

**DEPARTMENT OF STATISTICS AND OPERATIONS RESEARCH  
ALIGARH MUSLIM UNIVERSITY  
SYLLABUS OF RESEARCH METHODOLOGY OF WRITTEN TEST PAPER  
OF Ph.D. Statistics & Operations Research  
ADMISSION TEST 2018-19**

40 Marks

Syllabus for Section –A (Research Aptitude/Methodology) will comprise of the following topics:

- a) Logical Reasoning
- b) Graphical Analysis
- c) Analytical & Numerical Ability
- d) Quantitative Comparisons
- e) Series Formation
- f) Puzzles etc.

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Theory of simplex methods, simplex algorithm, degeneracy, duality in linear programming. Random variables (*rv*) and function for *rv*, probability density function (*pdf*), cumulative distribution function (*cdf*). Joint, marginal and conditional distribution. Compound, truncated and mixture distributions. Mathematical expectation and conditional expectation.

Discrete and continuous distribution and their properties, probability generating function (*pgf*), moment generating function (*mgf*) and characteristic function (*cf*). Properties of *cf* and inversion theorem. Central and non-central  $\chi^2$ , *t* and *F* distributions. Multinomial, bivariate and multivariate normal distributions.

Distribution of functions of random variables. Inequalities in probability and various mode of convergence and their inter-relationships. Weak and strong law of large numbers. Central limit theorem.

Order statistics, distribution of single and joint order statistics and of censored sample.

Non-parametric tests: Sign test, signed rank test, Kolmogorov-Smirnov test, run test, Wilcoxon Mann-Whitney test, Median test, Ansari-Bradely test, Mood test, Kendall's tau test, test of randomness, consistency of test and ARE.

BLUE estimators, Gauss-Markov theorem, Test of linear hypothesis-one and two way classifications. Fixed, random and mixed effect models. Variance components. Bivariate, multiple and polynomial regressions and use of orthogonal polynomials, Residuals and their plots as test for departure from assumptions of fitness of model, homogeneity of variance and detection of outliers, multicollinearity.

Estimation of population mean, total and proportion in SRS and Stratified sampling, Estimation of gain due to stratification, Ratio and Regression methods of estimation, Optimality of Ratio estimate, cluster sampling : Estimation of population mean and their variances based on cluster of equal sizes, Variance in terms of intra-class correlation coefficient, Two stage sampling : Estimation of Population total and mean with equal first stage units, Variances and their estimation, Optimum sampling and sub-sampling fractions, Double sampling for Ratio and Regression methods of estimation, Double sampling for stratification.

Dual and Revised Simplex Methods, Sensitivity Analysis in Linear Programming, Linear Programming under uncertainty.

Unconstrained Optimization: Fibonacci, Golden section and Quadratic interpolation methods, The general Nonlinear Programming Problem, Difficulties introduced by nonlinearity, The Kuhn-Tucker necessary conditions for optimality, Solution of simple NLPP using K-T conditions, Quadratic Programming : Beale's method, Restricted basis entry method (Wolfe's method), Convex Programming : Methods of feasible directions, Rosen's gradient projection method for linear constraints.

Marketing Management: Meaning and definitions of marketing and marketing management, Importance of marketing management in Indian economy, Functions of marketing, Objective & functions of advertising models, Media selection models, Warehouse location, Financial management, Capital structure decisions.

Basic concept of network analysis, The maximal flow problem, Max flow min cut theorem, the shortest route problem, shortest route algorithm, Bellman's principal of Optimality, Solution of stage coach problem by Dynamic Programming, The general characteristics of Dynamic Programming Problems, Solution of LP problems by DP.

Applications of Integer Programming: Capital budgeting problem, the Knapsack problem, Travelling salesman problem, The fixed charge problem, The cutting stock problem and the set covering problem, Cutting Plane Methods, Gomory's  $f$ -cut, Branch and Bound method: Branching, bounding and fathoming, Land and Doig's method, Dakin's approach.

Determination of critical path, CPM, PERT, Probability of completing the project on schedule.

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