Tamil Nadu Public Service Commission

Statistics and Mathematics (PG Degree Standard)

Code: 506

Unit I: Probability and Distribution Theory (25 Questions)

Random variables and Distribution function, Distribution function of a random vector – Mathematical expectation and conditional expectation

Chebychev's inequality – Convergence in probability – Convergence in distributions – Weak and Strong laws of large numbers – Central limit theorems (Lindeberg-Levy, Liapunov's)

Introduction to distributions:

Discrete distributions: Negative binomial and Hyper geometric distributions

Continuous distributions: Cauchy, Beta, Gamma, Weibull and Log-Normal.

Sampling distributions: Non central t, F and Chi-square distributions and their properties – Bivariate Binomial, Poisson Normal and their properties.

Unit II: Estimation Theory and Testing of Hypotheses (25 Questions)

Introduction to estimation theory and properties of estimators.

Theorems and inequalities: Cramer – Rao inequality, Batacharya inequality, Rao – Blackwell, Neyman – Fisher factorization theorems with examples.

Methods of estimation: Method of moments, Maximum likelihood, Minimum Chi-Square and method of least squares, Bayesian estimation – Introduction - Point and interval estimation and Bayes estimator under squared error loss function.

Introduction to testing of hypotheses: Basic concepts – More powerful Test - Neyman – Pearson lemma: UMP and unbiased tests – MLR property and its uses for construction of UMP tests.

Non-Parametric tests: Run test, Median test, Mann-Whitney test, Wilcoxon test, Kolmogoro-Smirnov test (one and two sample test procedures), Kruskal-Wallis test and SPRT test

Unit III: Regression analysis (20 Questions)

Introduction to linear regression model – Simple and multiple regression models: Description of data model – Estimation and testing of hypotheses on regression coefficients – Adequacy measures – Predicted values and standard error – Evaluation of fit – Analysis of residuals.

Multicolinearity and its effects on inference and forecasting – Selection of variables – Forward selection procedure (step-wise method).

Introduction to Generalized Linear Models: Components of GLM – Logistic regression model- Classification in two population, Fitting and interpretation.

Unit IV: Sampling Theory and Design of Experiments (25 Questions)

Ratio and Regression estimators, estimation under double sampling – Cluster sampling – Two stage sampling – Sampling and Non sampling errors.

Contrasts: Linear and orthogonal contrasts – Linear models: Fixed, random.

Principles of experimental designs – Construction and analysis of 2^3 and 3^2 factional experiments – Partial and complete confounding – BIBD - PBIBD (Two Associates only) - Youden Square design.

Unit V: Statistical Quality Control and Time series (15 Questions)

Acceptance sampling: Sampling inspection – AOQL, LTPD, Producers' and consumers' risks – Single, double, sampling plans for attributes and variables – OC, ASN, ATI and AOQ curves. Six sigma – Overview and implementation.

Time series – Components, uses – Determination of trend by Method of moving averages, fitting of first and second order degree, seasonal indices and the estimate of the variance for random components, autoregressive, moving averages and ARIMA models.

Unit VI: Machine Learning Techniques through R and Python Languages (10 Questions)

Overview of R language – Defining the R project – Objects and data structures – Graphics using R language – Calculation of measures of central tendency, dispersion, correlation and fitting of regression lines (Linear and logistic).

Overview of Python Language – Regular expressions – Scientific libraries: Numpy, Scipy, Matplotlib and Pandas.

Machine Learning: Supervised learning – Classification (KNN and Naïve Bayes) and Regression (Linear and Logistic) techniques – Unsupervised learning (Clustering methods).

Unit VII: Algebra and Functional Analysis (20 questions)

Algebra: Groups – Subgroups – Normal subgroups – homomorphisms – Isomophism – Cayley's theorem – Cauchy's theorem – Sylow's theorem – Finite ablian groups – Rings – Euclidean rings – Polynomial rings – Polynomial over the rational field – Polynomials over Commutative rings – Division rings – Frobenius theorem.

Field: Finite fields – Wedderburn's theorem, Extension Fields.

Functional Analysis: Fundamentals of normed Linear spaces, bounded Linear maps on Banach spaces, open mapping theorem, Bounded operators of Hilbert spaces.

Unit VIII: Real and Complex Analysis (20 questions)

Limit, Continuity, types of discontinuities, infinite limits, function of bounded variation, metric spaces. Reimann Integral –Fundamental theorem of calculus – mean value theorem. Reimann Stieltjes Integral.

Complex Analysis: Local properties of analytic functions – Removable singularities Taylor's theorem - Zeros and poles, local mapping – maximum principle – Harmonic functions – power series expansions – Weierstrassis theorem – Taylor's series, Laurents series.

Unit IX: Differential Equations (20 questions)

Linear differential equations of higher order – Linear dependence and Wronskian basic theory – solutions in power series – Introduction to second order linear equations with ordinary points. Legendre equations and legender polynomial, Second order equations with regular singular points, Bessel equations. Partial differential equations; first order, Complete Integral, General Integral, Singular Integral, Compatible systems of first order equation, Charpit's method.

Unit X: Differential Geometry (20 questions)

Curves, analytic representation, arc length, tangent, oscillating plane, Curvature, torsion, formula of Frenet, Contact, natural equations, helices, involutes and evolutes, Elementary theory of surfaces – Analytic representation – first & second fundamental forms, normal – tangent form, developable surfaces, Euler's theorem, Dupin's indicatries – Conjugate directions, Triply orthogonal system of surface.

Note: Medium of Instruction is English only.

Date: 26.12.2024