POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

December, 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. *5×2=10*

(a) If probability density function of a χ^2-distribution is $f(\chi^2) = \frac{\chi^2}{8} e^{-\frac{\chi^2}{2}}$, $0 < \chi^2 < \infty$, then the degrees of freedom will be 8.

(b) Rejecting the null hypothesis H_0 when it is not true, is called Type-II error.

(c) If sample size in a survey has increased 4 times, then standard error will decrease by 4 times.

(d) If estimators T_1 and T_2 of a parameter θ, calculated from a random sample of size n, have variances $\frac{1}{n}$ and $\frac{5}{n}$, respectively, then T_1 is more efficient than T_2.

(e) Sign test is a more powerful test in comparison to Wilcoxon signed-rank test.

2. (a) A machine produces a large number of items of which 15% are found to be defective. If a random sample of 200 items is taken from the manufactured lot, find : *3+3*

(i) Mean and standard error of sampling distribution of mean.

(ii) The probability that less than or equal to 12% defectives are found in the sample.

(b) If probability density function of variate t is given as :

$$f(t) = \frac{1}{\sqrt{5}\, B\left(\frac{1}{2}, \frac{5}{2}\right)\left(1 + \frac{t^2}{5}\right)^3}, \quad -\infty < t < \infty$$

(i) Obtain the degrees of freedom for the above distribution;

(ii) Obtain the mean and variance for the above distribution. *2+2*

3. Two types of seeds (I and II) were sown in 9 and 7 one-acre plots, respectively, keeping other conditions constant. The yields (in kg) are given as follows :

Seed I : 18, 20, 36, 50, 49, 36, 34, 49, 41

Seed II : 29, 28, 26, 28, 16, 11, 23

(a) Assuming that the variances are equal, compute 95% confidence limits for the difference of the average yields due to both seeds.

(b) Compute the point estimates of the average yields due to both seeds. *8+2*

4. A company that manufactures chocolate bars is concerned about the mean and variability of the weight of chocolate bars. A sample of 25 chocolate bars is selected and the sample mean and the sample standard deviation are found to be 10·2 grams and 0·2 grams, respectively.

(a) Is there any evidence that the population mean weight of the chocolate bars is greater than 10 grams at 1% level of significance ?

(b) Is it justifiable to conclude that the variance of the weights is less than $0{\cdot}05\ (\text{grams})^2$ at 1% level of significance ? *5+5*

5. The waiting time (in minutes) of 60 patients waiting for a doctor, in a particular hospital, to be examined is recorded. The results are as follows :

Waiting time (in minutes)	Frequency
0 or 1	5
2	8
3	10
4	11
5	10
6	9
7 or more	7

Does the number of patients waiting for the doctor follow Poisson distribution with standard deviation of 2 minutes at 5% level of significance ? *10*

6. (a) The number of mobile phones in 4 families is as follows : 2, 4, 3, 1. If we select a sample of size 2 with replacement,

(i) How many samples are possible ? Write them.

(ii) Compute the mean of all samples and construct the sampling distribution of the sample mean. *2+3*

(b) If 4, 3, 6, 2, 5, 4, 3, 2, 5, 6, is a random sample taken from Poisson distribution with parameter λ, then show that sample mean $\overline{X}$ is a consistent estimator of λ. *5*

7. (a) An agency claimed that 70% of its employees felt that work stress had a negative impact on their personal lives. To check this statement, an analyst took a random sample of 200 employees and found that out of 200 employees, 150 felt that work stress had a negative impact on their personal lives. Formulate the null and alternative hypotheses and test the claim at $\alpha = 0{\cdot}05$. *5*

(b) Two different types of drugs A and B were tested on some patients for increasing their weights. Drug A was given to 6 patients and Drug B to 7 other patients. The gain in weights (in kg) are given below :

Gain in Weight Due to Drug A	Gain in Weight Due to Drug B
5	9
8	10
7	15
10	12
9	14
6	7
	12

If distribution of increase in weights due to both the drugs are unknown, check whether both the drugs differ significantly with regard to their average increase in weights at 1% level of significance. *5*