



KRISTU JAYANTI
(DEEMED TO BE UNIVERSITY)
Under Section 3 of UGC Act 1956
A CMI INSTITUTION | BENGALURU | INDIA

Centre for Research and Development

Office of Doctoral Studies

Syllabus for Part B of

Kristu Jayanti University Entrance Test (KJUET)

Ph. D. Programme in Statistics

Unit 1: Linear Algebra

Vector space, subspace, linear dependencies and independencies, orthogonal basis, Gram Smith orthogonalization process, Special types of matrices: symmetric, idempotent, orthogonal matrix etc. System of linear equations. Eigenvalues and eigenvectors, Caley Hamilton Theorem, spectral value decomposition. G-inverse, Moore-Penrose inverse. Quadratic form.

Unit 2: Descriptive Statistics and Exploratory Data Analysis

Descriptive statistics, exploratory data analysis. measures of central tendency, dispersion, and graphical representation of data. It also covers exploratory data analysis techniques for summarising and visualising data to identify patterns, trends, and variability.

Unit 3: Basic Probability and Distribution Theory

Random experiments, Sample space, Events and their types, Mathematical, Statistical and axiomatic approach of probability, Conditional probability, Bayes theorem. Random variable: Continuous & discrete R.V.'s, Probability mass function (pmf), probability density function (pdf), Distribution function and its properties, Two dimensional random variables, conditional distribution. Functions of RV's: Distribution function technique, Univariate and bivariate transformation. Expectation and variance and their properties, Moment generating function (mgf) and its properties. Continuous distributions: Uniform, exponential, normal, beta, gamma, Cauchy, Laplace, t, Chi-square. Discrete distributions: Bernoulli, Binomial, Geometric, Poisson, Hyper-geometric, negative binomial, multinomial.

Unit 4: Statistical Inference

Unbiasedness, consistency, sufficiency. Neyman factorization criterion, completeness. Minimum variance bound estimator, C-R inequality, Rao-Blackwell Theorem, Lehmann Scheffe theorem, Uniformly minimum variance unbiased estimators. Method of Maximum Likelihood, Method of moment, Interval estimation, Tests of hypothesis, concepts of critical regions, test functions, two kinds of errors, size function, power function, level, MP and UMP test, non-parametric tests.

Unit 5: Stochastic Processes

Types of the Stochastic Processes, Markov chain, transition probabilities matrix, Chapman Kolmogorov equation, n-step transition probabilities matrix, stationary distribution, classification of the states, Poisson process, pure birth process, pure death process, pure birth death process, branching process.

Unit 6: Design of Experiments

Analysis of Variance: Introduction, assumptions for ANOVA, One-way ANOVA, Two-way ANOVA, estimation of parameters, expectations of various sum of squares. Role, historical perspective, terminology, experimental error, basic principles, uniformity trials, Basic designs: Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD) layout, model and statistical analysis, relative efficiency. Factorial design: Basic definitions and principles, Advantages, main effect and interaction effects, 2^2 , 2^3 , 2^k factorial designs, Confounding in factorial designs, complete and partial confounding.

Unit 7: Sampling Techniques

Concepts and distinct features of probability sampling and non – probability sampling schemes, sampling designs and sampling error. SRSWOR and SRSWR related to the estimation of population mean/total and proportions. Stratified sampling and allocation problem in stratified random sampling, systematic sampling, cluster sampling. Ratio, regression and product estimators under simple random sampling as well as in double sampling. Unequal probability sampling: PPSWR/PPSWOR methods of sample selection and comparison with SRSWR schemes. Horvitz Thompson's, Yates and Grundy, π PS sampling scheme and some of its important results. Midzuno-Sen sampling scheme. Non-sampling errors, response and non-response errors, Hansen and Hurwitz's model and their treatments, randomized response, Warner's model.

Unit 8: Multivariate Analysis

Multivariate normal distribution- marginal and conditional distribution, characteristic function, properties of multivariate normal distribution, and distribution of quadratic forms, correlation matrix. Samples from multivariate normal distribution, MLE of mean vector and dispersion matrix. Wishart distribution: definition and properties. Hotelling's T^2 and Mahalanobis' D^2 distribution and properties. Discrimination and Classification problems, Principal components, extraction of principal components, canonical variables and canonical correlation, factor analysis and cluster analysis.

Unit 9: Regression Analysis

Simple linear regression: the least squares estimators and properties, testing the overall regression, individual parameters, confidence intervals for the parameters and expected value of the response. Multiple linear regression model: Gauss-Markov setup, the least squares estimators and properties, testing overall regression, individual coefficients, subset of coefficients, confidence interval for the parameters and expected value of the response variable, R^2 adjusted R^2 . General linear models. Non full rank model: Gauss-Markov setup, best linear

unbiased estimator, estimability of parameters. Residual analysis, subset selection. Generalized linear regression models: logistic regression, Poisson regression.

Unit 10: Quality Control

The principles of statistical quality control and process monitoring. control charts for variables and attributes. mean charts, range charts, p-charts, np-charts, c-charts, and u-charts, for detecting variations in processes. process capability analysis and the use of control charts in maintaining quality standards. acceptance sampling plans, single- and double-sampling plans, and concepts such as producer's risk and consumer's risk for decision-making in quality assurance.