

Essentials of Mathematics

Functions. Global/local maximum and minimum. Infimum, supremum. Concavity and convexity of functions of one or more variables. Limits of functions of one and more variables. Continuity, derivability and differentiability of functions of one or more variables. Polynomial expansions (Taylor's and Mc Laurin's expansions) of one or more variables. Necessary and sufficient conditions for local maxima and minima of differentiable functions of one or more variables. Criteria for concavity and convexity of differentiable functions of one or more variables. Constrained optimization, Lagrange multipliers. Numerical sequences, convergence and divergence criteria. Numerical series and series of functions, uniform convergence, radius of convergence. Riemann integral, integrability of continuous functions, and monotonic functions. Improper integrals. Mean value theorem for integrals. Fundamental theorem of calculus. Computation of indefinite and definite integrals by means of different methods such as: immediate integrals, integrals by parts, integrals by substitution, integrals of rational functions. Riemann-Stieltjes integral.

Essentials of Probability

Classical approach, frequentist, subjectivist and axiomatic of probability. Probability distributions of discrete random variables: Bernoulli, binomial, Poisson, geometric, negative binomial. Probability density functions and distributions functions of the continuous random variables: uniform, normal, negative exponential, gamma, Weibull, lognormal, Pareto. Mixed random variables. Moments of a random variable, moment generating function and its existence. Monotonic function of a random variable. Multivariate probability distributions. Covariance matrix and correlation coefficients.

Measure Theory

The course introduces to the theory of Lebesgue integration. After defining appropriate structures of sets such as algebras, semi- and sigma-algebras, we provide the notion of measures, and their main properties. We then constructively define integrals with respect to a given measure and state their most relevant properties.

Outline:

- classes of subsets: algebras, semi-algebras, sigma-algebras, monotone classes
- measures: definition and properties, finite- and sigma-additivity;
- measurable functions
- Lebesgue integrals: construction and properties
- convergence theorems