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(Sem-3) STS-HR-3.1

2022

STATISTICS

(DSC/GE)

Paper : 3.1

(Basics of Statistical Inference)

Full Marks : 60

Time : 3 hours

***The figures in the margin indicate
full marks for the questions.***

1. Answer the following questions as directed :
1×7=7

(a) Compare to parametric methods, the non-parametric methods

(i) are less accurate

(ii) are less efficient

(iii) are computationally easier

(iv) (ii) and (iii) are correct but not (i)
(Choose the correct answer)

Contd.

- (b) ANOVA is a statistical method of comparing the _____ of several populations. (Fill in the blank)
- (c) In 5×4 contingency table the number of degrees of freedom is _____. (Fill in the blank)
- (d) What do you mean by point estimation?
- (e) In any testing problem, if $P \leq$ _____, then we reject H_0 . (Fill in the blank)
- (f) Smaller the experimental error, more accurate is the design. (Write True or False)
- (g) What do you mean by analysis of variance (AOV)?

2. Answer **any four** of the following questions :
 $2 \times 4 = 8$

- (a) Define type I error and type II error.
- (b) Write *two* differences between parametric and non-parametric tests.
- (c) If T is an unbiased estimator for θ , show that T^2 is a biased estimator for θ^2 .

- (d) Define experimental error.
- (e) What is meant by a completely randomized design ?
3. Answer **any three** of the following questions : 5×3=15
- (a) Define χ^2 (chi-square). Write down all the conditions for the validity of χ^2 -test of goodness of fit.
- (b) Show that $\frac{[\sum x_i(\sum x_i - 1)]}{n(n-1)}$ is an unbiased estimate of θ^2 for the sample $x_1, x_2, \dots, x_n$ drawn on X which takes values 1 or 0 with respective probabilities θ and $(1-\theta)$.
- (c) A researcher reports that the average salary of Assistant Professor is more than 4,200 dollar. A sample of size 30 Assistant Professors, has a mean salary of 43,260 dollar. At $\alpha = 0.05$, test the claim that Assistant Professors earn more than 42,000 dollar per year. The standard deviation of the population is 5,230 dollar [$Z_\alpha = 1.65$].

(d) Discuss the advantages and disadvantages of CRD and RBD.

(e) Write a short note on Wilcoxon two-samples test.

4. Answer **any three** of the following questions : 10×3=30

(a) (i) Explain the method of constructing 95% confidence interval for mean of population following normal distribution with mean μ and variance σ^2 , if — 6

(A) σ^2 is known;

(B) σ^2 is unknown but sample size is large (i.e., $n \geq 30$).

(ii) A coin was tossed 200 times resulting in 115 heads. Test the hypothesis that the coin was unbiased at 1% level of significance [$Z_\alpha = 2.58$]. 4

(b) (i) Explain the characteristics of a good estimator. 6

- (ii) The table given below is the sex wise classification of a group of individuals based on their employment status :

Type	Male	Female	Total
Employed	50	20	
Unemployed	15	15	
Total	65	35	

Test if the employment status have relation with sex of the individuals.

[Table value of χ^2 for 1 d.f. is 3.841.] 4

- (c) (i) A researcher wishes to try three different techniques to lower the blood pressure of individuals diagnosed with high blood pressure. The subjects are randomly assigned to three groups; the first group takes medications, the second group takes exercise and the third group follows a special diet. After four weeks, the reduction in each

person's blood pressure is recorded. At $\alpha = 0.05$, test the claim that there are no differences among the means. The data are shown below :

Medication	Exercise	Diet
10	6	5
12	8	9
09	3	12
15	0	08
13	2	14

[Table value of F for d.f $N 2$ and d.f $D12$ is 3.89.]

(ii) Explain the following terms :
2+2=4

(A) Level of significance

(B) One-tailed test and two-tailed test.

(d) Discuss the analysis of randomised block design (RBD).

(e) (i) What are the basic principles of design of experiment ? 6

(ii) In a simple random sampling with replacement, show that sample variance is the consistent estimator of population variance.

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(f) State and prove Neyman-Pearson lemma.
