

## **Statistical Inspector**

### **Syllabus**

---

#### **Statistics**

Probability – Definitions, Limit of Sequence of events, monotone and continuity properties of probability measure, conditional probability, Bayes' Theorem, Borel – Cantelli lemma, Borel Zero-one law, Kolmogorov zero -one law. Random variables, probability distribution and distribution function -its properties, Moment generating function and characteristic function. Law of large numbers, Central limit theorem.

Standard distributions:-Uniform , Binomial, Poisson, Geometric, Hypergeometric, Normal, Exponential, Pareto, Gamma and Beta distributions and their characterizations, sampling distributions - Chi square, t, F distributions and their properties and applications. Multivariate normal distribution:-properties and characteristics

Probability and non-probability sampling, Sampling design, Probability sampling methods – Simple random sampling, Systematic sampling, Stratified random sampling, Cluster sampling , Multi – stage sampling, PPS sampling, Non-Probability sampling methods; Principles of Design of Experiments, Completely Randomized design, Randomized Block Design, Latin square design, Incomplete block design, BIBD, PBIBD, Factorial experiments  $2^2$  ,  $2^3$  ,  $3^2$  and  $3^3$ .

Point estimation – properties of estimators, BLUE, UMVU estimators, Interval estimation ,methods of estimation – MLE, Method of moments, Minimum chi square, Testing of hypothesis – Types of hypothesis, significance level, power of a test, Most powerful Test, UMP test, Unbiased test, Likelihood ratio, Analysis of variance.

#### **Agricultural Statistics**

Concepts of compound, truncated and mixture distributions (definitions and examples). Sampling distributions of sample mean and sample variance from Normal population, central and non-central chi-Square, t and F distributions, their properties and inter relationships. Order statistics, distribution of r-th order statistics, joint distribution of several order statistics and their functions, marginal distributions of order statistics.

Non-parametric tests: Sign test, Wilcoxon signed rank test, Runs test for randomness, Kolmogorov – Smirnov test for goodness of fit, Median test and Wilcoxon-Mann-Whitney U-test. Chi-square test for goodness of fit and test for independence of attributes. Spearman's rank correlation and Kendall's Tau tests for independence.

Wishart distribution and its simple properties. Hotelling's  $T_2$  and Mahalanobis  $D_2$  statistics. Concepts of discriminant analysis, computation of linear discriminant function, classification between  $k$  multivariate normal populations

Split plot and strip plot designs, analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, Balanced Incomplete Block Design, resolvable designs and their applications. Factorial experiments, Concept of confounding

Principal Component Analysis, factor analysis. Canonical variables and canonical correlations. Cluster analysis: similarities and dissimilarities of qualitative and quantitative characteristics, Hierarchical clustering. Single, Complete and Average linkage methods. K-means cluster analysis.

### **Mathematics**

System of linear equations; Elementary matrices, the process of Gaussian elimination, Row reduced echelon matrices, Rank of a matrix. Determinants-Eigen values and eigenvectors, characteristic equations. Vector space- Examples and properties, subspaces, linear independence of vectors, finite vector spaces, basis, dimensions, linear transformations, and Representation of linear transformations as matrices.

Groups, subgroups, normal subgroups, cyclic groups, permutation groups, group homomorphism, isomorphism, isomorphism theorems, Sylow theorems and applications. Rings and fields, examples.

Algebraic and completeness properties of real numbers, intervals, cluster points, open and closed set, sequence and their limits, monotone sequences, subsequences, divergent sequences, Limit of functions, continuous functions, combination of continuous functions, sequence of functions, uniform convergence and pointwise convergence, properties of Riemann integral, integral as a limit, convergence of infinite series, test of convergence, series of functions, derivatives.

Analytic and harmonic functions, Cauchy Riemann equations, analytic functions as mappings, Mobius transforms, power series representations of analytic functions, zero of analytic functions, singularities, residue theorem and applications in the evaluation of integrals.

Orthogonal trajectories, exact equations, Non-Linear differential equations of the first order, second order differential equations with constant or variable coefficient and their solutions, Simultaneous differential equations and their applications. Linear differential equations of first order., solution by successive approximation, Lipschitz condition, Picard's theorem-convergence of successive approximations, Power series solution of differential equation.

Construction of first order partial differential equations, solution of first order partial differential equations, solution using Charpit's method, solution using Cauchy's characteristics, solution by separation of variables.

Metric spaces, Open Sets, Closed Sets in Metric Spaces, Interior, Closure and Boundary, Continuous Functions, Complete Metric Spaces. Topological Spaces, Interior, Closure, and Boundary, Basis and Sub basis, Continuity and Topological Equivalence, Subspaces, Connectedness, Connected and Disconnected Spaces, Connected Subsets of the Real Line, Applications of Connectedness, Path Connected Spaces.

### **Econometrics**

Econometric modelling, relationship among economic variables, linear and non-linear economic models, single equation general linear regression model, basic assumptions, Ordinary least squares method of estimation for simple and multiple regression models; standard errors of estimated parameters, tests of significance and confidence interval estimation. Gauss Markov Theorem, properties of Least Squares estimates. Chow test, test of improvement of fit through additional regressors. Maximum likelihood estimation.

Heteroscedasticity, Auto-correlation, Durbin Watson test, Multi-collinearity. Stochastic regressors, Errors in variables, Use of instrumental variables in regression analysis. Dummy Variables. Distributed Lag models: Koyck's Geometric Lag scheme, Adaptive Expectation and Partial Adjustment Mode, Rational Expectation Models and test for rationality.

Simultaneous equation model: Basic rationale, Consequences of simultaneous relations, Identification problem, Conditions of Identification, Indirect Least Squares, Two-stage least squares, K-class estimators, Limited Information and Full Information Maximum Likelihood Methods, three stage least squares, Generalized least squares, Recursive models, SURE Models. Mixed Estimation Methods, use of instrumental variables, pooling of cross-section and time series data, Principal Component Methods.

Demand analysis – Demand and Supply Curves; Determination of demand curves from market data. Engel's Law and the Engel's Curves, Income distribution and method of its estimation, Pareto's Curve, Income inequality measures.

Time Series Analysis - Stationarity & Non Stationarity-Random Walk Models-Autocorrelations and Partial Autocorrelation Functions-Unit roots and Units roots tests-ARMA and ARIMA modelling.

-----