

## Mathematical Statistics

The Mathematical Statistics (MS) test paper comprises of Mathematics (40% weightage) and Statistics (60%weightage).

Mathematics

**Sequences and Series:** Convergence of sequences of real numbers, Comparison, root and ratio tests for convergence of series of real numbers.

**Differential Calculus:** Limits, continuity and differentiability of functions of one and two variables. Rolle's theorem, mean value theorems, Taylor's theorem, indeterminate forms, maxima and minima of functions of one and two variables.

**Integral Calculus:** Fundamental theorems of integral calculus. Double and triple integrals, applications of definite integrals, arc lengths, areas and volumes.

**Matrices:** Rank, inverse of a matrix. systems of linear equations. Linear transformations, eigenvalues and eigenvectors. Cayley-Hamilton theorem, symmetric, skew-symmetric and orthogonal matrices.

**Differential Equations:** Ordinary differential equations of the first order of the form  $y' = f(x,y)$ . Linear differential equations of the second order with constant coefficients.

**Statistics Probability:** Axiomatic definition of probability and properties, conditional probability, multiplication rule. Theorem of total probability. Bayes' theorem and independence of events.

**Random Variables:** Probability mass function, probability density function and cumulative distribution functions, distribution of a function of a random variable. Mathematical expectation, moments and moment generating function. Chebyshev's inequality.

**Standard Distributions:** Binomial, negative binomial, geometric, Poisson, hypergeometric, uniform, exponential, gamma, beta and normal distributions. Poisson and normal approximations of a binomial distribution.

**Joint Distributions:** Joint, marginal and conditional distributions. Distribution of functions of random variables. Product moments, correlation, simple linear regression. Independence of random variables.

**Sampling distributions:** Chi-square, t and F distributions, and their properties.

**Limit Theorems:** Weak law of large numbers. Central limit theorem (i.i.d. with finite variance case only).

**Estimation:** Unbiasedness, consistency and efficiency of estimators, method of moments and method of maximum likelihood. Sufficiency, factorization theorem. Completeness, Rao-Blackwell and Lehmann-Scheffe theorems, uniformly minimum variance unbiased estimators. Rao-Cramer inequality. Confidence intervals for the parameters of univariate normal, two independent normal, and one parameter exponential distributions.

**Testing of Hypotheses:** Basic concepts, applications of Neyman-Pearson Lemma for testing simple and composite hypotheses. Likelihood ratio tests for parameters of univariate normal distribution.