STATISTICS

Unit 1: Events, Sample space, Probability measure and properties, Independent events, Conditional probability and Bayes' theorem, Measurable functions, random variables, sums, product and functions of random variables, sequence of random variables. Induced Probability measure, Distribution functions, Jordan decomposition theorem. Bivariate distributions-joint marginal and conditional distributions. Expectations and conditional Expectations.

Unit 2: Standard discrete and continuous univariate distributions and their properties, Probability generating function and moment generating function. Bivariate normal and Multinomial distributions, Transformation technique. Sampling distributions, Chi-square, t, F, non-central chi-square, non-central t, non-central F and their properties. Bivariate Negative Binomial, Beta and Gamma distributions. Markov, Chebyshev, Hoelder, Minkowski, Jensen, Liapunov inequalities. Relationship between tail of distributions and moments.

Unit 3: Monotone convergence theorem, Fatou's lemma and dominated convergence theorem. Various modes of convergences of a sequence of random variables and their implications. Weak law of large numbers- Ko1mogorov's generalized WLLN, Khintchine's WLLN, Chebyshev's WLLN. Borel-Cantelli lemma, Strong law of large numbers - Kolmogorov's SLLN's. Characteristic function - properties, Inversion theorems, Uniqueness theorem, Continuity theorem, Central limit theorem- Lindeberg-Feller, Levy-Lindeberg and Liapunov forms. Order Statistics- their distributions and properties, Extreme value distributions and their properties.

Unit 4: Sufficiency, completeness, Uniformly minimum variance unbiased estimators, C-R inequality, exponential class of densities and its properties, some special classes of distributions admitting complete sufficient statistics. Test function, Neyman- Pearson lemma for test functions. Uniformly most powerful tests for one sided alternative for one parameter exponential class of densities and extension to the distributions having monotone likelihood ratio property. Confidence Intervals, shortest expected length confidence intervals, relations with testing of hypotheses, uniformly most accurate confidence intervals.

Unit 5: Consistency and asymptotic normality (CAN) of real and vector parameters. Invariance of consistency under continuous transformation. Method of moments, method of maximum likelihood, Special cases such as exponential class of densities and multinomial distribution, Cramer-Huzurbazar theorem, method of scoring. Tests based on MLEs. Likelihood ratio tests, asymptotic distribution of log likelihood ratio, Wald Test, Score Test, locally most powerful tests. Pearson's chi-square test and LR test. Asymptotic comparison of tests. Asymptotic Relative Efficiency (Pitman's). Nonparametric tests.

Unit 6: Basic finite population sampling techniques (SRS WR/ WoR, stratified, systematic), related problems of population mean estimation, allocation problems in stratified sampling. Unequal probability sampling: PPS WR / WoR methods (including Lahiri's scheme) and related estimators of a finite population mean (Hansen-Hurvitz and Desraj estimators for a general sample size and Murthy's estimator for a sample of size 2). Ratio and regression estimators based on SRS WoR method of sampling, two-stage sampling with equal number of second stage units, double sampling, cluster sampling.

Unit 7: Gauss-Markov setup, normal equations and least squares estimates and their properties, estimation with correlated observations, least squares estimates with restriction and parameters. simultaneous estimates of linear parametric functions. Test of hypothesis for one and more than one parametric functions. Multiple comparison test like Tukey and Scheffe, simultaneous confidence interval. Simple linear regression, multiple linear regression, polynomial regression and use of orthogonal polynomials. Non-linear regression. Model adequacy, Multicollinearity, ridge and principal component regression. Validation of regression model.

Unit 8: Introduction to designed experiments; General block design and its analysis, BIBD, Youden square design. Analysis of covariance. Missing plot technique - general theory and applications. Variance components estimation - study of various methods; General factorial experiments, factorial effects: best estimates and testing the significance of factorial effects; study of 2^M and 3^M factorial experiments in randomized blocks. Complete and partial confounding.

Unit 9: Multivariate normal distribution, maximum likelihood estimators of parameters, distribution of sample mean vector, Wishart distribution and its properties. Sample correlation coefficient, partial and multiple Correlation coefficients. Application in testing and interval estimation. Hotellings- T^2 and its application in test on mean vectors for single and several multivariate normal populations. Multivariate linear regression model. Classification and discrimination procedures, Principal components.

Unit 10: Random walk and gambler's ruin problem. Discrete state space, discrete time and continuous time Markov Chains, Transience, Recurrence, Periodicity, Kolmogorov- Feller differential equations; Poisson process, birth and death process; Renewal theory: Elementary renewal theorem and applications. Statement and uses of key renewal theorem; study of residual life time process. Stationary process: weakly stationary and strongly stationary. processes: Moving average and auto regressive processes. Galton-Watson branching process, Martingales in discrete time.