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MST–004

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

December, 2023

MST-004 : STATISTICAL INFERENCE

Time : 3 Hours *Maximum Marks : 50*

Note : *Question No.* ***1*** *is compulsory. Attempt any* ***four*** *questions from the remaining Question Nos.* ***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.*

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

   (a) If sample size of a survey has increased 3 times, then the standard error will be increased 3 times.

(b) If probability density function of a random variable X follows F-distribution

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

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

(c) For testing $H_0 : \theta = 2$ against $H_1 : \theta = 3$, the pdf of the variable is given by

$$f(x, \theta) = \frac{1}{\theta}; \ 0 \le x \le \theta$$

If the critical region is $x \geq 0.6$, the size of the test will be 0.6.

(d) Kruskal-Wallis test is a non-parametric version of two-way analysis of variance.

(e) A sample of size 4 is drawn randomly $(X_1, X_2, X_3 \text{ and } X_4)$ from a normal population with unknown mean μ, then $\frac{X_1 + 2X_2 + 3X_3 + X_4}{7}$ is an unbiased estimator of μ.

2. The systolic blood pressure (SBP) of five women are given as follows :

120, 110, 130, 140, 100

(a) How many samples of size 2 can be drawn without replacement ? Write them.

(b) Compute the mean of all samples of size 2 and set up the sampling distribution of the sample mean.

(c) Compute the expected value of the sample mean.

(d) How many samples of the same size 2 are possible with replacement ? Calculate expected value of the sample mean and compare it with the expected value calculated in the case of without replacement. 2+2+2+4

3. (a) The following table gives the classification of 150 products according to types of tools and materials used to produce these products :

Tool	Material		
	A	B	C
T_1	15	5	20
T_2	20	10	30
T_3	25	15	10

Test whether the tools and materials used are independent at 5% level of significance.

(b) Explain the general procedure of testing of hypothesis. 6+4

4. (a) A random sample of 15 stores was taken to analyse the sales of mobiles during last month. The correlation coefficient between sales and expenditure on advertisement was found to be 0.68. Assuming that sales and expenditure on advertisement follow normal distribution, then test if these two are positively correlated at 1% level of significance.

(b) An electric equipment manufacturing company claims that at most 10% of its products are defective. A store wants to purchase its products but before that they decided to test a sample of 200. If there are 30 defective products among these 200, can we agree with the manufacturer's claim at 1% level of significance ? 5+5

5. (a) An experiment was conducted to compare the defective items produced by two different machines A and B. The data on

number of defective items produced by the machines were observed and given in the table as follows :

A	B
26	19
37	22
40	24
35	27
30	24
30	18
40	20
26	19
30	25
35	
45	

Obtain 95% confidence interval for variance ratio of the number of defective items produced by machines A and B, respectively.

(b) Write *four* differences between parametric and non-parametric tests. 8+2

6. (a) The length of a steel rod is distributed normally with mean 12 metre and standard deviation 0.1 metre. For a random sample of size 10, find :

(i) Mean and variance of the sampling distribution of mean. 2

(ii) The probability that the sample mean lies between 11.94 metre and 12.06 metre. 2

(b) The reduction of weight (in kg) after a diet-plan are recorded as follows :

6.5, 7.7, 5.6, 7.3, 6.7, 7.8, 6.7, 6.2, 5.2, 6.6, 6.0, 7.0, 7.2, 6.8 and 7.2.

It is observed that reduction in weight follows an exponential distribution with parameter θ whose pdf is given by :

$$f(x) = \frac{1}{\theta} e^{-x/\theta};\ x \geq 0,\ \theta > 0$$

(i) Find the maximum likelihood estimator of the parameter θ. 3

(ii) Determine the maximum likelihood estimate of θ on the basis of the given data. 3

7. (a) Explain the properties of good estimator with examples.

(b) The measurements of length (in cm) of a random sample of 10 boxes are given as follows :

20.2, 24.1, 21.3, 17.2, 19.8, 16.5, 21.8, 18.7, 17.1 and 19.9.

Use suitable test to test the hypothesis that the sample is taken from a population which is symmetrical about 18 cm against the alternative that symmetry is about the point which is greater than 18 cm at 5% level of significance. 5+5