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**MST-004**

# POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

## Term-End Examination

00964

**December, 2015**

## MST-004 : STATISTICAL INFERENCE

*Time : 3 hours* *Maximum Marks : 50*

***Note :***

*(i)* *Attempt **all** questions.*

*(ii)* *Questions no. 2 to 5 have internal choices.*

*(iii)* *Use of scientific calculator is allowed.*

*(iv)* *Use of Formulae and Table Booklet for PGDAST is allowed.*

*(v)* *Symbols have their usual meaning.*

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

(a) The tabulated value of t-variate for which the area on the right tail ($\alpha$) = 0·05 and the degrees of freedom ($\nu$) = 8 is 2·306.

(b) The number of runs in the sequence

HHHTTHTTHTTT is 5.

(c) If $X_1$, $X_2$ and $X_3$ is a random sample of size 3 taken from a population with mean $\mu$ and variance $\sigma^2$, the estimator $T = \frac{X_1 + 2X_2 + 3X_3}{6}$ is an unbiased estimator for $\mu$.

(d) F-test is used for testing the population mean.

(e) The parametric test is used when the form of population is unknown.

**2.** (a) The yearly turnover (in crores) of five business farms are as follows :

250, 200, 300, 150, 100

An analyst wishes to estimate the average turnover of these farms on the basis of samples.

(i) How many samples of size 2 are possible without replacement ? Write them.

(ii) Compute the mean of all samples of size 2 and set up the sampling distribution of the sample mean. 7

(b) Obtain the tabulated value of chi-square variate for which the area on the right tail is 0·01 and the degrees of freedom is 6. Write any two applications of chi-square distribution. *3*

**OR**

A bolt machine produces 10% defective bolts. A random sample of 100 bolts is taken and the sample proportion of defective bolts is calculated.

Find

(i) the mean and standard error of the sampling distribution of the proportion of defectives. *3*

(ii) the probability that less than or equal to 12% defectives are found in the sample. *7*

**3.** (a) Write the properties of a good estimator. Explain any one of them. *3*

(b) A factory produces an item. To estimate the variance of the weight of the items, the analyst of the factory 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. *7*

**OR**

(a) It is known that the number of weekly accidents occurring on a one km stretch of a particular road follows Poisson distribution with parameter $\lambda$. Write the maximum likelihood estimator of the parameter $\lambda$ and compute its value on the basis of the following data : *6*

| Number of Accidents | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Frequency | 4 | 6 | 10 | 8 | 4 |

(b) A researcher wants to estimate the average mileage of motorcycles of a company. How large a sample of the motorcycles should be taken, if she wants 95% confidence that the estimate lies within the range of 4 km/litre ? Assume that a reasonable estimate of the population standard deviation is 6 km/litre. *4*

4. A group of 6 children was tested to find out how many digits they would repeat from memory after hearing them once. They were given practice sessions for this test. Next week they were retested. The results were obtained as follows :

| Child Number | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Recall Before | 3 | 4 | 5 | 7 | 5 | 4 |
| Recall After | 6 | 6 | 8 | 9 | 8 | 3 |

It is known that the difference of the scores before and after the practice sessions is normally distributed. Answer the following questions to ascertain if the memory practice sessions improve the performance of the children :

(i) Are the two samples of data paired or independent ? *1*

(ii) State the null and alternative hypotheses. *1*

(iii) Which test is used for testing the null hypothesis in this case and why ? *2*

(iv) Conduct the test at the 0·01 level of significance. What do you conclude ? *6*

**OR**

(a) A machine produces a large number of items out of which 25% are found to be defective. To check this, the company manager takes a random sample of 100 items and found 30 items defective. Is there any evidence that the machine produces more defective items at 5% level of significance ? *6*

(b) Two sources (A and B) of raw materials are under consideration by a bulb manufacturing company. A sample of 12 bulbs from source A yields a variance of 120, and a sample of 10 bulbs from source B yields a variance of 110. Is it likely that the variance of source A significantly differs to the variance of source B at significance level $\alpha = 0{\cdot}01$ ? *4*

**5.** The following contingency table presents the analysis of 300 persons according to their hair colour and eye colour :

| Hair Colour | Eye Colour | | | |
|---|---|---|---|---|
| | Brown | Blue | Black | Total |
| Brown | 70 | 30 | 80 | 180 |
| Black | 50 | 30 | 40 | 120 |
| Total | 120 | 60 | 120 | 300 |

Test the hypothesis that there is no association between hair colour and eye colour at 1% level of significance. *10*

**OR**

The following data represents the lifetime (in hours) of batteries for two different brands, A and B :

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Brand A | 45 | 30 | 35 | 40 | 40 | 35 | 30 | 40 |
| Brand B | 40 | 60 | 50 | 60 | 35 | 50 | 60 | 45 |

Examine, if the average life of the two brands is the same at 5% level of significance, using Mann-Whitney U test. Write your conclusion. *10*