Ph.D. Entrance
Statistics
w.e.f. 2025 - 2026

UNIT 1

Descriptive Statistics: Concepts of statistical population and sample, quantitative and qualitative data, Nominal, ordinal and time series data, discrete and continuous data. Presentation of frequency distributions by histogram and frequency polygon, cumulative frequency distributions and ogive curve. Measures of location and dispersion, measures of skewness and kurtosis, absolute moments and factorial moments, Sheppard corrections. Bivariate data, scatter diagram, principle of least squares. Simple and multiple Correlation and Regression analysis.

UNIT 2

Probability and probability distribution:

Definition of Probability. Classical and relative frequency approach to probability; Bayes theorem. Random variables and distribution functions, expectation and moments. Independent random variables, marginal and conditional distributions. Characteristic and generating functions. Probability inequalities (Tchebyshef, Markov, Jensen). Modes of convergence, weak and strong laws of large numbers, Central Limit theorems (i.i.d. case). Markov chains with finite and countable state space, classification of states, limiting behavior of n-step transition probabilities, stationary distribution. Poisson birth-and-death processes, Probability distributions: Binomial, Poisson, exponential, Negative Binomial, Geometric, Hyper geometric, Normal, uniform, beta, gamma, Cauchy and Laplace.

UNIT 3

Statistical Sample Survey and Experimental Design:

Sample Surveys: Basic sampling methods: Simple random sampling with or without replacement, Determination of sample size. Probability proportional to size sampling (with replacement). Stratified random sampling: Different allocations. Post-stratification. Ratio and Regression methods of estimation, optimality of regression estimator. Linear and circular systematic sampling, Cluster sampling, Two stage sampling (Sub-sampling) with equal first stage units. Completely randomized designs, randomized block designs and Latin-square designs. Connectedness and orthogonality of block designs, BIBD. 2^k factorial experiments: confounding and construction. Hazard function and failure rates, censoring and life testing, series and parallel systems.

UNIT 4

Statistical Inference:

Tests of significance: Null and alternative hypotheses, level of significance, Type I and Type II errors, critical region and p-value. Large sample tests, use of CLT for testing single proportion, difference of two proportions, single mean, difference of two means, standard deviation and difference of standard deviations. Tests of significance based on t, F and Chi-square distributions.

Estimation: Parametric space, sample space, point estimation. Requirements of good estimator: Consistency, unbiasedness, efficiency, sufficiency and completeness. Minimum variance unbiased (MVU) estimators. Cramer-Rao inequality. Minimum Variance Bound (MVB) estimators, Interval estimation: Confidence intervals for the parameters of various distributions. Confidence intervals for difference of means and for ratio of variances. Data reduction techniques: Principal component analysis, Discriminant analysis, Cluster analysis, Canonical correlation

UNIT 5

Operational Research:

Introduction to OR, Linear Programming: Models, graphical solution, simplex method Big M, and two-phase technique. Concept of duality, dual simplex method post-optimality analysis. Revised simplex method, Transportation and Assignment problems. Integer programming, Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1.

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SUGGESTED READINGS:

1. Cochran, W.G. and Cox, G.M. (1959): Experimental Design. Asis Publishing House.

2. Das, M.N. and Giri, N.C. (1986): Design and Analysis of Experiments. Wiley Eastern Ltd.

3. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2005): Fundamentals of Statistics. Vol. II, 8th Edn. World Press, Kolkata.

4. Gupta, S.C. and Kapoor, V.K. (2007): Fundamentals of Mathematical Statistics, 11th Edn.(Reprint), Sultan Chand and Sons.

5. Rohatgi, V. K. and Saleh, A. K. Md. E. (2009): An Introduction to Probability and Statistics, 2nd Edn. (Reprint). John Wiley and Sons.

6. Hadley, G. (2002): Linear Programming (Reprint). Narosa Publishing House.

7. Hillier, F.S. and Lieberman, G. J. (2001): Introduction to Operational Research, 7th Edn. Irwin.

8. Kantiswarup, Gupta, P.K. and Manmohan (2008): Operations Research, 13th Edn. Sultan Chand