots each. The data are given in the following table :

Plot No.	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
1	8	6	18	13	17	12
2	13	5	8	7	15	15
3	11	16	6	13	10	11
4	26	5	10	6	21	17
5	13	16	16	7	20	8
6	31	5	20	2	25	10

Select a first-stage sample of size 2 and then the second-stage sample of size 6 from the above data by two-stage sampling method. 4+2+4

3. If we have three fertilizers and we have to compare their efficacies, this could be done by a field experiment in which each fertilizer is applied to 10 plots. The crop yield data is recorded in the following table :

	Fertilizer		
	1	2	3
Yield (in tonnes) from 10 plots	6.27	3.07	4.04
	5.36	3.29	3.79
	6.39	4.04	4.56
	4.85	4.19	4.55
	5.99	0.41	4.53
	7.14	0.75	3.53
	5.08	04.87	3.71
	4.07	3.94	7.00
	4.35	6.49	4.61
	4.95	3.15	4.55

Using appropriate method, what is your conclusion if you want to select a fertilizer which can be preferred in comparison with others ?

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**OR**

A manufacturer wishes to determine the effectiveness of four types of machines (A, B, C, D) in the production of bolts. To this end, number of defective bolts produced day-wise in each of the two shifts are reported in the following table :

Machine	First Shift					Second Shift				
	M	T	W	Th	F	M	T	W	Th	F
A	6	4	5	5	4	5	7	4	6	8
B	10	8	7	7	9	7	9	12	8	8
C	7	5	6	5	9	9	7	5	4	6
D	8	4	6	5	5	5	7	9	7	10

Perform an analysis of variance technique to determine, at 5% level of significance, whether there is a significant difference

- (a) between the machines, and
- (b) between the shifts.

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4. Five different cars each of four makes were chosen at random and were put on the road in 5 different ways. The car of make A runs at different speeds on different days. The speeds are 25, 35, 50, 60 and 70 mph. Which car was to be put on the road on which day and what speed it should have, was determined through a chance mechanism subject to the above conditions of the

experiment. The procedure was adopted for each make of cars. For each car, number of miles covered per gallon of petrol was observed. The observations are presented as follows :

Table : Miles per Gallon of Petrol

Makes of Cars	Speed of the Cars in miles per hour (mph)				
	25	35	50	60	70
A	20.6	19.5	18.1	17.9	16.0
B	19.5	19.0	15.6	16.7	14.1
C	20.5	18.5	16.3	15.2	13.7
D	16.2	16.5	15.7	14.8	12.7

Identify the design and carry out analysis of the above data. 10

**OR**

Analyse the data of a  $2^3$  factorial experiment conducted using a RBD with three replications. The three factors were fertilizers, viz., Nitrogen (N), Phosphorus (P) and Potassium (K). The purpose of the experiment is to determine the effect of different kinds of fertilizers on potato crop yield. The yields under 8 treatment combinations for each of the three randomised blocks are given below : 10

Block I

npk	(1)	k	np	p	n	nk	pk
450	101	265	373	312	106	291	391

Block II

p	nk	k	np	(1)	npk	pk	n
324	306	272	338	106	449	407	89

Block III

p	npk	nk	(1)	n	k	pk	np
323	471	334	87	128	279	423	324

5. Random numbers from uniform  $U(0, 1)$  distribution are given below :

0.696, 0.457, 0.493, 0.784, 0.123

0.478, 0.487, 0.031, 0.681, 0.258

- (a) Using the above random numbers, obtain three random numbers from Poisson distribution with  $\lambda = 2$ .
- (b) Using the above random numbers and cumulative probabilities for binomial distribution with  $n = 10$  and  $p = 0.25$  given below :

X	$\Sigma p(x)$
0	0.0563
1	0.2440
2	0.5256
3	0.7759
4	0.9219
5	0.9803
6	0.9965
7	0.9996
$\geq 8$	1.0000

obtain three random numbers from the above distribution using Inverse Probability Transformation (IPT) method.

5+5

OR

The following table gives the grouped data for number of items demanded per day. They were generated by Poisson distribution algorithm with mean  $\lambda = 6$ .

Demand (X)	Frequency ( $n_j$ )
$\leq 3$	12
4	10
5	12
6	18
7	10
8 - 9	20
$\geq 10$	5

Use chi-square test to test the goodness of fit of the above distribution.

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