INSTITUTE OF SCIENCE, NAGPUR.

(An Autonomous Institute of Government of Maharashtra)

DEPARTMENT OF STATISTICS

Syllabus

Bachelor of Science (B.Sc.) Semester Pattern

STATISTICS

(STA/UG 2021/01)

(To be Implemented from 2021-2022)

B.Sc. (Semester Pattern) Syllabus

Semester wise Name of Papers

Subject - Statistics

Semester	Paper	Name of the Paper	Paper Code
I	I	PROBABILITY THEORY	**BSFS11**
	II	DESCRIPTIVE STATISTICS - I	**BSFS12**
	Laboratory Coursework Practical (if applicable)		**BSFS13**
II	I	PROBABILITY DISTRIBUTIONS	**BSFS21**
	II	DESCRIPTIVE STATISTICS – II	**BSFS22**
	Laboratory Coursework Practical (if applicable)		**BSFS23**
III	I	STATISTICAL METHODS	**BSSS31**
	II	ECONOMIC STATISTICS	**BSSS32**
	Laboratory Coursework Practical (if applicable)		**BSSS33**
IV	I	STATISTICAL INFERENCE	**BSSS41**
	II	APPLIED STATISTICS	**BSSS42**
	Laboratory Coursework Practical (if applicable)		**BSSS43**
V	I	STATISTICAL QUALITY CONTROL AND LINEAR PROGRAMMING PROBLEM	**BSTS51**
	II	SURVEY SAMPLING TECHNIQUES	**BSTS52**
	Laboratory Coursework Practical (if applicable)		**BSTS53**
VI	I	OPERATIONS RESEARCH	**BSTS61**
	II	EXPERIMENTAL DESIGNS	**BSTS62**
	Laboratory Coursework Practical (if applicable)		**BSTS63**

Ex. BSTS62 : B -B.Sc, S-Statistics, T-Third Year, S6- Semester-6, 2- Subject Paper-2

Marking Scheme of Syllabus

Faculty of Science B.Sc. Semester-I to VI (Statistics)

Semester	Paper	Total Periods / Week	Marks Theory / Practical	Internal	Total Marks	Total Marks
I to VI	I	03	50	10	60	150
	II	03	50	10	60	
	Laboratory Course (Practical) If Applicable	06	30	--	30	

SUBJECT: STATISTICS

B.Sc. –I SEMESTER - I
BSFS11: PAPER- I PROBABILITY THEORY

OBJECTIVES:

A majority of topics in Statistics depend upon a strong foundation of Probability theory It also serves as base for applied probability theory. Another basic concept is that of a random variable , its distribution and associated properties. This course includes topics like Conditional probability, Baye's theorem,p.m.f., p.d.f., moments,etc.

OUTCOMES:

Students acquire knowledge about: independence of random variables, applications of Bayes' theorem, expectation of a random variable, etc.

Unit-I (7.5 Hrs)

(A) 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.

(B) 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.

Instruction

Unit-II (7.5 Hrs)

(C) Conditional Probability: Independence of events

(D) Bayes' theorem: Theorem and its applications. Chebyshev's inequality and applications with problems.

Unit-III (7.5 Hrs)

(E) Random variables: Definition of discrete random variables, Probability mass function, idea of continuous random variable,

(F) Probability density function: Illustrations of random variables and its properties, expectation of a random variable and its properties.

Unit-IV (7.5 Hrs)

(G) Moments: Measures of location, dispersion, skewness and kurtosis

(H) Probability generating function (if it exists): Moment generating function, their properties and uses

B.Sc. –I SEMESTER - I

BSFS12: PAPER II DESCRIPTIVE STATISTICS - I

OBJECTIVES:

Students acquire knowledge about how to classify and tabulate data .

They also learn various methods of graphical and diagrammatic representations of data.

OUTCOMES:

Students acquire knowledge about: Construction of tables with many factors of classification. They also learn analysis of categorical data.

Unit-I   **(7.5 Hrs)**

(A) 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 Instruction

Unit-II   **(7.5 Hrs)**

(B) 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   **(7.5 Hrs)**

(C) 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 (7.5 Hrs)

(D) 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 and R commands

BSFS13: PRACTICAL COURSE

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

SUBJECT: STATISTICS
B.Sc. –I SEMESTER - II
BSFS21: PAPER 1 PROBABILITY DISTRIBUTIONS

OBJECTIVES:

The entire analysis in statistics is based on probability distribution of the random variable under consideration. The course includes a study of some basic standard discrete and continuous distributions along with their properties.

OUTCOMES:

1. Students will get knowledge of some basic standard discrete distributions like Binomial distribution, Poisson distribution,etc. and continuous distributions like Normal distribution, Uniform distribution etc. along with their properties.

2. Students also learn the applications of the random variables studied in real life situations. Students develop the ability to test whether the given random variable follows any of the standard distributions based on which further analysis can be done

Unit-I (7.5 Hrs)

(A) 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 (7.5 Hrs)

(B) 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 (7.5 Hrs)

(C) 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 **(7.5 Hrs)**

(D) 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 rth moment, Mean and variance).

OBJECTIVES:

Students acquire knowledge about analysis of quantitative data, concepts of dispersion,etc.

OUTCOMES:

Students learn various measures of dispersion, correlation coefficient, measures of central tendency and their applications

Unit-I   **(7.5 Hrs)**

(A) 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   **(7.5 Hrs)**

(B) 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   **(7.5 Hrs)**

(C) 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 (7.5 Hrs)

(D) 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.

BSFS23: PRACTICAL COURSE

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.

SUBJECT: STATISTICS
B.Sc. – II SEMESTER - III
BSSS31: PAPER I STATISTICAL METHODS

OBJECTIVES:

The course includes a study of some discrete and continuous bivariate probability distributions along with their properties.

OUTCOMES:

1. Students will get knowledge of some bivariate standard discrete and continuous distributions along with their properties.
2. Students also learn F,t, chi square distributions and their properties.

Unit-I (7.5 Hrs)

(A) 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 (7.5 Hrs)

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

Unit-III (7.5 Hrs)

(C) 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 (7.5 Hrs)

(D) 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).

OBJECTIVES:

1. To give the students' knowledge of Index numbers, cost of living index, national income

2. To let the students, know about laws of Demand and Supply and how the market keeps changing in accordance with time

OUTCOMES:

1. Students have gained knowledge about the market statistics, inflation and deflation, consumers price index, wholesale price index, etc

2. How to compute National income and understand the purchasing power of money

3. Market demand and price relation, supply and its relation to price, elasticities of price and effect of time series on market

Unit-I (7.5 Hrs)

(A) 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 (7.5 Hrs)

(B) 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 (7.5 Hrs)

(C) **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 (7.5 Hrs)

(D) **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

BSSS33: PRACTICAL COURSE

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. usingLaspeyre's, Paasche's, MashallEdgeworth'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.

OBJECTIVES:

Estimation theory is an important part of statistical Inference. The objective of this course is to train the students in obtaining point and interval estimate of the parameter based on given data.To train the students to construct confidence intervals for single mean, single proportion, etc.

OUTCOMES:

At the end of the course, students become well versed with,

1. The basic problem of estimation, various methods of estimation and properties that are to be satisfied by a good point estimator, CRLB etc.

2. Students get knowledge of large sample tests, construction of confidence interval of the parameters of various distributions

Unit-I (7.5 Hrs)

(A) 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.

(B) 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 (7.5 Hrs)

(C) Confidence interval -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 (7.5 Hrs)

(D) 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 (7.5 Hrs)

(E) 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

OBJECTIVES:

To give the students' knowledge about birth and death rates and to help them understand the population science

To teach them how statistics is used in education and psychology and different tests of reliability and validity

OUTCOMES:

At the end of the course, students become well versed with,

Knowledge of demography, educational statistics and psychological statistics

Unit-I (7.5 Hrs)

(A) 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 (7.5 Hrs)

(B) 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 (7.5 Hrs)

(C) 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   **(7.5 Hrs)**

(D) Reliability and Validity -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.

BSSS43: PRACTICAL COURSE

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 forsingle 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 intervalsfor 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.

SUBJECT: STATISTICS
B.Sc. – III SEMESTER - V
BSTS51: PAPER I STATISTICAL QUALITY CONTROL AND LINEAR PROGRAMMING PROBLEM

OBJECTIVES:

Objective here is to introduce to the students a branch of statistics that helps in maintaining quality of the product . Course contains various methods for quality maintenance and to construct various control charts. It also contains various optimization techniques to solve L.P.P.

OUTCOMES:

1. Students get theoretical knowledge to construct control charts.
2. Students get knowledge about various sampling inspection plans.
3. They also learn various methods to solve L.P.P.

Unit-I (7.5 Hrs)

(A) 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 (7.5 Hrs)

(B) 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, CSPII, CSP III,

Unit-III (7.5 Hrs)

(C) Linear programming problem: Mathematical background, linear independence of vectors in En, 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 (7.5 Hrs)

(D) 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.

OBJECTIVES:

Statisticians draw conclusion on the basis of samples. The conclusions are close to reality only when they are based on a sample which is a proper representative on the population. This course is designed to train the students to obtain an appropriate sample in any given situation with the help of various sampling techniques.

OUTCOMES:

1. Students will get knowledge about various methods of sampling like SRSWOR, SRSWR, Stratified random sampling, Cluster sampling, systematic sampling etc.
2. Students will get knowledge about the efficiency of one method of sampling with respect to the other so that in any given situation, they will be able to apply an appropriate method of sampling.

Unit-I (7.5 Hrs)

(A) 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 (7.5 Hrs)

(B) 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 (7.5 Hrs)

(C) 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 (7.5 Hrs)

(D) 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.

BSTS53: PRACTICAL COURSE

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.

OBJECTIVES:

Operations research deals with the application of advanced analytical methods which helps in taking better decisions. The course includes techniques like Network analysis, Assignment problem,etc.

OUTCOMES:

1. Students get theoretical knowledge and the applications of the advanced techniques in O.R. in business, management, industry, project planning etc. through the topics like

2. Concept of project time cost trade off, CPM,PERT,etc.

Unit-I   (7.5 Hrs)

(A) 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   (7.5 Hrs)

(B) 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   (7.5 Hrs)

(C) 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 (7.5 Hrs)

(D) 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 maximum principle, pure- strategy, value of a game, saddle point, solution of a game with saddle point.

SUBJECT: STATISTICS
B.Sc. – III SEMESTER - VI
BSTS62: PAPER II EXPERIMENTAL DESIGNS

OBJECTIVES:

Design of Experiments is a systematic method to determine the relationship between factors affecting a process and its output. It is useful in understanding cause and effect relationships. This is useful in managing inputs that will be reflected as variations in outputs. It is used in areas like agriculture, Psychology, medicine, engineering, biochemistry etc

OUTCOMES:

1. Students acquire knowledge about how to design an experiment for comparing various effects on the output of an experiment through following designs.

2. They learn basic design like CRD, RBD, LSD, techniques of estimating missing values (if any) in the data.

3. They learn use of factorial experiments as per the requirement of the situation where the effects of treatments are studied at two levels and their interactions.

Unit-I (7.5 Hrs)

(A) 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 if entries per cell, three way classification.

Unit-II (7.5 Hrs)

(B) 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 (7.5 Hrs)

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

Unit-IV (7.5 Hrs)

(D) 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.

BSTS62: PRACTICAL COURSE

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 22 and 23 factorial experiments