

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

Term-End Examination

June, 2022

MST-004 : STATISTICAL INFERENCE

Time : 3 hours

Maximum Marks : 50

Note :

- (i) Question no. 1 is **compulsory**.
 - (ii) Attempt any **four** questions from the remaining questions.
 - (iii) Use of scientific (non-programmable) calculator 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 answers.

$5 \times 2 = 10$

- (a) The lifespan (in '00 hours) of five batteries are 40, 42, 44, 46 and 48. There are 15 samples of size 2 possible without replacement.
- (b) The number of runs in the sequence MMNMMNNMNNNMMMNN is 7.

- (c) If X_1, X_2 and X_3 is a random sample of size 3 taken from a population with mean μ and variance σ^2 , then estimator

$$T = \frac{3X_1 + 2X_2 - X_3}{5}$$

is an unbiased estimator for μ .

- (d) If the probability density function of a random variable X which follows F-distribution is

$$f(x) = \frac{1}{(1+x)^2}; 0 < x < \infty,$$

then the degrees of freedom of the distribution will be (2, 2).

- (e) Accepting the null hypothesis (H_0) when it is not true, is called Type-I error.

2. Consider a population consisting of 5 villages, the areas (in hectares) of which are given below :

Village	A	B	C	D	E
Area	460	400	480	500	420

- (a) How many samples of size 3 are possible without replacement ? Write them.
- (b) Compute the mean of all samples of size 3 obtained in (a), and set up the sampling distribution of the same.
- (c) Compute the expected value and standard error of the sample mean. 3+4+3

3. (a) An industry produces a particular type of items. To estimate the variance of the weight of the items, an analyst of the industry takes a random sample of 10 items. He measures their weights (in kg). The data so obtained are given as follows :

48, 50, 62, 75, 80, 60, 70, 56, 52, 77

Obtain 99% confidence interval for the variance of the weight of all items. 5

- (b) It is known that the number of weekly accidents occurring on one km stretch of a particular road follows Poisson distribution with parameter λ . Determine the maximum likelihood estimator of the parameter λ and compute its estimated value on the basis of the following data : 5

<i>Number of Accidents</i>	<i>Frequency</i>
0	4
1	6
2	10
3	8
4	4

4. (a) A statistician wishes to test the hypothesis that standard deviation of weight of the students for Batch A is greater than that of Batch B. The data obtained from both batches are as follows :

Batch A

Batch B

$$n_1 = 9$$

$$n_2 = 11$$

$$\bar{x} = 59$$

$$\bar{y} = 60$$

$$\Sigma (x_i - \bar{x})^2 = 26$$

$$\Sigma (y_i - \bar{y})^2 = 36$$

Is there enough evidence to support the claim at 5% level of significance ?

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- (b) A mobile manufacturer claims that at most 10% of the mobiles produced are defective. A company wants to purchase the mobiles but before that it is decided to test a sample of 200 mobiles. If there are 30 defective mobiles among these 200 mobiles, can we agree with the manufacturer's claim at 1% level of significance ?

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5. (a) A cricket coach has developed a new technique of bowling a reverse swing. To determine how well this method works, the coach selected two teams, say, A and B, of 12 players in each team. Each player of team A was asked to bowl 60 balls using the old technique, while each player of team B, by the new technique. The number of successful attempts for each player of team A and B is given in the following table :

<i>Team A</i>	<i>Team B</i>
40	45
30	60
55	50
35	60
40	35
40	50
30	55
40	60
50	50
45	50
40	40
35	55

Examine whether the average successful attempts by the two methods are the same at 1% level of significance, using suitable non-parametric test. Also, write the conclusion.

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- (b) Differentiate between Parametric and Non-parametric tests.

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6. (a) Write any two applications of t-distribution.

The probability density function (pdf) of chi-square distribution is given by

$$f(\chi^2) = \frac{1}{96} e^{-\chi^2/2} (\chi^2)^3; 0 < \chi^2 < \infty.$$

- (i) What is the degree of freedom of this chi-square distribution ?
- (ii) What are the mean and variance of the chi-square distribution ?

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- (b) Show that the sample mean \bar{X} is an unbiased estimator of the population mean μ . To determine the average amount of money spent by the students of a university on textbooks, a random sample of 10 students was chosen at random. The amounts spent (in ₹) on the textbooks were as follows :

1000, 1520, 5600, 7110, 2270, 1460, 4220,
6800, 520, 2120

What is the point estimate of the average amount spent by all students of the university ?

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- (c) Write any four properties of MLE.

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7. (a) A bath soap manufacturing company claims that the average weight of the bath soap is 100 g. For testing the claim, a sample of 9 soaps is selected at random under normal conditions. The data is given in the following table :

<i>Weight (in grams)</i>
103
98
99
101
96
97
96
98
103

Assuming that the weights of soaps are normally distributed, use a suitable test for testing the claim at 5% level of significance, and draw conclusion.

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- (b) The following table gives the number of aircraft accidents that occurred during the various days of the week :

<i>Days</i>	<i>No. of Accidents</i>
Sunday	14
Monday	15
Tuesday	08
Wednesday	20
Thursday	11
Friday	09
Saturday	14

Find whether the accidents are uniformly distributed over the week at 5% level of significance.

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