

K22U 3674

Reg. No. :

Name :

**Third Semester B.Sc. Honours in Mathematics Degree (C.B.C.S.S. –
Regular) Examination, November 2022
(2021 Admission)**

3B12BMH : ADVANCED STATISTICAL TECHNIQUES – I

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **any four** questions from the following. **Each** question carries **1** mark :

1. Define the 'error of estimate'.
2. What is direct correlation ?
3. Show that two independent variables are uncorrelated.
4. Point out one difference between one-tail test and two-tail test.
5. Derive the expressions for the standard error of the mean of a random sample of size n .

SECTION – B

Answer **any six** questions. **Each** question carries **2** marks :

6. Write the normal equations for the best fit of the straight line $Y = a + bX$.
7. Convert the curve $Y = 2 \times 3^x$ into a straight line.
8. Give an example that two uncorrelated variables may not be independent.

P.T.O.

K22U 3674

-2-

9. Define the following terms :

- i) Linear Regression.
- ii) Curvilinear Regression.

10. Write Spearman's formula for the rank correlation coefficient.

11. What is a null hypothesis ?

12. Give an example of a two-tailed test.

13. A random sample of 500 pineapples was taken from a large consignment and 65 were found to be bad. Show that the S.E. of the proportion of bad ones in a sample of this size is 0.015.

14. Derive the expressions for the standard error of the difference of the means of two independent random samples of sizes n_1 and n_2 .

SECTION – C

Answer **any eight** questions. **Each** question carries **4** marks :

15. Explain the method of fitting of the curve $Y = a + bX + cX^2$.

16. Show that the correlation coefficient r between two random variables X and Y is given by $r = \frac{\sigma_X^2 + \sigma_Y^2 - \sigma_{X-Y}^2}{2\sigma_X\sigma_Y}$ where σ_X , σ_Y and σ_{X-Y} are standard deviations of X , Y and $X - Y$ respectively.

17. The variables X and Y are connected by the equation $aX + bY + c = 0$. Show that the correlation between them is -1 if the signs of a and b are alike and $+1$ if they are different.

18. If X and Y are discrete random variables. If $\text{Var}(X) = \text{Var}(Y) = \sigma^2$ and $\text{Cov}(X, Y) = \sigma^2/2$. Find
i) $\text{Var}(2X - 3Y)$ and
ii) $\text{Corr}(2X + 3, 2Y - 3)$.

19. Define the following terms :

- i) Type I Error
- ii) Type II Error
- iii) Critical Region
- iv) Level of significance.



20. A dice is thrown 9000 times and a throw of 3 or 4 is observed 3240 times. Show that the dice cannot be regarded as an unbiased one.
21. Twenty people were attacked by a disease and only 18 survived. Will you reject the hypothesis that the survival rate, if attacked by this disease is 85% in favour of the hypothesis that it is more, at 5% level by using large sample test ?
22. A normal population has a mean of 0.1 and standard deviation of 2.1. Find the probability that mean of a sample of size 900 will be negative.
23. The guaranteed average life of a certain type of electric light bulbs is 1000 hours with a standard deviation of 125 hours. It is decided to sample the output so as to ensure that 90 percent of the bulbs do not fall short of the guaranteed average by more than 2.5 percent. What must be the minimum size of the sample ?
24. Let \bar{x}_1 be the mean of a random sample of size n_1 from a population with mean μ_1 and variance σ_1^2 and let \bar{x}_2 be the mean of an independent random sample of size n_2 from another population with mean μ_2 and variance σ_2^2 . Show that, under the hypothesis $H_0 : \mu_1 = \mu_2$, the test statistics Z follows the normal distribution with mean 0 and standard deviation 1.
25. Show that if x_1, x_2, \dots, x_n is a random sample of size n from a normal population with mean μ and variance σ^2 , then the sample mean is distributed normally with mean μ and variance $\frac{\sigma}{\sqrt{n}}$.
26. Explain the terms "Standard Error" and "Sampling Distribution". Show that in a series of n independent trials with constant probability p of success, the standard error of the proportion of successes is $\sqrt{\frac{pq}{n}}$, where $q = 1 - p$.



SECTION - D

- Answer **any two** questions. **Each** question carries **6** marks :
27. Fit a curve of the form $Y = ab^x$ to the following data.
- | X | Y |
|---|-----|
| 1 | 1 |
| 2 | 1.2 |
| 3 | 1.8 |
| 4 | 2.5 |
| 5 | 3.6 |
| 6 | 4.7 |
| 7 | 6.6 |
| 8 | 9.1 |
28. In a partially destroyed laboratory record of an analysis of correlation data, the following results only are legible : Variance of X = 9, regression equations $8X - 10Y + 66 = 0$, $40X - 18Y = 214$. What were
- The mean values of X and Y
 - The correlation coefficient between X and Y
 - The standard deviation of Y ?
29. Describe the following :
- Purposive sampling
 - Random sampling
 - Stratified sampling
 - Systematic sampling.
30. In a survey of buying habits, 400 women shoppers are chosen at random in super market 'A' located in a certain section of the city. Their average weekly food expenditure is Rs. 250 with a standard deviation of Rs. 40. For 400 women shoppers chosen at random in super market 'B' in another section of the city. The average weekly food expenditure is Rs. 220 with a standard deviation of Rs. 55. Test at 1% level of significance whether the average weekly food expenditure of the two populations of shoppers are equal.