

RASHTRASANT TUKADOJI MAHARAJ NAGPUR
UNIVERSITY, NAGPUR
B. A. / B.Sc. STATISTICS
SEMESTER PATTERN SYLLABUS

B. Sc. Part-I

SEMESTER I

Statistics Paper I :

PROBABILITY THEORY

UNIT I:

Important concepts in Probability:

Definition of Probability—Classical and relative frequency approach to Probability. Richard Von Mises, Cramer and Kolmogorov's approaches to Probability, merits and demerits of these approaches. Only general ideas to be given.

Random Experiment: Trial, sample point and sample space, definition of an event, operation of events, mutually exclusive and exhaustive events. Discrete sample space, properties of Probability based on axiomatic approach.

UNIT II:

Conditional Probability, independence of events, Bayes' theorem and its applications. Chebyshev's inequality and applications with problems.

UNIT III:

Random variables: Definition of discrete random variables, Probability mass function, idea of continuous random variable, Probability density function, illustrations of random variables and its properties, expectation of a random variable and its properties.

UNIT IV:

Moments, measures of location, dispersion, skewness and kurtosis, Probability generating function (if it exists), moment generating function, their properties and uses.

REFERENCES:

1. Bhat B.R, Srivenkataramana T And RaoMadhava K.S. (1997): STATISTICS: A BEGINNER'S TEXT, VOL II, NEW AGE INTERNATIONAL (P) LTD.
2. Edward P.J, Ford J.S And Lin(1974): PROBABILITY FOR STATISTICAL DECISION MAKING, PRENTICE HALL.
3. Goon A. M, Gupta M. K, Das Gupta, B (1999): FUNDAMENTALS OF STATISTICS, VOL II, WORLD PRESS, CALCUTTA.
4. Mood A.M, Graybill F.A And Boes D.C (1974): INTRODUCTION TO THE THEORY OF STATISTICS, MCGRAW HILL.
5. Freund J. E: Mathematical Statistics (Prentice Hall India)
6. P. L. Meyer: Introductory Probability and Statistical Applications, (Oxford and IBH)
7. Sudha Purohit, Gore S.D., Deshmukh S. R: 'Statistics Using R' (Narosa)
8. Walpole Ronald E.: INTRODUCTION TO STATISTICS, Macmillan,
9. KVS Sarma, Statistics Made Simple: Do it yourself on PC (PHI)

SEMESTER I**Statistics Paper II :****DESCRIPTIVE STATISTICS - I****UNIT I:**

Types of data: Concepts of a statistical population and sample from a population; qualitative and quantitative data; nominal and ordinal data; cross sectional and time series data; discrete and continuous data; frequency and non-frequency data. Different types of scales—nominal, ordinal, ratio and interval.

Primary data and Secondary data, Methods of data collection: Interview method, Questionnaire method, Personal Observation method, designing a questionnaire and a schedule; checking their consistency, Pilot survey

UNIT II

Controlled experiments, observational studies and Scrutiny of data for internal consistency and detection of errors of recording.

Sample surveys and Population Census: methods of conducting population census with special reference to Census in India.

Analysis of Categorical data: Consistency of categorical data. Independence and association of attributes. Various measures of association for two- way classification, Odds ratio.

UNIT III:

Presentation of data: Construction of tables with one or more factors of classification, Classification: Geographical, chronological, qualitative and quantitative. Formation of frequency distribution of discrete and continuous type, relative frequency, frequency density and cumulative frequencies. Construction of Stem and leaf chart

Construction of tables and frequency distribution using MS-Excel (COUNT, COUNTIF, PIVOT TABLE etc) and R commands

UNIT IV

Diagrammatic representation of data: Construction of Simple bar diagram, multiple bar diagram, subdivided bar diagram, percentage bar diagram, pie- diagram and pictogram.

Graphical representation of grouped data: Construction of Frequency bar diagram, frequency polygon, histogram, cumulative frequency diagrams and ogives.

Construction of graphs and diagrams by using MS-Excel and R commands

REFERENCES:

1. Bhat B.R, Srivenkataramana T And Rao Madhava K.S (1997): STATISTICS: A BEGINNER'S TEXT, VOL I, NEW AGE INTERNATIONAL (P) LTD.
2. Goon A. M, Gupta M. K, Das Gupta, B (1999): FUNDAMENTALS OF STATISTICS, VOL I, WORLD PRESS, CALCUTTA.
3. Croxton F.E, Cowden D.J And Kellin S (1973): APPLIED GENERAL STATISTICS, PRENTICE HALL OF INDIA
4. Agrawal B. L.: BASIC STATISTICS (New Age International Publishers)
5. Sudha Purohit, Gore S.D., Deshmukh S. R.: Statistics Using R (Narosa)
6. Christian S. Albright, Wayne L. Winston, Zappe Christopher J. : Decision Making using Microsoft Excel (CENGAGE Learning)
8. MS Excel

SEMESTER I**PRACTICALS**

1. Evaluation of Probabilities using addition theorems,
2. Evaluation of Probabilities using multiplication theorems
3. Evaluation of Probabilities using concepts of counting technique and independence,
4. Problems on probabilities using Bayes' theorem.
5. Exercises on mathematical expectations and finding measures of central tendency, dispersion, skewness and kurtosis of univariate probability distributions.
6. Presentation of data by frequency tables.
7. Problems on diagrammatic representation of data
8. Problems on graphical representation of frequency distribution.
9. Problems on consistency of categorical data
- 10 Calculation of Yule's coefficient of association
11. Construction of tables, diagrams and graphs using MS EXCEL
12. Construction of tables, diagrams and graphs using R-COMMANDS

B. Sc. Part-I**SEMESTER II****Statistics Paper I :Probability Distributions****UNIT I:**

Discrete distributions: Bernoulli, Binomial, Poisson Finding (Mgf and pgf, Mean, Variance, mode, skewness and kurtosis, recurrence relation for central moments and for probabilities, additive property), Ms-Excel and R commands for fitting of these distributions

UNIT II:

Geometric (Finding Mgf and Mean, Variance, Lack of memory property, problems), Negative Binomial Distributions (Finding Mgf and Mean, Variance, problems), and Hypergeometric, (Finding Mean, Variance, problems)

UNIT III:

Probability distributions: Discrete Uniform (Finding Mean, Variance), Continuous Uniform (Finding Mgf and Mean, Variance), Normal. (Properties of normal distribution, Finding Mgf and Mean, mode, median, Variance, recurrence relation for central moments, skewness and kurtosis, additive property, standard normal variable and problems), Ms-Excel and R commands for fitting of Normal distributions

UNIT IV:

Continuous Univariate distributions—Exponential (Finding Mgf and Mean, Variance, Lack of memory property), Gamma with one parameter and gamma with two parameters (Finding Mgf and Mean, Variance, Additive property), Beta distributions of both types (Finding r^{th} moment, Mean and variance).

REFERENCES:

1. Bhat B.R, Srivenkataramana T And RaoMadhava K.S. (1997): STATISTICS: A BEGINNER'S TEXT, VOL II, NEW AGE INTERNATIONAL (P) LTD.
2. Edward P.J, Ford J.S And Lin(1974): PROBABILITY FOR STATISTICAL DECISION MAKING, PRENTICE HALL.
3. Goon A. M, Gupta M. K, Das Gupta, B (1999): FUNDAMENTALS OF STATISTICS, VOL I, WORLD PRESS, CALCUTTA.
4. Mood A.M, Graybill F.A And Boes D.C (1974): INTRODUCTION TO THE THEORY OF STATISTICS, MCGRAW HILL.
5. Freund J. E: Mathematical Statistics (Prentice Hall India)
6. Sudha Purohit, Gore S.D., Deshmukh S. R: 'Statistics Using R' (Narosa)
7. Meyer P.L.: INTRODUCTORY PROBABILITY AND STATISTICAL APPLICATIONS (Oxford and IBH Publishing Company)
8. Christian S. Albright, Wayne L. Winston, Zappe Christopher J. : Decision Making using Microsoft Excel (CENGAGE Learning)
9. KVS Sarma, Statistics Made Simple: Do it yourself on PC (PHI)

SEMESTER II**Statistics Paper II : DESCRIPTIVE STATISTICS - II****UNIT I:**

Analysis of Quantitative data: Uni-variate data - Concepts of central tendency and location, Measures of central tendency: Mean, Median and Mode, Geometric Mean and Harmonic mean (Definitions, merits and demerits, properties, theoretical problems), weighted averages.

UNIT II:

Concepts of dispersion, Measures of dispersion: Range, Mean Deviation, Quartile deviation and standard deviation (Definitions, merits and demerits and properties), Measures of and relative dispersion: coefficient of dispersion and coefficient of variation, Moments: Raw and Central moments, expression for central moments in terms of raw moments, Sheppard's corrections for moments for grouped data (without derivation)

UNIT III:

Partition values: Quartiles, Deciles, Percentiles (definition, formulae and procedure for finding these values graphically), Concepts of skewness and kurtosis and their measures including those based on quantiles), Box plot, q-q plot and their use in describing data.

R commands for Histogram, Box plot and q-q plot.

MS-Excel and R commands for Computation of mean, mode and median, and measures of dispersion.

UNIT IV:

Bivariate Data: Scatter diagram, Product moment correlation coefficient and its properties. Coefficient of determination (ANOVA APPROACH). Concepts of error in regression (NORMALITY OF ERRORS). Principle of least squares. Fitting of linear regression and related results. Rank correlation—Spearman's and Kendall's measures.

MS-Excel and R command for plotting Scatter diagram, calculation of correlation coefficient, fitting of regression line.

REFERENCES:

1. Bhat B.R, Srivenkataramana T And Rao Madhava K.S (1997): STATISTICS: A BEGINNER'S TEXT, VOL I, NEW AGE INTERNATIONAL (P) LTD.
2. Goon A. M, Gupta M. K, Das Gupta, B (1999): FUNDAMENTALS OF STATISTICS, VOL I, WORLD PRESS, CALCUTTA.
3. Croxton F.E, Cowden D.J And Kellin S (1973): APPLIED GENERAL STATISTICS, PRENTICE HALL OF INDIA
4. Agrawal B. L.: BASIC STATISTICS (New Age International Publishers)
5. Sudha Purohit, Gore S.D., Deshmukh S. R: 'Statistics Using R' (Narosa)
6. Christian S. Albright, Wayne L. Winston, Zappe Christopher J. : Decision Making using Microsoft Excel (CENGAGE Learning)

SEMESTER II

PRACTICALS

1. Fitting of Binomial distribution and verification of the results by using MS EXCEL and R-commands.
2. Fitting of Poisson distribution and verification of the results by using MS EXCEL and R-commands..
3. Fitting of Normal distribution and verification of the results by using MS EXCEL and R-commands..
4. Problems on Normal distribution and verification of results using MS EXCEL and R-commands.
5. Calculation of Measures of central tendency and Dispersion and verification of the results by using MS EXCEL and R-Commands.
6. Calculation of Quartiles and drawing box plots using R-commands.
7. Calculation of Measures of dispersion, skewness and kurtosis and verification of the results by using MS EXCEL and R-Commands.
8. Problems on calculation of coefficient of correlation and fitting of lines of regression.
9. Plotting Scatter diagram, calculation of correlation coefficient, fitting of regression line by using MS EXCEL and R-Commands.

B.Sc. Part-II
SEMESTER –I
Statistics: Paper – I (STATISTICAL METHODS)

Unit – I

Bivariate probability distributions (discrete and continuous): Joint distribution, marginal and conditional distributions (Mean, Variance), moment generating function, stochastic independence, covariance, correlation coefficient and theoretical problems on these topics.

Unit – II

Bivariate normal distribution: marginal and conditional distributions (Mean, Variance), moment generating function, Multinomial Distribution (three variables' case): (Mean, Variance, moment generating function)

Unit – III

Sampling from a distribution: Definition of a random sample, Drawing random samples from standard distributions, Distribution of a function of random variables: Concept of a statistic and its sampling distribution, Transformation of variables technique: mgf and cdf techniques, univariate and bivariate transformations of discrete and continuous variables. Theoretical problems on these topics.

R commands for drawing a random sample from binomial, Poisson, Uniform, exponential and Normal distributions

Unit – IV

Sampling distribution of sum of binomial, Poisson variables and mean of normal variables, derivations Chi-square, t and F distributions (mgf, mean, variance, mode, additive property - if it exists), independence of sample mean and variance in random sampling from a normal distribution (without derivation).

References:

1. Freund J.E. (2001): Mathematical Statistics, Prentice Hall of India.
2. Goon A.M., Gupta M.K., Dasgupta B.(1991): Fundamentals of Statistics, Vol.I, World Press, Calcutta.
3. Hodges J.L. and Lehman E.L.(1964): Basic concepts of Probability and Statistics, Holden Day.
4. Mood A.M., Graybill F.A. and Boes D.C.(1974): Introduction to the theory of Statistics, McGraw Hill.

5. Hogg R. V. and Craig A. T.: Introduction to Mathematical Statistics , McMillan Publishing Company
6. SudhaPurohit, GoreS.D., Deshmukh S. R.: Statistics Using R,Narosa
7. Christian S. Albright, Wayne L. Winston, Zappe Christopher J. : Decision Making using Microsoft Excel (CENGAGE Learning)
8. KVS Sarma, Statistics Made Simple: Do it yourself on PC (PHI)

SEMESTER I

Statistics Paper II:Economic Statistics

UNIT I:

Index number: Its definition, applications of index numbers, price relatives and quantity or volume relatives, link and chain relatives, problems involved in computation of index numbers, use of averages, simple and weighted aggregative and simple and weighted average methods, Laspeyre's, Paasche's, Marshall Edgeworth's, Walsch's, Kelly's DrobishBowley's and Fisher's quantity and price index numbers, Time and Factor reversal tests of index numbers.

UNIT II:

Base shifting, Splicing of index number series, Consumer Price Index: steps in its construction, methods and uses, Index of Industrial Production: method of construction and its uses, Wholesale price index number: method of construction and its uses, concept of purchasing power of money, inflation and deflation, Methods of computation of national income.

UNIT III:

Demand Analysis: Demand and Supply function, Static laws of demand and supply, price elasticity of demand, price elasticity of supply, Income and cross elasticity of demand. Engel' law and Engel's curves, analysis of income and allied size distribution – Pareto distribution, fitting of Pareto's law, Lorenz curve and Gini's coefficient.

UNIT IV:

Time Series Analysis: Economic time series, its different components, illustrations, additive and multiplicative models, methods of determination of trend, analysis of seasonal fluctuations, methods of construction of seasonal indices. Estimation of elasticity from time series data: Leontief's method, Pigou's method,

REFERENCES

- Croxton F.E and Cowden D.J. (1969): Applied General Statistics, Prentice Hall of India.
- Goon A.M., Gupta M.K., Das Gupta. B. (1986): Fundamentals of Statistics, Vol.II, World Press, Calcutta
- Gupta and Mukhopadhyay P.P.: Applied Statistics, Central Book Agency
- Hooda R P: 'Statistics for Businessand Economics'; MACMILAN Business books, third edition
- Nagar A. L. and Das R. K. : Basic Statistics; Oxford University Press
- Asthana and Shrivastav: Applied Statistics of India ,Chaitanya Publishing House

SEMESTER I**List of Practicals**

1. Drawing random samples from uniform, and Normal distributions.
2. Drawing random samples from uniform and normal populations using R-commands
3. Exercises on finding moments and correlation coefficient of bivariate probability distributions.
4. Construction of price and quantity Index numbers by simple aggregative method.
5. Construction of price and quantity Index numbers by weighted aggregative method. using Laspeyre's, Paasche's, Marshall-Edgeworth's, Walsch's, Drobish-Bowley's, Fisher's method and Kelly's fixed weight method.
6. Construction of price indices using simple and weighted average of price relatives using arithmetic mean and geometric mean.
7. Construction of chain base indices.
8. Problems on base shifting of index numbers.
9. Construction of cost of living index numbers by (i) aggregate expenditure method (ii) family budget method.
10. Determination of trend in a time series using moving average method.
11. Determination of trend in a time series using least square method.
12. Construction of seasonal indices using ratio to moving average method.
13. Construction of seasonal indices using ratio to trend method.
14. Construction of seasonal indices using link relative method.
15. Fitting of demand curve / function and Estimation of price elasticity of demand from time series data.
16. Fitting of Pareto curve to income data.
17. Fitting of Lorenz curve of concentration.

B.Sc. Part-II**SEMESTER –II****Paper – I (STATISTICAL INFERENCE)****Unit – I**

Point Estimation: Point estimate of a parameter, Unbiased estimator, concept of bias and standard errors of sample mean, sample proportion.

Concept of UMVUE, Cramer – Rao Inequality (without proof) and simple problems on CRLB.

Interval Estimation: Concept of confidence intervals.

Concepts of testing of hypothesis: Statistical tests, Null and alternative hypothesis, Types of errors, Critical region, level of significance, p-values, power of a test, Two-tailed and one tailed tests. Simple problems on finding sizes of type-I and Type-II errors.

UNIT –II

Test and construction of Confidence intervals for the mean of univariate normal distribution, Test and construction of confidence intervals for the difference of two means and two variances of two univariate normal distributions, confidence interval for ratio of two variances, Paired t-

test and the corresponding confidence interval, Testing for the significance of sample correlation coefficient in sampling from bivariate normal distribution

MS-Excel and R commands for the test of single mean, difference of means and paired t- test, and R command for test of equality of variances.

UNIT – III

Chi-square tests: Test and construction of Confidence intervals for variance of univariate normal distribution, Pearson's chi-square test for goodness of fit and for homogeneity for standard distributions, Contingency tables and test of independence of attributes.

MS-Excel command for construction of contingency table (using Pivot table command), R command for goodness of fit test.

UNIT – IV

Large Sample tests: Use of central limit theorem for interval estimation of a single mean, single proportion and difference of two means and two proportions. Tests and construction of confidence intervals for a single mean, single proportion and difference of two means and two proportions.

MS-Excel command for Large Sample test for difference of two means.

References:

1. Freund J.E. (2001): Mathematical Statistics, Prentice Hall of India.
2. Goon A.M., Gupta M.K., Dasgupta B.(1991): Fundamentals of Statistics, Vol.I, World Press, Calcutta.
3. Hodges J.L. and Lehman E.L.(1964): Basic concepts of Probability and Statistics, Holden Day.
4. Mood A.M., Graybill F.A. and Boes D.C.(1974): Introduction to the theory of Statistics, McGraw Hill.
5. Hoel P.G.
6. Kulkarni M. B., Ghatpande S.B., Gore S.D.: Common Statistical Tests (Sathidar Printers, Pune)
7. Sudha Purohit, Gore S.D., Deshmukh S. R.: Statistics Using R (Narosa)
8. Christian S. Albright, Wayne L. Winston, Zappe Christopher J. : Decision Making using Microsoft Excel (CENGAGE Learning)
9. KVS Sarma, Statistics Made Simple: Do it yourself on PC (PHI)

Additional References:

10. Bhat B.R., Srivenkatramana T. and Rao Madhava K.S.(1997): Statistics: A Beginner's Text, Vol.II, New Age International (P) Ltd.
11. Rohatgi V.K. (1967): An Introduction to Probability Theory and Mathematical Statistics, John Wiley & Sons.
12. Snedecor G.W. and Cochran W.G.(1967): Statistical Methods. Iowa State University Press.

SEMESTER II**Statistics Paper II: Applied Statistics****UNIT I:**

Demographic Methods: Sources of demographic data – census, register, adhoc survey, hospital records, Measurement of mortality and life tables – crude death rates, age specific death rate, standardized death rate, infant mortality rates, death rate by cause, case fatality rate, complete life table – its main features, central mortality rate force of mortality, construction of life tables and uses of life tables.

UNIT II:

Measurement of fertility: crude birth rate, general fertility rate, total fertility rate, Rates of population growth: Pearl's vital index and crude rate of natural increase, gross reproduction rate, and net reproduction rate with relative merits and demerits.

UNIT III:

Psychological and Educational Statistics: Scaling difficulty value, scaling of scores-Z-scores and standard scores, normalized scores, T scores, percentile scores, Comparison of T-scores and standard scores, Uses of T-scores and percentile scores, scaling of ranking and rating in terms of normal probability distribution.

UNIT IV:

Concept of Reliability of test scores, index of reliability, methods for estimating test reliability with relative merits and demerits: Test-retest method, parallel forms method, split half method, method of rational equivalence, Rulon and Kudar Richardson formulae of test reliability. Validity of test scores, validity and test length, comparison between reliability and validity, intelligence tests and their uses, intelligence quotient.

REFERENCES:

Croxtan F.E and Cowden D.J. (1969): Applied General Statistics, Prentice Hall of India.
 Goon A.M., Gupta M.K., Das Gupta. B. (1986): Fundamentals of Statistics, Vol.II, World Press, Calcutta.
 Srivastava O.S (1983): A Textbook of Demography, Vikas Publishing.
 Garret,H.E.: Statistics in Psychology and Education
 Guilford : Fundamental Statistics in Psychology and Education
 ADDITIONAL REFERENCES
 Gupta and Mukhopadhyay P.P.: Applied Statistics, Central Book Agency
 Pressat R. (1978): Statistical Demography, Methuen and Co.Ltd.

SEMESTER II**List of Practicals**

- 1) Computation of CDR and Standardized death rates by direct and indirect methods.
- 2) Computation of general fertility rates, age specific fertility rates and TFR.
- 3) Computation of Gross and Net reproduction rates.
- 4) Numerical problems on construction and use of life table.
- 5) Calculation of Z-scores, Standard scores for a given frequency distribution of raw scores.

- 6) Calculation of Percentile scores and T-scores for a given frequency distribution of raw scores and verification using MS EXCEL
- 7) Scaling of rating in terms of normal curve.
- 8) Comparison of raw scores on the basis of (i) Percentile, (ii) Z scaling, (iii) T scaling
- 9) Calculation of coefficient of reliability and test reliability.
- 10) Calculation of validity of a test.
- 11) Problems on t-tests and construction of confidence intervals for single mean and difference of two means, paired t-test, test for significance of correlation coefficient (Verification of results by using MS EXCEL and R commands)
- 12) Problems on chi-square test and confidence intervals for a single variance and chi-square test for goodness of fit (Verification of results by using MS EXCEL)
- 13) Problems on chi-square for testing independence of attributes
- 14) Problems on F-tests for equality of two variances and construction of confidence interval for the ratio of population variances (Verification of results by using MS EXCEL)
- 15) Large sample tests for a single mean, difference of means (Verification of results by using MS EXCEL) and for single proportion and difference of two population proportions. Construction of confidence intervals in each case.

B.Sc. III

Semester I

Paper – I:

Statistical Quality Control and Linear Programming Problem

Unit I

Statistical Quality Control: Introduction, Chance and assignable causes of variation, Uses of SQC. Process and product control, Tools for SQC, Control charts, principles of control chart, 3-sigma control limits, Control charts for mean, standard deviation and range. Natural tolerance limits and specification limits, modified control limits.

Unit II

Acceptance sampling by attributes, AQL, LTPD, consumer's risk, producer's risk, AOQL, ASN, OC, single & double sampling plans and their comparison, Continuous sampling inspection plans – CSP I, CSP II, CSP III,

Unit III

Linear programming problem: Mathematical background, linear independence of vectors in E_n , Bases, linear inequalities, solution of simultaneous equations, lines and hyperplanes, convex sets. Linear programming problem, general and standard form, redundancy of constraints, slack and surplus variables. Feasible solution, basic feasible solution, non-degenerate basic feasible solution, optimum solution. Theorems related to extreme point solution, conversion of minimization problem to maximization problem. Graphical method of solving a Linear programming problem

Unit IV

Simplex method, generating extreme point solution, development of optimum solution, unbounded solution, alternative solution, computational procedure, simplex algorithm, artificial basis technique, case of non-feasible solution, degeneracy and breaking of ties, condensed simplex method.

REFERENCES

1. SudhaPurohit, Gore S.D., Deshmukh S. R: 'Statistics Using R' (Narosa)
2. KVS Sarma, Statistics Made Simple: Do it yourself on PC (PHI)
3. Brownlee K.A. (1960): Statistical Theory and Methodology in Science and Engineering, John Wiley & Sons.
4. Grant E.L.(1964): Statistical Quality Control, McGraw Hill.
5. Duncan A.J.(1974): Quality Control and Industrial Statistics, Vol.I, Taraporewala and Sons.
6. Montgomery: Introduction to Statistical Quality Control (Wiley 2ndEdn)
7. J. K. Sharma: Operations Research: Theory and Applications (MacMillan)
8. N. D. Vohra: Quantitative Techniques in Management (Tata McGraw Hill)
9. Gass S.I.(1975): Linear Programming Methods and Applications, McGraw Hill.
10. Mahajan M. (2001): Statistical Quality Control, DhanpatRai& Co.(P) Ltd.
11. Rao S.S. (1984): Optimization Theory and Application, Wiley Eastern.

Semester I**Paper II****Survey Sampling Techniques****Unit I:**

Official Statistics: Functions of Central Statistical Organization and its purpose, National sample survey organization, its purpose, functions and important aspects.

Sample Survey: complete enumeration versus sampling, requirements of a good sample, Planning, Execution and Analysis of a survey, Types of sampling, Sampling units, frames, sampling errors and Non-sampling errors.

Unit II:

Sampling Designs: Simple random sampling with and without replacement, sampling for proportions, and determination of sample size for estimating population mean and population proportions.

Unit III:

Stratified Random sampling: Method, various allocations and their comparisons, cost and variance analysis in stratified sampling, comparison with simple random sampling, Estimation of gain in precision due to stratification.

Unit IV:

Cluster Sampling with equal sizes: Population mean, variance and their estimation, Efficiency of cluster sampling in terms of intra-class correlation. Comparison of Cluster sampling with SRSWOR, Clusters formed by random selection Estimation of efficiency and relative efficiency w.r.to SRS.

Systematic sampling: Resemblance of Systematic sampling with Stratified and cluster sampling, Estimation of population mean & variance, comparison of systematic sampling with stratified and simple, random sampling for population with linear trend.

REFERENCES

1. Kenney and Keeping: Mathematics of Statistics, Vol.II.
2. Sukhatme P.V. and Sukhatme V.V. Sampling theory of surveys with applications.
3. Cochran, W.G.: Sampling Techniques.
4. Asthana and Shrivastava: Applied Statistics of India.
- 4 Guide to Current Indian Official Statistics: Central Statistical Organization, Govt. of India, New Delhi.
12. Saluja M.P: Indian Official Statistical Systems, Statistical Publishing Society, Calcutta.
13. Panse and Sukhatme: Statistical methods for Agricultural workers
14. Chakravarti I.E., Laha and Roy: Handbook of methods of Applied Statistics.
15. Goon, Gupta and Dasgupta: Fundamentals of Statistics, Vol.II.
16. Murthy M.N. (1967): Sampling Theory and Method.
17. Sampath S. (2000) Sampling Theory and Methods.

ADDITIONAL REFERENCES

- 1 Des Raj (2000): Sample Survey Theory, Narosa Publishing House

LIST OF PRACTICALS:

1. Drawing of control charts for mean and range
2. Drawing of control charts for mean and standard deviation
3. Problems on Drawing of np-chart, p-chart,
4. Drawing of c-chart.

5. Problems on OC curve for single and double sampling inspection plans for attributes, AOQ and ATI curves.
6. Formulation of LPP
7. Solving LPP by graphical method
8. Solution of LPP by simplex method.
9. Problems on drawing simple random samples without replacement by using random number tables
10. Problems on calculation of sample mean and its variance, and estimation of population mean and sampling variance of the sample mean in SRSWOR
11. Problems on Sampling for proportions
12. Determination of sample size in sampling for proportions and for variables
13. Problems on Stratified random sampling: Calculation of population mean, sample mean and its variance, and estimation of population mean and sampling variance of the sample mean.
14. Cost and variance analysis in stratified sampling
15. Problems on Cluster sampling: Calculation of population mean, sample mean and its variance, and estimation of population mean and sampling variance of the sample mean.
16. Problems on Systematic sampling: Calculation of population mean, sample mean and its variance, Estimation of population mean and its variance in a population with Linear Trend.

B.Sc. III
Semester II
Paper – I: Operations Research

Unit I:

Network analysis: Introduction , basic concepts, construction of network diagram, (Rules of construction, errors, Fulkerson's rule), Time estimates, forward pass method, backward pass method, float of an activity, CPM, advantages and drawbacks of CPM, PERT, three time estimates, probability of computation of the project within scheduled time, distinction between PERT and CPM.

Unit II:

Project time-cost trade off, project crashing, Time-cost optimization algorithm.

Duality: Primal and dual problem, Rules for converting primal into dual, economic interpretation of dual, characteristics of the dual problem, advantages of duality, interpretation of primal-dual optimum solutions.

Unit III

Transportation problem: General transportation problem, Linear programming formulation of Transportation problem, balanced and unbalanced transportation problem, existence of feasible solution, construction of basic feasible solution,, its properties. Solution procedure for Transportation problem: a) methods of finding initial basic feasible solution, b) testing optimality of the solution, c) improving solution. Maximization Transportation problem.

Unit IV:

Assignment problem: Definition, unbalanced assignment problem, Theorems related to solution of an assignment problem, solution method, maximization in an assignment problem, restriction on assignment.

Game Theory: Definition, two person zero sum game, pay-off matrix, minimax and maximin principle, pure- strategy, value of a game, saddle point, solution of a game with saddle point.

Semester II:**Paper II - Experimental Designs****Unit I**

The theory of linear estimation (basic concepts without derivations), statement of Gauss-Markoff's theorem.

Analysis of variance: Assumptions involved in A.V. Techniques, one way classification, two way classification with one and multiple but equal number of entries per cell, three way classification.

Unit II

Design of Experiments: General principles of designs of experiments, randomization, replication and local control, uniformity trials, shape and size of plots and blocks, analysis of completely randomized design.

Unit III

Design of Experiments: Randomized block and Latin square design, standard error of treatment differences, estimation of efficiencies.

Unit IV:

Factorial experiments: Purpose advantages, 2^2 and 2^3 factorial experiments. Calculations of main effects and interaction effects, Yates' method.

MS EXCEL and R commands for ANOVA of one-way, two-way and two-way with multiple entries classification.

REFERENCE

1. Das and Giri: Design of Experiments.
2. Chakravarti I.E., Laha and Roy: Handbook of methods of Applied Statistics.
3. Goon, Gupta and Dasgupta: Fundamentals of Statistics, Vol.II.
4. Cochran and Cox: Experimental Designs.
5. Kenney and Keeping: Mathematics of Statistics, Vol.II.
6. SudhaPurohit, Gore S.D., Deshmukh S. R.: Statistics Using R (Narosa)
7. Christian S. Albright, Wayne L. Winston, Zappe Christopher J. : Decision Making using Microsoft Excel (CENGAGE Learning)

8. KVS Sarma, Statistics Made Simple: Do it yourself on PC (PHI)

ADDITIONAL REFERENCES

- 1 Kemthorne O. (1965):The Design and Analysis of experiments, Wiley Eastern.

LIST OF PRACTICALS:

1. Construction of network diagrams
2. Finding critical path and finding slack at the nodes and floats of activities
3. Problems on PERT analysis and finding the probability of project completion
4. Problems on Time – cost Trade-off Analysis
5. Finding Optimum solution to the transportation problem
6. Finding Optimum solution to the assignment problem.
7. Problems on two-person zero-sum game.
8. Analysis of variance of One – way, Two-way classified data with one entry and Two-way classified data with m-entries per cell, verification of results using MS EXCEL and R-programming
9. Analysis of variance of Three way classified data
10. Analysis of CRD, RBD and LSD and verification of the results of CRD and RBD using MS EXCEL and R-programming
11. Analysis of variance of 2^2 and 2^3 factorial experiments