Ph.D. Entrance Test - SYLLABUS - 2019

Statistics

Part - 1
Research Methodology (50%)

1. Research Methodology Introduction:
   Meaning of research, characteristic of research, objectives of research, classification of research, kind of research, types of research, research and scientific research.
2. Defining the Research Problem:
   Research problem, selecting the problem, necessity and techniques of defining the problem
3. Research Design:
   Meaning of research design, need for research design, features of good design, importance of research design, different types of research design, basic principles of experimental design.
4. Sampling Design:
   Census and sample survey, implications and steps in sampling design, criteria and characteristic of good sample design, types of sample design.
5. Measures and Scaling Techniques:
   Measurement in research, measurement scales, sources of error in measurement, techniques of measurement tools, meaning of scaling and its classification.
6. Method of Data Collection:
   Collection of primary data, observation method, types of collection of data, other methods of data collection, collection of secondary data.

Part - 2
Core Subject (Statistics) (50%)

1. Exploratory data analysis and Descriptive Statistics: Random Variables, Types of Variable and Data Types, Graphical Displays of Sample Data, Histograms, Box plot, Scatter plot, Bar chart, Measures of Centre Tendency, Measures of Dispersion, Moments, Skewness and Kurtosis.
2. Theory of Probability: Basic Ideas, Definitions and Properties. Conditional Probability and Independent Events, Bays Formula.
3. Classical Probability Distributions:
   Discrete Distributions: Bernoulli, Binomial, Poisson, Negative Binomial, Geometric, Hyper geometric,
   Continuous Distributions: Normal, Uniform, Gamma, Beta distribution of first kind, Beta distribution of second kind, Exponential, Weibull, Cauchy, Central Limit Theorem.
4. Sampling Distributions: Chi-Square Distribution, t-distribution, F- distribution.
5. Statistical Inference and Hypothesis Testing: One sample tests, two sample tests, several sample tests. Applications: Case-Control Studies, Test of Association.
6. Correlation and Regression: Karl Pearson's Coefficient of Correlation, Spearman's

rank correlation coefficient, Linear Regression.

7. Power series distribution: its mean, variance, mgf, cgf, and recurrence relations. Various discrete distributions as its particular cases.
8. Sampling distributions: Non central chi square, t and f – distributions and their properties. Distributions of quadratic form under normality.
9. Vector space, subspace, linear dependence and independence, basis, dimension of a vector space, example of vector spaces.
10. Null space, Special types of matrices: elementary operations, rank of a matrix. Orthonormal basis and orthogonal projection of a vector. Gram-Schmidt orthogonalisation, Kroneckar product. Idempotent matrices, inverse of a matrix, their Simple properties, Partitioned Matrices, Orthogonal matrices.
11. Characteristic roots of a matrix, algebraic and geometric multiplicities, characteristic vectors and their orthogonal property. Caley-Hamilton Theorem and applications.
12. Balanced incomplete block design, its properties, parametric relations, intra block analysis of BIB design. Finite group and finite field geometry projective and Euclidean. Mutually orthogonal lattice square design. Construction of (1) MOLS and (2) BIB designs using MOLS, PG (N, S), EG(N, S) and other methods.
13. General factorial experiment, main effects and interaction effects. 2^n and 3^n factorial experiment. Analysis of 2^n and 3^n factorial experiments in randomized block. Confounding experiments: complete partial and balanced confounding and its ANOVA table.
14. Control charts for measurements and attributes x, R, S, p, np. Charts with sub grouping, CUSUM chart, tabular form and V-mask use of these charts for process control. Moving average and exponentially weighted moving average charts
15. Linear programming problem (LPP): Theorems related to the development of Simplex algorithm, Proof of the theorems related to a basic feasible solution (b.f.s); Reduction of a feasible solution to a basic feasible solution, Improvement of a basic feasible solution, Existence of unbounded solution, Optimality conditions. For other related theorems, statements only.
16. Transportation problem: North-West method, Least – Cost method, Vogel's approximation method, Modi method.
17. Assignment Problem: Introduction, Mathematical Statement, Hungarian Method, Variations of assignment problem.
18. Nature of econometrics: the general model (GLM) and its existence. Ordinary least square (OLS) estimation and prediction. Use of dummy variables. Generalized least square (GLS) estimation and prediction. Heteroscedastic disturbance.
19. Auto correlation, its consequences and tests. Their BLUE procedure. Estimation and prediction. Multi co linearity problem, its implication and tools for handling the problem. Ridge regression