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MST-004

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

December, 2019

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 question nos. 2 to 7.*

(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. 5x2=10

(a) If sample size of a survey has increased 4 times, then the standard error will be doubled.

(b) If p-value and level of significance for testing a hypothesis $H_0 : \sigma = 10$ against $H_1: \sigma > 10$, are 0.06 and 0.05, respectively, then the H_0 may be accepted.

(c) For testing pulse rate of an infant is to be 120 per minute, a researcher measured (per minute) pulse rates of 10 infants and applied sign test and Wilcoxon signed-rank test. Then power of sign test is more than the Wilcoxon signed-rank test.

(d) If police arrest a person whom they suspect is a murderer and place before the court. The court has to test hypotheses.

H_0 : Arrested person is innocent (not murderer)

H_1 : Arrested person is a murderer

If suspected person who is actually an innocent is sent to jail then court commits Type II error.

(e) Suppose X_1, X_2 and X_3 is a random sample taken from normal population with mean μ and variance σ^2. If following two estimators (T_1 and T_2) are suggested to estimate μ, then T_1 is more efficient estimator than T_2.

$$T_1 = \frac{X_1+X_2+X_3}{3}, T_2 = \frac{X_1+X_2}{2} + X_3$$

2. (a) What is degree of freedom ? Explain with an example. 2

(b) The pdf of a random variable "T" $f(t) = \dfrac{3}{8\left(1+\frac{t^2}{u}\right)^{5/2}}$; $-\infty < t < \infty$ 5

Obtain degrees of freedom of the distribution. Also find mean and variance of the given distribution.

(c) Write any two applications of F-distribution. 2

(d) Obtain tabulated value of a Chi-square variate for which area on the right tail is 0.05 and degrees of freedom is 10. 1

3. The administration of IGNOU head quarter collects data regarding the persons visit to IGNOU for enquiry about the programmes offered by IGNOU for 15 working days. The collected data are given below : 5+2+3

305, 280, 260, 340, 262, 344, 320, 274, 236, 320, 265, 250, 310, 332, 350

If it is observed that arrival of the visitors follows Poisson distribution with parameter "λ", then

(i) Find maximum likelihood estimator of λ,

(ii) Calculate maximum likelihood estimate of λ on the basis of the above data.

(iii) Is obtained estimator sufficient for λ ? Give reason in support of your answer.

4. The following data relate to the number of items produced in a shift by two workers A and B for six days : 10

Worker A	28	27	30	35	20	28
Worker B	19	22	24	25	24	18

Assuming that the parent populations are normal, can it be inferred that worker A is more consistent worker than B by testing variation in the number of items produced by them at 5% level of significance ?

5. The following data represent distribution of number of girls among the children of 100 families containing 4 children each : 10

Number of Sons	0	1	2	3	4
Number of Families	4	23	38	28	7

Test whether the number of girls in a family follows binomial distribution (4, 0.5) at 5% level of significance.

6. (a) A company is trying to improve the work efficiency of its employees. It has organised a special training programme for all employees. In order to assess the effectiveness of the training programme, the company has selected 10 employees randomly and administered a well structured questionnaire. 1+1+4

The scores (out of 50) obtained by the employees are given in the following table :

Employee	Scores	
	Before Training	After Training
1	30	35
2	32	34
3	27	31
4	34	33
5	36	33
6	33	37
7	39	37
8	33	42
9	30	40
10	32	43

It is known that the distribution of the differences of the scores before and after the training programme is symmetrical about its median. To examine whether the training programme has improved the efficiency of the employees, answer the following :

(i) Are both samples paired ?

(ii) State the null and alternative hypotheses.

(iii) Conduct suitable test at 1% level of significance and interpret the result.

(b) A manufacturer of mobile phones has determined from past experience that 3% of the mobile phones, they produce are defective. If all possible random samples of 100 mobile phones are examined and sampling distribution of sample proportion is prepared, then find the probability that the proportion of defective mobile phones lies between 0.02 and 0.04. 4

7. (a) A company manufacturing motorcycles claims that its motorcycles give an average mileage of 60 km/litre. For testing the claim of the company, an analyst selects 10 motorcycles randomly of that company and records their mileages. The data so obtained are given in the following table : 6

S.No.	Mileage (km/litre)	S.No.	Mileage (km/litre)
1	45	6	53
2	50	7	48
3	56	8	62
4	60	9	56
5	65	10	54

Assuming that the mileage of the motorcycles is normally distributed :

(i) Formulate the null and alternative hypotheses.

(ii) Use a suitable test for testing the claim of the company at 5% level of significance when standard deviation of the mileage of the motorcycles is unknown.

(b) A survey is planned to determine average annual family medical expenses of employees of a large scale company. The management of the company wishes to be 95% confident that the sample average is corrected to within $\pm$ 100 rupees of the true average family medical expenses. A pilot study indicates that the standard deviation of medical expenses can be estimated as 400 rupees. How large a sample size is necessary ? 4