

Unique Paper Code : **32375301\_OC**

Name of the Paper : **Basics of Statistical Inference**

Name of the Course: **Statistics: Generic Elective for Honours (GE-III) under CBCS**

Semester : **III**

Duration : **3 Hours**

Maximum Marks : **75**

**Instructions for Candidates**

1. *Attempt FOUR questions in all.*
2. All questions carry equal marks.
3. Use of simple calculator is allowed.

1. What do you understand by point estimation? Discuss in detail three properties possessed by good estimators and furnish suitable examples. Further, let  $X_1, X_2$ , and  $X_3$  be independent variables such that each  $X_i, i=1, 2, 3$ ; has mean  $\mu$  and variance  $\sigma^2$ . If  $T_1, T_2$  and  $T_3$  are the estimators used to estimate  $\mu$ , where (i)  $T_1 = X_1 + X_2 - X_3$  (ii)  $T_2 = (X_1 + X_2 + X_3)/3$ . (iii)  $T_3 = (X_1 + 2X_2 + 3X_3)/6$ . Are  $T_1, T_2$  and  $T_3$  unbiased estimators for  $\mu$ ? Compute variance of all the estimators. Which one is the most efficient?
2. Explain the method of constructing  $100(1-\alpha)$  % confidence interval for  $\mu$  of normal population with mean  $\mu$  and variance  $\sigma^2$ . How do you proceed if  $\sigma^2$  is (i) known and (ii) unknown? In the second case, what happens when the sample size exceeds 30? Next suppose that a doctor wants to determine the average complete recovery time of COVID patients. If for 12 patients, he obtained a mean recovery time of 14 days and a standard deviation of 2.5 days, construct a 95% confidence interval for the population mean  $\mu$ .
3. Describe Wilcoxon signed-rank test for one sample. How do you proceed for paired data? Further suppose that, it is desired to test the hypothesis that the median value  $\mu$  of a continuous distribution is 15 against the alternative hypothesis  $\mu > 15$ . The following results were obtained: 17, 18, 16, 19, 14, 21, 19, 13, 17 and 14. Use  $\alpha = 0.05$ .
4. What do you understand by ~~is~~ Yate's correction? When do you apply it? The following data was collected on two characters:

	Mask-wearers	Non mask-wearers	Total
Literate	83	57	140
Illiterate	45	68	113
Total	128	125	253

Based on this, can you conclude that there is no relation between the habit of wearing a mask and literacy? ( $\chi^2_{0.05, 3} = 7.815, \chi^2_{0.05, 2} = 5.991, \chi^2_{0.05, 1} = 3.841$ )

Next suppose a random sample of 400 men and 600 women were asked whether they would like to have a shopping mall near their residence. 200 men and 325 women were in favour of the proposal. Test the hypothesis that proportions of men and women in favour of the proposal are same against that they are not, at 1% level of significance.

5. For a two-way classified data with one observation per cell: Give the fixed effect mathematical model stating clearly: the assumptions used, the hypotheses to be tested, the test statistics to be used and the ANOVA Table. Also obtain: (i) the estimates of the parameters in the model and (ii) the expectation of the mean square error.
6. What do you understand by 'Experimental error'? What are its main sources? What methods are adopted to increase the accuracy of an experiment? How do shape and size of the plots and blocks influence the experimental error?

An experiment was carried out on wheat with three treatments in four randomised blocks. Complete the following table for the analysis of variance of a fixed effects randomised block design:

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	Variance ratio
Blocks	3	6.67	-	-
Treatments	2	-	-	-
Error	-	-	2.22	
Total	-	28		

Test the hypothesis that the treatment effects are equal to zero, showing all the steps in the general test procedure. ( $F_{0.05}(2, 6) = 5.14$ ,  $F_{0.05}(3, 6) = 4.76$ )