K24U 0751

Reg. No. : .....

Name : .....

IV Semester B.Sc. Degree (CBCSS – OBE – Regular/Supplementary/ Improvement) Examination, April 2024
(2019 to 2022 Admissions)
COMPLEMENTARY ELECTIVE COURSE IN STATISTICS FOR MATHEMATICS/COMPUTER SCIENCE
4C04STA : Statistical Inference

Time : 3 Hours Max. Marks : 40

***Instruction** : **Use** of calculators and statistical tables are **permitted**.*

PART – A **(Short answer)**

Answer **all 6** questions. **(6×1=6)**

1. Define convergence in probability.
2. State Bernoulli's law of large numbers.
3. When do you say an estimator is consistent ?
4. Write an example of an estimator that is sufficient and unbiased.
5. Define null and alternative hypotheses.
6. Write the assumptions of Student's t test.

PART – B **(Short essay)**

Answer **any 6** questions. **(6×2=12)**

7. Explain weak law of large numbers.
8. Find the least value of $P\{|X - 5| < 3\}$ using Chebyshev's inequality if X is a random variable with a mean of 5 and a variance of 3.

P.T.O.

9. Why do we say that "the Cramer-Rao inequality provides a lower bound to the variance of an unbiased estimator" ?

10. Consider a random sample of observations 2.5, 4.1, –1.2, –2.6 drawn from a Normal population with population variance 4. Obtain the 99% confidence interval for the population mean.

11. State Neyman-Pearson lemma.

12. Define :
    i) Critical region and
    ii) Most powerful critical region.

13. Distinguish between type I error and type II error.

14. Write the test statistic and critical region for the large sample test for testing the equality of population proportions of two independent populations.

PART – C **(Essay)**

Answer **any 4** questions. **(4×3=12)**

15. State and prove Chebyshev's inequality.

16. For the geometric distribution, $f(x, \theta) = \theta (1 - \theta)^{x-1}$, $x = 1, 2,...; 0 < \theta < 1$; show that the sample mean $\bar{x}$ is an unbiased estimator of $\frac{1}{\theta}$.

17. Derive the $100(1 - \alpha)\%$ confidence interval for the proportion of success of a Binomial population.

18. Explain the steps involved in large sample test for testing the significance of an assumed population proportion.

19. Illustrate the procedure for testing the significance of an assumed population variance of a normal population.

20. A random sample of 6400 men from Country A has a mean height of 172 cm with a standard deviation of 6.5 cm, while a sample of heights of 2500 men from Country B has a mean of 175 cm with a standard deviation of 6.4 cm. Do the data indicate that the men from Country B are taller than those from Country A ? Use $\alpha = 0.05$.

PART – D **(Long Essay)**

Answer **any 2** questions. **(2×5=10)**

21. i) Explain the method of moments estimation technique.
    ii) Consider the binomial distribution with pmf $f(x) = {}^{n}C_{x}p^{x}(1-p)^{n-x}$, $x = 0, 1,...,n$. Estimate p by the method of moments.

22. To test the hypothesis $H_0 : \theta = 2$ against $H_1 : \theta = 5$ based on a random variable with pdf $f(x) = \frac{1}{\theta}e^{-\frac{x}{\theta}}$, $x > 0$. Compute the level of significance and power of the test if the critical region is $X > 3$.

23. Describe the Student's t tests for testing the equality of population means of two normal populations when the populations are
    i) independent and
    ii) not independent

24. The following table gives the length of lives of electric bulbs produced by 3 companies. Examine whether the durability of the bulb produced by the different companies differ at 5% level of significance.

Company	**Durability in hours**				
I	1550	1560	1600	1630	1650
II	1530	1590	1650	1700	
III	1410	1500	1550	1570	1590

K23U 1147

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PART – A **(Short answer)**

Answer **all 6** questions. **(6×1=6)**

1. Define convergence in distribution.
2. State Cramer-Rao inequality.
3. Define estimator.
4. What do you mean by interval estimation ?
5. Write any two properties of maximum likelihood estimate.
6. State Naymann - Pearson Lemma.

PART – B **(Short essay)**

Answer **any 6** questions. **(6×2=12)**

7. Find the least value of probability P $\{1 \leq x \leq 7\}$ when x is a random variable, with E(X)=4 and V(X) =4.
8. Explain the weak law of large numbers.
9. Explain consistency with an example.
10. $X_1, X_2 \ldots\ldots X_n$ is a random sample from a population with mean θ and variance one. Show that both X_1 and $\overline{X}$ are unbiased for θ. Compare their efficiencies.

P.T.O.

11. Find the maximum likelihood estimate for the probability density function $f(x,\theta) = \theta e^{-x\theta} X > 0, \theta > 0.$

12. Derive 95% confidence interval for the mean of normal population N (μ, σ) when σ is unknown.

13. What do you mean by statistical hypothesis ? Also explain simple and composite hypothesis.

14. Define analysis of variance. What are the assumptions of one-way analysis of variance ?

PART – C **(Essay)**

Answer **any 4** questions. **(4×3=12)**

15. State and prove Chebyshev's inequality.

16. Show that sample mean is sufficient for population mean when x follows Poisson distribution with parameter m.

17. Estimate θ in the density function $f(x,\theta) = (1+\theta)x^{\theta}, 0 < x < 1$ by the method of moments.

18. A medical study showed 57 of 300 persons failed to recover from a particular disease. Find 95% confidence interval for the mortality rate of the disease.

19. Explain paired t-test.

20. Explain chi square test of independence.

PART – D **(Long Essay)**

Answer **any 2** questions. **(2×5=10)**

21. Find probability of type one error and power of the test which rejects H_o : if $x > 1 - \alpha$ in favour of H_1 if X has pdf $f(x) = \theta x^{\theta-1}, 0 < x < 1$ with H_o : $\theta = 1$ and H_1: $\theta = 2$.

22. The following are samples from two independent normal populations. Test the hypothesis that they have the same mean assuming that the variances are equal by taking 5% level of significance.

Sample 1:	14	18	12	9	16	24	20	21	19	17
Sample 2:	20	24	18	16	26	25	18			

23. The theory predicts the proportion of beans in the four groups A, B, C, D should be 9 : 3 : 3 : 1. In an experiment among 1600 beans the numbers in the four groups were 882, 313, 287, 118. Does the experimental result support the theory ?

24. From different drugs have been developed in a certain disease. These drugs are used in 3 different hospitals and the result given below, show the number of cases of recovery from the disease per 100 people who have taken the drugs.

	A1	**A2**	**A3**	**A4**
B1	19	8	23	8
B2	10	9	12	6
B3	11	13	13	10
