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MST–004

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

December, 2024

MST-004 : STATISTICAL INFERENCE

Time : 3 Hours *Maximum Marks : 50*

Note : *Question No.* ***1*** *is compulsory. Attempt any* ***four*** *questions from 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 answer : 2×5=10

   (a) Let X_1, X_2, X_3, ..., X_n be a random sample from normal population with mean μ and variance σ^2. If $\bar{X} = \sum_{i=1}^{n} X_i$ and σ^2 is assumed to be known, then the estimator $T = \frac{\bar{X}}{\sqrt{n}}$ is consistent estimator for μ.

   (b) The non-parametric tests are applied when the form of distribution is known.

   (c) Suppose T is calculated from the sample values $x_1, x_2, x_3, ..., x_n$ to estimate θ. Then $\sum_{i=1}^{n} \sqrt{x_i \theta}$ is a statistic but $\sum_{i=1}^{n} \frac{\log x_i^3}{x_i^3}$ is not a statistic.

   (d) Decision of rejecting the null hypothesis or do not reject it depends on the approach of *p*-value or confidence interval or tabulated value approach.

(e) In a testing of hypothesis problem null and alternative hypotheses are formed as follows :

$$H_0 : \mu > \mu_0, H_1 : \mu < \mu_0$$

A statistics student says that H_0 and H_1 do not satisfy philosophy of the subject statistics.

2. (a) Suppose an experimenter tests the hypothesis $H_0 : \theta = 0.8$ *vs.* $H_1 : \theta = 0.4$ based on 8 Bernoulli trials, the decision rule is to find the test statistic T as the total number of observed successes and accept the null hypothesis if T > 4 else reject the null hypothesis. Calculate Type I and Type II errors.

(b) Suppose that 81 LED bulbs can work on an average 200 weeks with a standard deviation of 10 weeks. Test the hypothesis $H_0 : \mu \geq 220$ *vs.* $H_1 : \mu < 220$ at 5% level of significance. 6+4

3. (a) Suppose a pump can throw the water at a distance of on an average 85 metres. Nine such pumps are randomly selected and the distance of water thrown by them is recorded as 68.9, 71.6, 82.5, 91.8, 68.0, 78.3, 78.4, 84.9 and 89.1 metres. Also, if population is symmetric about its median, then test the hypothesis $H_0 : \tilde{\mu} \geq 85$ *vs.* $H_1 : \tilde{\mu} < 85$ at 5% level of significance.

(b) A machine that automatically fills the juice has recently been installed. This machine will be judged to be effective if the standard deviation σ of the amount of juice in a 200 ml glass is less than 0.0225 ml. If a sample of 20 glasses of juices yields a sample variance of 0.025 ml

sq., then test that the machine is effective under the normality assumption at 5% level of significance. 5+5

4. (a) It is given that the yearly growth in the sales of a departmental store (in lakhs) follows geometric distribution with parameter θ. If 11.1, 11.3, 11.8, 12.2, 12.5, 12.7, 13.3, 13.7, 13.8 and 14.6 are sales of 10 stores, then show that $\bar{X}$ is a consistent estimator of $\frac{1}{\theta}$.

(b) Given x "successes" in n trials, find the maximum likelihood estimator of the parameter θ of the corresponding binomial distribution. 5+5

5. (a) A pharmaceutical company wants to estimate the mean life of a particular drug under typical weather conditions. Following results were obtained from a

simple random sample of 64 bottles of the drug :

Sample mean : 20 months

Population standard deviation : 3 months

Sample size : 64

Find an interval estimate for μ with a confidence level of 90%.

(b) A pathologist wants to determine on the basis of sample study, the mean time required to complete a certain analysis so that he may 98% confident that the mean may remain within $\pm$ 3 days of the true mean. As per the available record, the population variance is 81 days. What must be the size of the sample for his study ? How large a sample would be required if the precision is to be doubled ? 4+6

6. Weight of four boys are recorded (in kgs) as 30, 32, 34 and 36. Draw all possible sample of size 2 from them with replacement and hence find the sampling distribution of the sample means. Also, find the mean and standard error of the sample mean directly from the sampling distribution of mean as well as by use of suitable formulae. Verify that mean of the sampling distribution of the mean is equal to the population mean. 10

7. A class of high school has 25 boys. Twelve boys lived in villages and rest lived in a town. A test was conducted to see that the village boys in general were physically more fit than the town boys. Each boy in the class was given a physical fitness test in which a low score indicates poor

physical condition. The scores of the village boys (V) and the town boys (T) are as follows :

Villages Boys (V)		Town Boys (T)	
15.7	10.6	12.7	7.9
8.2	12.4	3.2	2.7
6.5	16.2	11.8	6.1
7.2	12.9	7.9	3.6
9.0	11.4	5.6	6.5
4.5	5.6	6.7	2.8
		12.6	

Test whether the village boys are more fit than the town boys at 5% level of significance. 10

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