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Name: ………………………

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Statistics Degree Examination, November 2022

MST1C02 – Analytical Tools for Statistics – II

(2022 Admission onwards)

Time : 3 hours Max. Weightage : 30

Part A

Short Answer Type questions

(Answer any four questions. Weightage 2 for each question)

1. Check the independence of the vectors $(3,1,2),(5,2,3),(2,3,-1)$.
2. Define inner product and inner product space.
3. Define Hermitian and skew Hermitian matrices. Give examples.
4. Definerank of a matrix. Prove that if A is an idempotent matrix, then rank(A)=trace(A).
5. Define characteristic root and characteristic vector of a matrix. Show that characteristic roots of idempotent matrix areeither 0 or 1.
6. Define gram matrix and discuss its definiteness.
7. Define Moore-Penrose inverse and show that it is unique.

(4 x 2= 8 weightage)

Part B

Short Essay Type/ problem solving type questions

(Answer any four questions. Weightage 3 for each question)

8. Define subspace of a vector space and give an example. Show that linear span of a set of vectors is a subspace.
9. Define orthogonal and orthonormal basis and obtain the orthogonal basis of the set of vectors $\{(1,1,1,1),\ (1,2,4,5),(1,-3,-4,-2)\}$.
10. Define rank factorization of the matrix A. Obtain the rank factorization of $A=\begin{bmatrix}2 & 1 & 4\\ 1 & \frac{1}{2} & 2\\ 0 & 0 & 0\end{bmatrix}$.
11. Show that the sum of the characteristic roots of the matrix A is the trace of A and the product of the characteristic roots of A is the determinant of A.
12. Define geometric and algebraic multiplicities of the eigen values of a matrix.Obtain the eigen values and eigen vectors of the matrix $A=\begin{bmatrix}4 & -6 & 2\\ 0 & 2 & -4\\ 0 & 0 & 3\end{bmatrix}$.

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Statistics Degree Examination, November 2022

MST1C03 – Probability Theory – I

(2022 Admission onwards)

Time : 3 hours Max. Weightage : 30

Part A: Short answer type questions.
(Answer any four questions. Weightage 2 for each question)

1. Distinguish between a field and a sigma field. Show that intersection of two fields is a field.
2. Define conditional probability. Show that conditional probability satisfies the axioms of probability.
3. What you mean by distribution function of a random variable? Prove that a distribution function is right continuous.
4. Define a simple function. Explain how you define the integration of a nonnegative measurable function using a sequence of simple function.
5. Define moment generating function of a random variable. Explain any one of its use by an example.
6. Define a product measure. State Fubini's theorem.
7. State and prove Cr-inequality.

Part B :Short essay/problems
(Answer any four questions. Weightage 3 for each question.

8. Explain the concept of sigma field generated by a class of sets. Illustrate it with the help of an example. Show that sigma field generated by open intervals and closed intervals are one and the same.
9. An unbiased coin is tossed three times. Let X denotes the number heads. Construct the sigma field induced by the random variable X and the probability measure induced by the random variable.
10. Show that a distribution function can have at the most a finite number of discontinuity points.

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Statistics Degree Examination, November 2022

MST1C04 – Distribution Theory

(2022 Admission onwards)

Time : 3 hours Max. Weightage : 30

Part A
Answer any four (2 weightages for each)

1. Define factorial moments. Derive the first four raw moments using factorial moments.
2. Derive the binomial distribution from Poisson distribution.
3. Explain Pearson system of distributions. Write an example.
4. Establish that E(X) does not exist for the Cauchy distribution.
5. Define Multivariate Normal distribution.
6. Derive the Characteristic function of Multivariate Normal distribution.
7. Define noncentral t statistic.

(2 x 4=8weightages)

Part B
Answer any four (3 weightages each)

8. Determine the P.G.F. of a binomial distribution with parameters n and p. The probability mass function may then be derived from this.
9. Demonstrate that the Hyper geometric distribution tends to the Binomial distribution under specific conditions (to be described).
10. Derive the MGF of Gamma distribution. Then Check that is holds additive property
11. Define lack of memory property. Show that exponential distribution holds lack of memory property good.
12. Let $X \sim U(0,1)$. Then based on a sample of size n, find the distribution for maximum and minimum.
13. Derive non-central F distribution.
14. State central t distribution, Also derive central F distribution from central t distribution

(3 x 4=12weightages)

Part C

Answer any two(5 weightages each)

15. Demonstrate the convergence of the following distributions.

    A. Poisson to exponential

    B. Binomial to Poisson

16. **A)** Derive discrete uniform distribution from continuous uniform distribution

    B) Derive geometric distribution from exponential distribution

17. Let $f(x, y, z) = e^{-x-y-z}$, $x > 0, y > 0, z > 0$, and $= 0$ otherwise, be the joint PDF of (X, Y, Z). Compute $P\{X < Y < Z\}$ and $P\{X = Y < Z\}$.

18. Let $X \sim N(0,1)$, then based on a sample of size n, prove that sample mean and sample variance are independent.

(5 x 2=10 weightages)

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

First Semester M.Sc Statistics Degree Examination, November 2022

MST1C05 – Sampling Theory

(2022 Admission onwards)

Time : 3 hours Max. Weightage : 30

Part A
Short Answer Type Questions
Answer any four questions. (Weightage 2 for each question)

1. What are the principles of sampling theory?
2. What are the principles of stratification?
3. What is Multi-Phase Sampling? Why it is differed from Multistage Sampling?
4. Explain Murthy's unordered estimator
5. Write a situation where two stage sampling is applicable?
6. Prove that in ratio estimation $B(\hat{R}) = -Cov(\hat{R}, \overline{x}) / \overline{X}$
7. Prove that the sample proportion is an unbiased estimator of population proportion.

(4 x 2 = 8 weightage)

Part B
Short Essay Type / Problem solving type questions
Answer any four questions. (Weightage 3 for each question)

8. Obtain an unbiased estimate of population mean in simple random sampling with replacement. Find the variance of the estimate.
9. Show that sample mean is an unbiased estimate of population mean in stratified random sampling. Also find its variance.
10. Show that Var $(\overline{y_s ys}) = \frac{N-1}{Nn}(1+(n-1)\rho)S^2$, where ρ is the interclass correlation between the units of the same systematic sample.
11. Derive Hartley - Ross unbiased ratio type estimator.
12. Derive the variance of unbiased estimator for mean per element under cluster sampling in terms of intracluster correlation.
13. Distinguish between census and sampling. Why we prefer Sampling?
14. Write about π **ps** sampling.

(4 x3=12 weightage)

Part C

Long Essay Type questions

Answer any two questions. (Weightage 5 for each question)

15. Explain the methods of allocation in stratified sampling and find efficiency of variances and compare them.
16. (a) Differentiate between Cumulative Total Method and Lahiri's method. Explain them with the help of an example.

    (b) Prove that in PPS sampling without replacement, Desraj ordered estimator is unbiased for population total. Derive its sampling variance.
17. (a)Derive the sampling variance of regression estimator.

    (b)Explain circular and linear systematic sampling with the help of an example.
18. a)State the principal steps involved in conducting a sample survey.

    (b) What are non -sampling errors? Explain its sources.

(2 x5=10 weightage)