STATISTICS

UNDER-GRADUATE SYLLABUS
B.A./B.Sc. Part I EFFECTIVE FROM 2014 EXAMINATIONS
Paper I: Probability Theory

Unit I: Random Experiment and Probability Measure

Random experiments, sample space, events, algebra of events, axiomatic definition of probability, probability spaces, relationship of axiomatic and classical probability, role of frequency ratios, properties of probability measure, subadditivity, Boole's inequality, probability of union of events, matching problem, repeated birthday problem, occupancy problem, statistics of physical particles, conditional probability and associated probability space, Bayes theorem, independence of events.

Unit II: Random Variable and Random Vector

Random variables as functions, induced probability measure via inverse mapping, induced probability distribution, distribution functions, distribution functions and their properties, probability mass function (pmf) of discrete random variables, probability density function (pdf) of continuous random variables,

Random vector, marginal and conditional distributions, independence of random variables

Unit III: Mathematical Expectation and Functions of Random Variables

Mathematical expectation, moments, factorial moments, moment generating function, probability generating function, Expectation of jointly distributed random variables, marginal and conditional expectation, correlation, Chebyshev's inequality, Markov's inequality, functions of random variables.

Unit IV: Statistical Distributions

Bernoulli distribution, binomial distribution, Poisson distribution, derivation of Poisson distribution as a limiting case of binomial distribution, geometric distribution, negative binomial distribution, hypergeometric distribution, multinomial distribution, uniform distribution, normal distribution and its relationship with the binomial and Poisson distribution, Cauchy distribution, bivariate normal distribution and its marginal and conditional distributions.

Book recommended:

1. Beumont, G.P.: Probability and random variables.

2. Meyer, Paul L. (1970): Introductory probability and statistical applications, Addision Wesley.

3. Mukhopadhyay, P. (1996): Theory of Probability, New Central Book Agency, Calcutta.

4. Parzen, E. (1960): Probability theory and its applications, Wiley Eastern.

Paper II: Statistical Methods and Computer applications

Unit I: Computer Applications

Origin of computers; Computer generations; Importance of computers; Hardware components: CPU, Memory, Input output devices. Mouse-navigation tool. Operating system: History, Windows operating system-Interface; File management; Input output services.

Software: Introduction to System software; Application software: Word processing software – Microsoft Office Word 2007, Spread sheet software – Microsoft Office Excel 2007, Presentation software – Microsoft Office PowerPoint 2007 (Interface of all the three application software, File handling, Editing, Formatting, and final output)

Excel as a database software: Cell referencing, Concept of list, Manipulation of data, Data sorting and filtering, Naming of cells, Functions specifically Numeric/Mathematical functions, Statistical functions, Logical functions, and Lookup functions; Statistical analysis using Excel – Descriptive statistics, Curve fitting, Correlation, and Regression analysis; Excel graphs.

Basics of internet and its application in communication.

R - Statistical package: Basics of R, R Studio and R commander; Creation of data files; Import export of data files; Transformation of data; Graphical representation of data using R; Descriptive statistics using R.

Unit II: Visualization of data and descriptive statistics

Concept of Statistical population and sample, classification of data, quantitative and qualitative data, ordinal and nominal data, time series and cross sectional data, multivariate data.

Construction of tables with one or more factors of classification, Diagrammatic and graphical representation of grouped data. Frequency distributions, cumulative frequency distributions and their graphical representation, histogram, frequency polygon and ogives, Stem and leaf chart. Box plot, scatter plot for bivariate data, trellis plot for multi-variable data.

Measures of central tendency, dispersion, moments, skewness and kurtosis.

<div align="center">Unit III: Correlation and Regression for Bivariate Data</div>

Simple linear regression, method of least squares, correlation coefficient, correlation ratio, intraclass correlation, rank correlation, fitting of some nonlinear curves.

<div align="center">Unit IV: Multivariate Data and analysis of categorical data</div>

Multivariate data: Multiple regression, multiple and partial correlation for three variables.

Analysis of Categorical Data: consistency, independence and association of attributes, coefficient of contigency.

Books recommended:

1. Freund J.E (2001): Mathematical Statistics, Prentice Hall of India.
2. Goon, A.M., M.K. Gupta and B. Dasgupta (1991): Fundamentals of statistics, vol I, World Press, Calcutta.
3. Goon, A.M., M.K. Gupta and B. Dasgupta (1991): Fundamentals of statistics, vol, II, World Press, Calcutta.
4. Weatherburn C.E. (1961): A first course of Mathematical statistics, Cambridge University press.
5. Sinha, P.K. (2010): Computer fundamentals, University Science press.
6. Rajaraman, V. (2010): Fundamentals of computers, PHI.
7. White, R. (1999): How computers work.

<div align="center">Practical</div>

Numerical problems and solutions based on theory papers I and II.

B.A./ B.Sc. Part II Effective from 2015 Examinations

Paper I: Statistical Inference

Unit I: Functions of Random Variables

Random sample from a given pdf or pmf, Functions of random variables and their distributions.

Unit II: Sampling Distributions

Sampling distribution of a statistic, Derivation of χ^2, t, F and z distributions, Beta, Gamma and Laplace densities, Binomial and Poisson indices of dispersion.

Unit III: Estimation Theory

Sufficiency, factorization theorem, consistency and the background theory of WLLN, Bernoulli theorem and CLT for iid variates Unbiasedness, Estimation method of maximum likelihood, method of moments.

Unit IV: Hypothesis Testing

Statistical Tests of Hypothesis- Fundamental concepts including the power function, p values, Neyman and Pearson Lemma, most powerful (MP) and uniformly most powerful (UMP) tests, Applications of χ^2, t, F and z distributions in tests of significance, large sample tests based on binomial and normal distributions.

Books recommended:

1. Hogg, R. V. and Craig, A. T. (2004): Introduction to Mathematical Statistics, Pearson Edward (Indian Print).

2. Rohatgi, V. K. and Saleh A. K. Md. E (2005). An Introduction to Probability and Statistics, Wiley, New York.

3. Rohatgi, V.K. (1986): An introduction to probability theory and mathematical statistics, Wiley Eastern.

Paper II: Applied Statistical Analysis

Unit I: Simple random sampling and Stratified sampling

Sample surveys versus complete enumeration, Non sampling errors, Simple random sampling with and without replacement, simple random sampling for attributes, Stratified random sampling, advantages of stratification, methods of allocation.

Use of auxiliary information: Ratio, regression and product method of estimation, Systematic sampling, Cluster sampling with equal clusters.

Unit III: Quality Control

Importance of statistical methods in industrial research and practice, specification of items and lot qualities corresponding to visual gauging, count and measurements, types of inspection, determination of tolerance limits. General theory of control charts, causes of variation in quality, control limits, sub-grouping, summary of out-of control criteria, charts for attributes, np chart, p-chart, c- chart, Charts for variables- X- and R charts, design of X and R charts versus p-charts, cumulative sum chart, V-mask.

Principle of acceptance sampling- problem of lot acceptance, stipulation of good and bad lots, producers and consumers risks, single and double sampling plans, their OC functions, concepts of AQL, LTPD, AOQL, average amount of inspection and ASN function, rectifying inspection plans.

Unit IV: Vital Statistics

Crude, death rates, infant mortality rates, standardized death rate, complete and abridge life table – construction and uses, mortality rate and probability of dying, use of survival tables. Measurement of fertility - crude birth rate, general fertility rate, total fertility rate, gross reproduction rate, net reproduction rate, population growth and logistic model for population projection.

Books recommended:

1. Agrawal, S.N. India's population problem.
2. Cochran, W.G. (1977) Sampling Techniques, Third Edition, Wiley.
3. Goon, A.M., M.K. Gupta and B. Dasgupta (1996): Fundamentals of statistics, vol, II, World Press, Calcutta.
4. Montgomery, D. C. (2003): Introduction to the statistical quality control. John Wiley & Sons.
5. Mukhopadhyay, P. (1996): Inferential Problems in Survey Sampling. New Age International.
6. Mukhopadhyay, P. (1999): Applied Statistics. New Central Book Agency Pvt. Ltd., Calcutta.
7. Mukhopadhyay, Parimal (1998): Theory and Methods of Survey Sampling. Prentice Hall.

8. Rama Kumar, R. (1986): Technical Demography, Wiley Eastern Ltd.
9. Sukhatme, P.V., Sukhatme, B.V., Sukhatme, S. and Asok, C. (1984): Sampling Theory of Surveys with Applications, Iowa State University Press and Indian Society of Agricultural Statistics.

Paper III: Statistics Practical

Numerical problems and solutions based on theory papers I and II.

B.A./B.Sc. III Effective from 2016 Examinations

Paper I: Advanced Inference

Unit I: Truncated, Mixture and Non-central Distributions

Compound, truncated and mixture distributions, Non-central chi-square, t- and F-distributions and their properties.

Unit II: Estimation Theory

Completeness and sufficiency, Rao-Blackwell theorem, Lehman Scheffé theorem, one parameter exponential family and its completeness, Cramér-Rao inequality, Best linear unbiased estimator

Unit III: Testing of Hypothesis

Likelihood ratio test, Unbiased test, Neyman Pearson Lemma for randomized tests, Randomized test for binomial and Poisson distributions, χ^2 -test of goodness of fit, Contingency table, Test of equality of several variances, Significance test for correlation coefficient.

Unit IV: Bayesian Estimation and Interval Estimation

Prior and posterior distributions, Bayes estimators under squared error loss function, posterior variance and Bayes risk.

Interval Estimation: Concepts of Confidence Interval and Confidence Coefficient, Shortest length confidence interval.

Books recommended:

1. Hogg, R. V. and Craig, A. T. (2004): Introduction to Mathematical Statistics, Pearson Edward (Indian Print).
2. Rohatgi, V. K. and Saleh A. K. Md. E (2001). An Introduction to Probability and Statistics, Wiley, New York.
3. Rohatgi, V.K. (1986): An introduction to probability theory and mathematical statistics, Wiley Eastern.

Paper II: Design of Experiments and Nonparametric Statistics

Unit I: Analysis of Variance

One-way ANOVA, two-way ANOVA with single observation per cell and equal number of observations per cell.

Unit II: Design of Experiments

Randomization, Replication, Local Control, Completely randomized design (CRD), Randomized block design (RBD), Latin square design (LSD), Missing plot technique, 2^2 and 2^3 factorial experiments.

Unit III: Order Statistics

Order statistics, Distribution of maximum, minimum and r-th order statistic, Joint distribution of r-th and s-th order statistic, distribution of range, distribution free confidence intervals for quantiles and distribution free tolerance intervals.

Unit IV: Non parametric Tests

Sign test, Wilcoxon test, Median test, Run test.

Books recommended:

1. David Herbert A. and H. N. Nagaraja (2004): Order Statistics, Wiley Interscience (John Wiley and Sons).

2. Gibbons Dickinson, J. and Subhabrata Chakraborti (2003) Nonparametric Statistical Inference, Fourth Edition, Marcel Dekker.

3. Goon, A.M., M.K. Gupta and B. Dasgupta (1991): Fundamentals of statistics, vol, II, World Press, Calcutta.

4. Gupta, S.C. and V.K. Kapoor (2007): Fundamentals of Applied Statistics, Sultan Chand and Sons.

5. Hoel, P.G. (2005): Introduction to mathematical statistics, John Wiley

6. Mukhopadhyay, P. (1999): Applied Statistics. New Central Book Agency Pvt. Ltd., Calcutta.

7. Sidney Siegel: Nonparametric statistics for the behavioral sciences.

Paper III: Economic Statistics and Operations Research

Unit I: Economic Time series and Income Distributions

Time Series, Components of time series, additive and multiplicative models, methods of determination of trend, growth curves, analysis of seasonal component and seasonal indices. Analysis of income and allied distributions - Pareto distribution, graphical test, fitting of Pareto's law, illustrations, log-normal distribution and its properties, Lorenz curve, Gini's coefficient.

Unit II: Index Number and Demand Analysis

Index number: Price relatives and quantity or volume relatives. Link and chain relatives, computation of index numbers, Laspeyre's, Paasche's, Marshal - Edgeworth's and Fisher's index numbers, chain base index number, consumer price-index numbers. Tests for index numbers: Time and Factor reversal tests.

Theory and analysis of consumer's demand: Law of demand, Price elasticity of demand, Estimation of demand curves; Forms of demand functions, Engel's curves, Income elasticity of demand.

Unit III: Linear Programming

Elementary theory of convex sets, definition of general linear programming problems (LPP), formulation problems of LPP, examples of LPP, graphical and Simplex method of solving an LPP, artificial variables, duality of LPP, Transportation Problem (non-degenerate and balanced cases only), Assignment Problem, solution of sequencing problems, Simulation and network scheduling by PERT/CPM.

Unit IV: Game Theory

Game theory: Two person two-choice zero-sum games, Strictly determined 2×2 game, pure strategies, 2×2 non strictly determined game and mixed strategies, Values and its uniqueness, Fundamental theorem for 2×2 games, Solution of games using linear programming method and algebraic method.

Books recommended:

1. Goon, A.M., M.K. Gupta and B. Dasgupta (1991): Fundamentals of statistics, vol, II, World Press, Calcutta.

2. Hiller, F. S. and Libermann, G. J. (1995). Introduction to Operations Research, McGraw Hill.

3. Mckinsey, J.C.C. (1952). Introduction to the Theory of Games, McGraw Hill Book Co.

4. Mukhopadhyay, P. (1999): Applied Statistics. New Central Book Agency Pvt. Ltd., Calcutta.

5. Sharma, J.K. (1997). Operations Research: Theory and Applications, MacMillan India Limited.

6. Swaroop, K., Gupta, P.K. and Singh, M.M. (1985). Operations Research, Sultan Chand & Sons.

7. Taha, H.A. (1982). Operations Research: An Introduction, Macmillan Publishing Company.

<div align="center">Paper IV: Statistics Practical</div>

Numerical problems and solutions based on theory papers I, II and III.