

## Syllabus of Ph.D. Entrance Examination

### 21. STATISTICS

- 1. Statistical Methods:** Measures of central tendency, dispersion, skewness, kurtosis, correlation, regression, interpolation, extrapolation, index numbers, time series and vital statistics.
- 2. Sampling Methods:** simple random Sampling, stratified sampling, systematic sampling, ratio and regression methods, cluster sampling, two-stage sampling, double sampling, Non cxsampling errors.
- 3. Design of Experiments:** Block designs, CRD, RBD, LSD, BIBD, PBIPD, Factorial designs, confounding in block designs.
- 4. Probability:** Compound probability, conditional probability, bayes theorem, expectation, MGF, characteristic function, Inversion and continuity theorems for C. F., Kolmogorov's inequality, The weak law of large numbers, The strong law of large numbers, Bernoulli's, Kintchine's theorems, Central limit theorem.
- 5. Testing of Hypothesis:** Null hypothesis, alternative hypothesis, simple and compound hypothesis, errors in testing, Neyman Pearson Lemma and its generalization, UMP Tests, Unbiased Tests, UMPU Tests, Tests with Neyman structure and UMP similar tests, Likelihood Ratio tests and their large sample properties along with simple applications.
- 6. Estimation:** Elements of Decision Theory, Admissibility, Properties of good estimators, Unbiasedness, Efficiency, Sufficiency and completeness, Cramer –Rao inequality and

it's generalization, Bhattacharya's Bounds, Characteristics of distribution admitting sufficient statistic, Rao-Blackwell Theorem and Lehmann - Scheffe theorem. Method of Estimation, Method of Maximum Likelihood, Method of Moments, Method of Chi-Square, Properties of M.L.E.

7. **Multivariate Analysis:** Singular and Non Singular Multivariate Normal distributions, Marginal and Conditional distributions, Characteristic Function and Moment Generating Functions, Maximum Likelihood Estimation of Mean and Co-Variance matrix, independence and joint sufficiency for these estimates, Hotelling's  $T^2$  statistic as a function of the Likelihood Ratio criterion, It's distribution and applications, Mahalanobis  $D^2$  statistic and it's distribution, Discriminant function(for two variables), Principal Components and Canonical Correlations. Path Analysis, Factor Analysis, Discriminant Analysis, MANOVA.
8. **Non-parametric Inference:** Tests for randomness, tests for goodness of fit, one sample and two sample tests, Linear rank statistic and general two way sample problem, Linear Rank tests for location and scale problems, Rank test for one way and two way classified data, Multivariate non parametric test for one sample location problems, Asymptotic relative efficiency, examples of ARE tests.
9. **Stochastic Process and Reliability Theory:** Definition of Stochastic processes, Markov Chain, one step and n- step transition probabilities, Chapman-Kolmogorov Equation, first passage and first return probabilities, classification of states, Markov Chains with continuous state space, Poisson Processes, Birth and death processes, elements of Markov

Process. Definition of Reliability , Maintainability and Availability, Life distributions, failure rates and bath tub failure curve, exponential, Gamma, Weibull and Log Normal models, Linearly increasing Hazard model, mean time to system failure and mean time between failure components and system reliability, series and parallel configuration, Active and standby redundancy and preventive Maintenance.

**10. Bayesian Inference and Econometrics:** General structure of a Bayesian Decision problem, role of loss function, Risk function, Prior information, Application of Bayes theorem in computing posterior distributions, Bayes estimators of the posterior mean under squared error loss, Bayesian notion of sufficiency, construction of conjugate priors, improper and diffuse priors. Construction of economic models, Endogenous and Exogenous Variables, concept of Multicollinearity, Identification Problems, rank and order condition of Identifiability, identification under bilinear restrictions, identifiability everywhere in the parametric space, WALA'S criterion of identification.