

RESTRICTED CURRICULUM
AND SYLLABI - STATISTICS

I Semester Core Course I

COMPLEMENTARY COMPONENT FIRST SEMESTER STATISTICS

COMPLEMENTARY COURSE TO B.SC. COMPUTER APPLICATIONS

COMPLEMENTARY COURSE TO PSYCHOLOGY

Complementary Course to Sociology.

Complementary Course to BCA

COMPLEMENTARY COURSE TO MATHEMATICS & PHYSICS

COMPLEMENTARY COURSE TO ECONOMICS

MAHATMA GANDHI UNIVERSITY
PRIYADARSHINI HILLS, KOTTAYAM ☎ 685 560

**RESTRICTED CURRICULUM
AND SYLLABI**

FOR

**UG COURSES
UNDER CHOICE BASED COURSE CREDIT SEMESTER SYSTEM &
GRADING**

IN

STATISTICS

May 2009

Mahatma Gandhi University, Kottayam has reconstituted the Board of Studies in various subjects and made strong and sincere steps to reconstitute UG Courses, which aims at an improved curriculum to contain the services of all teachers, to incorporate provisions for incremental changes for accommodating new courses and greater choices for students. It also targets the following specific features for introducing

- ◆ Semester system.
- ◆ Choice based credit system.
- ◆ A combination of internal and external evaluation.
- ◆ Grading system.

Accordingly a **Five-day Workshop** in Statistics was conducted, ensuring adequate participation from the academic community as a whole, on 14, 15, 20, 21, & 22 of May 2009 at St. Thomas College, Palai.

30 teachers in Statistics from various colleges participated in the workshop.

The following experts participated and presented papers.

- (i) Dr. P. Yageen Thomas, Professor and Head of the Department of Statistics, University of Kerala,
- (ii) Dr. K.K. Jose, Principal and former HOD of Statistics, St. Thomas College, Palai
- (iii) Prof. K.S. Jayachandran, HOD of Statistics, Sree Kerala Varma College, Thrissur.

Fruitful discussions and deliberations in the workshop lead to framing of the new curriculum and syllabi in Statistics the following programs.

1. B.Sc. Statistics Program (Core) with four Open courses and four choice based core courses
 2. Complementary course to Mathematics
 3. Complementary course to Physics
 4. Complementary course to Psychology
 5. Complementary course to Sociology
 6. Complementary course to Economics.
 7. Complementary course to BCA
 8. Complementary course to B.Sc. Computer Applications
- are presented herewith.

Syllabi for B.Sc. Statistics Core and Open Courses

Sem	Code	Title	Inst: hrs	Credit	Total hrs	Total Credit
I	1.1	Methodology and perspectives of Sciences	4	3	4	3
II	2.2	Descriptive Statistics	4	3	4	3
III	3.3	Probability Theory	5	4	5	4
IV	4.4	Statistical Distributions	5	4	5	4
V	5.5	Theory of Estimation	5	4		
	5.6	Mathematics for Statistics ♦ I	5	4		
	5.7	Sample Survey Designs	5	4		
	5.8	Vital Statistics	5	4		
					25	20
Open Course Choice based	(i)	Applied Statistics	5	4		
	(ii)	Bio-Statistics				
	(iii)	Spread Sheet Calculations and Elementary Data Analysis				
VI	6.9	Testing of Hypothesis	5	4		
	6.10	Mathematics for Statistics ♦ II	5	4		
	6.11	Design of Experiments	5	4		
	6.12	Statistical Quality Control	5	4		
					25	20
Core-Choice Based Elective						
6.13	(i)	Operations Research	4	3		
	(ii)	Stochastic Processes				
	(iii)	Mathematical Economics				
	(iv)	Computer Aided Statistical Data Analysis				
	Project		1	1		
					68 hrs	54

I Semester Core Course I**Core 1.1. Methodology and Perspectives of Sciences****Module I**

Science and Science Studies: Types of Knowledge ♦ Practical, Theoretical and Scientific Knowledge. What is Science, What is not Science, Laws of Science. Basis for Scientific Laws and Factual Truths. Science as a Human Activity, Scientific Temper, Empiricism, Vocabulary of Science. Science and Technology.

Module II

Methods and Tools: Origin and meaning of Statistics, Limitations and Misuses of Statistics. Methods of Collection and Editing of Primary Data. Designing of a Questionnaire and a Schedule. Sources and Editing of Secondary Data. Classification and Tabulation of Data. Diagrammatic Presentation, Line Diagram, Bar Diagrams and Pie Diagram.

20 hrs

Module III

Data Handling in Science: Graphical Representation of Frequency Distribution by Frequency Polygon, Frequency Curve and Ogives. Measures of Central Tendency, Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean. Positional Averages ♦ Quartiles, Deciles and Percentiles, Stem and leaf charts, Box - plot.

15 hrs

Module IV

Experimentations: Measures of Dispersion, Definition, Range, Quartile Deviation, Mean Deviation, Standard Deviation. Properties of these Measures, Relative Measures of Dispersion, Coefficient of Variation.

25 hrs

Total 72 hours

Books for study

1. S.P. Gupta: Statistical Methods, Sultan Chand & Sons, New Delhi.
2. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
3. H.C. Saxena: Elementary Statistics, S. Chand & Com.
4. Newton R.G.: The Truth of Science, New Delhi.

References

1. G.U. Yule and M.G. Kendall (1956): Theory and problems of statistics, Charles Griffin.
2. M.R. Spiegel (1961): Theory and Problems of Statistics, Schaum♦s outline series.
3. T.F. Gieryn: Cultural Boundaries of Sciences, Univ. Chicago press, 1999.

II Semester Core Course II**Core 2.2. Descriptive Statistics****Module I**

Moments: Raw and Central Moments, Relation between Central and Raw Moments, Grouping error and Sheppard♦s corrections, Skewness and Kurtosis, Karl Pearson♦s Measure of Skewness, Bowley♦s Measure of Skewness, moment measure of skewness, measures of Kurtosis.

12 hrs

Module II

Curve Fitting: Principle of Least Squares, Fitting of Straight Lines, Parabolas, Exponential Curves. Bivariate Linear Correlation ♦ Scatter Diagram Pearsons Correlation Coefficient, Spearman♦s Rank Correlation Coefficient. Bivariate Linear Regression ♦ Regression Lines, Coefficients of Regression. Multiple and Partial Correlation for three Variables (without proof).

25 hrs

Module III

Index Numbers: Simple and Weighted Index Numbers, Criteria of a Good Index Number, Cost of Living Index Number, Laspeyere♦s, Paasche♦s, Marshall-Edgeworth♦s and Fisher♦s Indices, Base Shifting, Splicing, Deflating, Fixed and Chain Base Indices.

20 hrs

Module IV

Time Series Analysis: Components of a Time Series, Measurement of Trend and Seasonal Variation.

15 hrs

Total 72 hours

Books for study

1. S.P. Gupta: Statistical Methods, Sultan Chand & Sons, New Delhi.
2. S.C. Gupta and V.K. Kapoor: Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi.

References

1. Medhi J: Statistical Methods an Introductory Text, Wiley Eastern 1992.
2. Croxton F.E., Crowden D.J. and Klein S.: Applied General Statistics, Prentice Hall of India.

III Semester Core Course III

Core 3.3 Probability Theory

Module I

Basic Concepts in Probability: Deterministic and Random Experiments, Trial, Outcome, Sample Space, Event, and Operations of Events, Mutually Exclusive and Exhaustive Events, and Equally Likely and favourable Outcomes with Examples. Permutation and Combination Theory. Algebra of Events.

Mathematical, Statistical and Axiomatic Definitions of Probability with Merits and Demerits. Addition Theorem and Properties of Probability based on Axiomatic Definition. Boole's Inequality.

Conditional Probability and Independence of Events. Multiplication Theorems. Bayes' Theorem (with proof). Problems on Probability using Counting Methods and Bayes' Theorem.

25 hrs

Module II

Definition of Random Variable, Discrete and Continuous Random Variables, Functions of Random Variables.

Probability Mass Function and Probability Density Function with Illustrations. Distribution Function and its Properties.

Bivariate Random Variable, Bivariate Distribution and Statement of its Properties. Joint, Marginal and Conditional Distributions. Independence of Random Variables. Transformation of Univariate and Bivariate Random Variables.

25 hrs

Module III

Mathematical Expectation of a Function of a Random Variable. Mean and Variance of a Random Variable. Addition and Multiplication Theorem on Expectation. Raw and Central Moments. Examples of Random Variables for which moments does not exist. Mode and Median of Discrete and Continuous Random Variables.

Covariance and Population Correlation. Cauchy-Schwartz's Inequality Conditional Expectation (regression function) and Conditional Variance.

20 hrs

Module IV

Definition of Moment Generating Function (MGF), Cumulant Generating Function (CGF), Characteristic Function (CF) and Probability Generating Function (PGF) Statements of their Properties with Applications. Method of Computing Mean and Variance from the MGF and Characteristic Function with Suitable examples.

20 hrs

Total 90 hours

Books for study

1. Hogg, R. V. and Craig, R. G. (1989): Introduction to Mathematical Statistics, Ed. 4, MacMillan Publishing Co., New York.
2. Kapoor V. K and Gupta S. C: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.

References

1. Goon A. M, Gupta M. K. and Das Gupta B. (1999) : Fundamentals of Statistics , Vol-I, the World Press Pvt. Ltd., Kolakatha.
2. Mood, A. M. and Graybill, F. A. and Boes, D.C.E. (1974): Introduction to Theory of Statistics, Ed.3, McGraw hill and Kagakusha ltd., London.

- Feller, W. (1963) Introduction to Probability theory and Its Applications. Vol. I, Asian Publishing house, Mumbai.

IV Semester Core Course IV

Core 4.4. Statistical Distributions

Module I

A revisit to the concept of probability mass function, probability density function, cumulative distribution function.

Standard discrete distributions and their applications - Degenerate, uniform, Bernoulli, binomial, geometric, Poisson - mean, variance, m.g.f, their properties-fitting of binomial and Poisson, memory less property of geometric distribution.

Generalized power series- uniform, binomial, Poisson etc as special cases.

25hrs

Module II

Standard continuous distributions and their applications - Uniform, Beta two types, exponential, gamma, double exponential (Laplace), Cauchy, Pareto, logistic- mean, variance, m.g.f, characteristic function, their properties - memory less property of exponential distribution

25hrs

Module III

Continuous distributions - Normal, lognormal- their properties- fitting of normal distribution, - linear combination of normal variates, use of standard normal tables for various probability computation. Bivariate normal- marginal and conditional distributions.

20hrs

Module IV

Chebyshev's inequality, convergence in probability, Chebyshev's weak law of large numbers, Lindberg-Levy form of Central Limit Theorem -Normal distribution as a limiting case of binomial and Poisson under suitable assumptions.

20hrs

Total 90 hours

Books for Study

- Hogg, R. V. and Craig, A. T. (1970). *Introduction to Mathematical Statistics*. Amerind Publishing Co., Pvt. Ltd.
- Gupta, S.C. and Kapoor, V. K. (2002). *Fundamentals of Mathematical Statistics*, 11th Edition. Sultan Chand and Sons, New Delhi.

References

- Rohatgi, V. K., and Saleh, A. K. M, D (2001). *An Introduction to Probability and Statistics*,  Edition. John Wiley and Sons. Inc. New York.
- Mood A.M., Graybill, F. A. and Boes D. C. (1974). *Introduction to the Theory of Statistics*, 3rd Edition. McGraw- Hill.
- Johnson, N.L., Kotz,S. and Balakrishnan,N. (1994). *Continuous univariate distributions*, Vol. 1,  Edition. John Wiley, New York.
- Johnson, N.L. Kotz,S. and Kemp,A.W. (1992). *Univariate Discrete Distributions*, 2nd Edition. John Wiley, New York.

V Semester Core Course V

Course 5.5 Theory of Estimation

Module I

Sampling distributions: Concept of random sample and statistic, sampling distribution of a statistic, standard error, sampling distributions of the mean and variance of a random sampling arising from a normal population. χ^2 , t and F distributions- derivations, properties, uses and inter relationships.

30 hrs

Module II

Point estimation: Describe properties of a good estimator \diamond unbiasedness, consistency, sufficiency and efficiency. Cramer-Rao inequality and its application, Minimum variance bound estimator Rao \diamond Blackwell Theorem. Completeness property of an estimator.

30 hrs

Module III

Methods of estimation: Method of moments; Method of maximum likelihood properties of maximum likelihood estimation (statement only), Method of minimum variance, uniqueness of minimum variance unbiased estimator.

15 hrs

Module IV

Interval estimation: Basic concepts- Confidence interval, confidence coefficient. Construction of confidence intervals for the mean, equality of means, variance and ratio of variances based on normal, t, χ^2 and F distributions. Large sample confidence intervals for mean, difference of means, proportion and difference of proportion.

15 hrs

Total 90 hrs

Books for study

1. V.K. Rohatgi: Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
2. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons.

References

1. Hogg, R.V. and Craig A.T. \diamond Introduction to Mathematical Statistics, Amerind Publishing Co. Pvt. Ltd.
2. Mood A.M., Gray bill F.A. and Boves D.C. \diamond Introduction to Theory of Statistics, Mc Graw Hill.

V Semester Core Course VI**Core 5.6 Mathematical Methods - 1****Module I**

Real Number System, Sets, Bounded Set, Supremum and Infimum, Neighbourhood of a point, Limit Point of a Set, Derived Set. Bolzano-Weierstrass Theorem. Open and Closed Sets. Countable and Uncountable Sets.

25 hrs

Module II

Real Sequences: Convergence and Divergence of Sequences, Cauchy \diamond s General Principle of Convergence, Cauchy Sequences. Algebra of Sequences, Cauchy \diamond s First and Second Theorems on Limits, Monotonic Sequences, Sub Sequences.

25 hrs

Module III

Infinite Series: Convergence and Divergence of Series, Comparison Tests, Cauchy's Root Test, D'Alembert's ratio test, Absolute Convergence

15 hrs

Module IV

Real Valued Functions: Limit, Continuity, and Differentiability, Uniform Continuity, Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem Uniform Convergence of Sequences and Series of Functions. Riemann Integral Definition and examples, Properties of integral, Fundamental Theorem of Integral Calculus, First Mean Value Theorem of Integral Calculus

25 hrs

Total 90 hours

Books for study

1. S.C. Malik and Savita Arora Mathematical Analysis
2. Goldberg K.R. Methods of Real Analysis

References

1. Rudin W.: Principles of Mathematical Analysis
2. Apostol T.M.: Mathematical Analysis
3. Shanti Narayanan: Elements of Real Analysis
4. Bartle R.G.: Elements of Real Analysis

V Semester Core Course VII

Core 5.7 Sample Survey Designs

Module I

Basic concepts: Census and Sampling, Types of Sampling Subjective, judgement, Probability, mixed, Advantages and disadvantages, Principal steps in a sample survey, sampling and Non-sampling error, organizational aspects of sample survey.

20 hrs

Module II

Simple random sampling: Simple random sampling with and without replacement, procedures of selecting a sample, unbiased estimates of the population mean and population total-their variances and estimates of the variances, confidence interval for population mean and total, simple random sampling for attributes, estimation of sample size based on desired accuracy for variables and attributes.

25 hrs

Module III

Stratified random sampling: Estimation of the population mean and population total-their variances and estimates of the variances, proportional allocation and Neyman allocation of sample sizes, cost function optimum allocation, comparison with simple random sampling.

22 hrs

Module IV

Systematic Sampling: Linear and Circular Systematic Sampling, estimates of the population mean and population total, Comparison of Systematic Sampling with simple random sampling, Cluster sampling

clusters with equal sizes ❖ estimation of population mean and total ❖ their variances and estimates of the variances.

23 hrs
Total 90 hours

Books for Study

1. D. Singh and F.S. Choudhary: Theory and Analysis of sample survey Designs, Wiley Eastern Ltd.
2. S.C. Gupta and V.K. Kapoor: Fundamentals of Applied Statistics, Sultan Chand & Co. New Dlehi.
3. Cochran W.G.: Sampling Techniques, Wiley Eastern Ltd.

References

1. Murthy M.N.: Sampling Theory and Methods, Statistical Publishing Society, Calcutta.
2. Sukhatme and Sukhatme: Sample survey methods and its applications, Indian Society of Agricultural Statistics.

V Semester Core Course VIII

Core 5.8 Vital Statistics

Module I

Sources of Vital Statistics in India, Functions of Vital Statistics, Census, Registration, adhoc surveys, hospital records.

15 hrs

Module II

Measurement of mortality: Rates and Ratios, Mortality rates ❖ crude death rate, age specific death rate and standardized death rates.

20 hrs

Module III

Life tables: Complete life tables and its characteristics, Abridged life tables and its characteristics, principal methods of construction of abridged life tables, Reed merrel❖s method, Greville❖s method, King❖s method.

30 hrs

Module IV

Measurement of fertility: Crude Birth Rate, General Fertility rate, age-specific fertility rate, Total Fertility rate, Gross reproduction rate, Net reproduction rate.

25 hrs

Total 90 hours

Books for study

1. S.C. Gupta and V.K. Kapoor: Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi
2. Benjamin B.: Elements of vital Statistics, G. Allen and Unwin.

References

1. Sri. Vastava O.S.: A text book of Demography, Vikas publishing house, New Delhi.
2. Ronald Pressak: Statistical Demography, Methuer & Co. Ltd.

3. A.M. Goon, M.K. Gupta & B. Das Gupta: Fundamentals of Statistics Vol II, World press, Calcutta.

V Semester Open Course I

Applied Statistics

Module I

Index Numbers: Meaning, classification, Construction of Index numbers. Un weighted INs, Weighted INs
Laspeyre's, Paasche's, Dorbish Bowley's, Fisher's, Marshall Edgeworth's and Kelly's
methods, Quantity INs.

15 hrs

Module II

Tests on Index Numbers Factor reversal test, Time Reversal test, Circular test. Chain INs, Base shifting,
splicing and Deflating of INs. Consumer price INs.

20 hrs

Module III

Time Series: Concept of time Series components of time series additive and multiplicative models,
measurement of trend using graphical, semi-average and moving average methods.

30 hrs

Module IV

Indian official statistics: Central statistical organization, National Sample Survey Organization. Population
Census De Facto and De Jure method. Economic Census, Agricultural Census. Agricultural Statistics, live
stock and poultry statistics, forest statistics, fisheries statistics, mining and quarrying statistics, labour statistics,
national income statistics, financial statistics.

25 hrs

Total 90 hours

Books for study

1. Gupta S.P.: Statistical methods, Sultan Chand and Sons, New Delhi
2. Kapur J.N and Saxena H.C.: Mathematical Statistics, Sultan Chand and Sons, New Delhi.
3. S.C. Gupta and V.K. Kapoor: Fundamentals of Applied Statistics, Sultan Chand and Sons.

References

1. Goon A.M, Gupta M.K. and Das Gupta: Fundamentals of Statistics Vol. II, The world press, Calcutta.
2. Agarwal B.L.: Basic Statistics, Wiley Eastern Ltd, New Delhi

V Semester Open Course -II

Bio-Statistics

Module I

Epidemiology and Health Statistics ♦ Introduction, Utilization of the Basic Data, Sources of Health Statistics, Problems in the Collection of Sickness Data, Measurement of Sickness, Hospital Statistics, International Classification of Diseases, Sample size determination.

20 hrs

Module II

Standardized Rates and Life Tables ♦ Introduction, Mortality and Morbidity rates, incidence rates, prevalence rates, Measures of accuracy and sensitivity index, specificity index, Adjusted or Standardized Rates, Life Tables, Construction of Life Tables. Vital Statistics ♦ Introduction, Uses of Vital Statistics, Mechanism for Collection of Vital Statistics, Basic Formulae for Calculation of Vital Statistics, Mortality Rates, Fertility Rates.

30 hrs

Module III

Demography ♦ Introduction, Population Growth, Age and Sex Composition, Dependency Ratio, Other Indices, Fertility and Morality, Demographic Transition, Population Estimation.

20 hrs

Module IV

Statistical Genetics, Linkage and crossing over genetic maps, Microarrays and genes, Mendel's law of inheritance, laws of segregation and independent assortment, concept of generation, use of chi-square in testing Mendel's segregation law, sex linked genes, Partition of chi-square, Estimation and Test to Detect Linkage, Clinical Trials.

20 hrs

Total 90 hours

Books for study

1. P.S.S. Sundar Rao and J. Richard (2006): Introduction to Biostatistics and Research Methods, 4th Edition, Prentice Hall of India Pvt Ltd, New Delhi.
2. M. Pagano and K. Gauvreau (2000): Principles of Biostatistics, 7th Edition, Thomson, New Delhi.

References

1. W.W. Daniel (2004): Biostatistics: A Foundation for Analysis in the Health Sciences, 7th Edition, John Wiley & Sons (Asia) Pvt. Ltd., Singapore.
2. I. Khan and A. Khanum (2004): Fundamentals of Biostatistics, Ukaaz Publications, Hyderabad.

V Semester Open Course ♦ III

Spread Sheet Calculations and Elementary Data Analysis

Objective: To equip the students with the knowledge of spread sheet calculations and elementary Statistical analysis using spread sheet programs.

Module I

Excel Basics: Introduction to electronic spread sheets, Working with work books, Formula basics, Editing formulas, Writing multiple copies of a formula, Usage of built in functions (Database functions, Lookup and

Reference functions, Math and Trigonometry functions, Text functions, Statistical functions), Formatting, saving and printing.

20 hrs

Module II

Charts and Pivot Tables: Creating charts with chart wizard, Picking and reviewing Chart types (line charts, bar charts, Pie charts, Scatter charts), Modifying charts, saving, printing and Sharing charts, Customizing Charts, Using Pivot table wizard, Modifying Pivot tables, Working with data in pivot tables, Using Pivot tables to create charts, Importing data into a pivot table, Combining Worksheets in pivot tables.

20 hrs

Module III

Descriptive Statistics Using Excel: Introduction to data analysis tool pack, Frequency distribution and histogram, Computation of summary measures, cross tabulation and pivot tables.

20 hrs

Module IV

Elementary Statistical analysis using Excel: Statistical tests concerning means (One sample Z test for mean, One sample t test for mean, Two sample Z test for means, Two sample t test for means, Paired t test), The F test for variance, Correlation Analysis, Simple Regression analysis, Fitting of Trend line.

30hrs

Total 90 hrs

Books for Study

1. Stephen L Nelson and Julia Kelly (2001) The complete Reference Office XP, Tata McGraw-Hill
2. Sarma KVS (2001), Statistics Made Simple Do It Yourself on PC, Prentice Hall of India.

References

1. Richard Johnson (2006), Miller & Freund's Probability and Statistics for Engineers.
2. Microsoft Office Online Help

V Semester Open Course IV

Statistical Applications Using R

Module I

Introduction to R with history of development of R. R download and library functions. R console, R symbols, functions and terms. Communicating with R using different ways (using word processor, excel, SPSS etc.). Getting data into R. Input data from keyboard using `c()`, `scan()` functions.

15 hrs

Module II

Handling of large data using R, combining vectors into a rectangular matrix, use of `rbind()`, `cbind()` functions. Reading from ASCII text file- `read.table()` function, `file.choose()` function. Use of data created by other statistical packages. Data frames, `colname()` function, R workspace, `attach()` function.

15 hrs

Module III

Application of R in statistical data analysis-summery statistics, variance-covariances, moments. Graphics using R-Plotting of curves, histogram, frequency table, Probability distributions, sampling distributions, testing of hypothesis,

30 hrs

Module IV

Simple, multiple regression- linear models. Time series applications, simple multivariate data analysis. Scatter diagram, error plotting, curve fitting. Analysis of experiments. R programming fundamentals.

30 hrs

Total 72 hrs

Books for study

1. The R book. (2007) Michael J. Crawley.
2. Statistics: An introduction using R (2005) . Michael J. Crawley.
3. Hand book of Statistical analysis using R (2006). Brian S. Everitt and Torsten Hothorn.

References

1. Using R for introductory statistics (2008) John Verzani.
2. R graphics (2005) Paul Murrell

VI Semester Core Course IX

Core 6.9 Testing of Hypotheses

Module I

Statistical hypothesis \diamond Simple and Composite hypotheses, null and alternative hypotheses, test of a hypothesis, two types of errors, critical region, significance level and power of a test. Unbiased test; Uniformly most powerful test.

25 hrs

Module II

Neyman-Pearson theorem and its application. Likelihood ratio tests - test for the mean, test for equality of means (common with unknown variance), test for the variance and test for equality of variances.

20 hrs

Module III

Large sample tests concerning means, equality of means, proportion and equality of proportions. Test based on χ^2 distribution for goodness of fit, independence and homogeneity. Small sample tests for the mean and equality of means. Testing equality of means using paired data. Tests based on χ^2 distribution for variance and F distribution for the equality of variances. Tests concerning correlation coefficients.

30 hrs

Module IV

Non parametric tests (All tests as techniques only). Basic ideas, sign test for one sample and two sample cases, signed rank tests for one sample and two sample cases, run test for randomness, Wald-Wolfowitz run test, Mann-

Whitney U-test, Kolmogorov-Smirnov tests for one sample and two samples, Median test for two independent samples.

15 hrs

Books for Study

1. V.K. Rohatgi- Introduction to probability theory and Mathematical Statistics.
2. Gibbons J.D. ♦ Non parametric methods for quantitative analysis.

References

1. Hogg R.V. and Craig A.T. ♦ Introduction to Mathematical Statistics, Amerind Publishing Co. Pvt. Ltd.
2. Gupta S.C. and Kapoor, V.K. ♦ Fundamentals of Mathematical Statistics, Amerind Publishing Co. Pvt. Ltd.
3. Gon A.M., Gupta M.K. and Das Gupta: Fundamentals of Statistics Vol. 1, the World Press, Calcutta.

VI Semester Core Course X

Core 6.10 Mathematical Methods ♦ II

Module I

Numerical Analysis: Operators E and Delta and their basic properties. Divided differences.

10 hrs

Module II

Interpolation formulae: Newton's forward and backward formulae. Lagrange's formula, Newton's divided difference formula, Central difference formulae, Stirling's, Bessel's and Everett's formula.

25 hrs

Module III

Numerical Integration: Trapezoidal rule, Simpson's $1/3^{\text{rd}}$ and $3/8^{\text{th}}$ rules and Weddle's rule.

20 hrs

Module IV

Complex Analysis: Analytic functions ♦ Cauchy Riemann equations ♦ Cauchy's integral formula Taylor and Laurent's series expansion fundamental theorem of algebra. Poles and Singularities ♦ Contour integration (simple problems).

35 hrs

Total 90 hrs

Books for study

1. H.C. Saxena: The Calculus of Finite Differences.
2. B.S. Tyagi: Functions of a Complex Variable

References

1. James Scarborough: Numerical Mathematical Analysis.
2. Milne- Thomson: Calculus of Finite Difference.
3. Churchill R.V.: Complex Variables and Applications.
4. Kasana H.S.: Complex Variables.

VI Semester Core Course XI

6.11 Design of Experiments

Module I

Principles of Experimentation, Linear Estimation, Estimability of Parametric functions, BLUE, Gauss-Markov Theorem (without proof)

20 hrs

Module II

Testing of Linear Hypothesis, ANOVA of one-way classified data, ANOVA of two-way classified data with multiple and equal number of observations per cell.

25 hrs

Module III

Layout and Analysis of the basic designs CRD, RBD and LSD. Missing Plot Techniques, Relative Efficiency of Designs.

20 hrs

Module IV

Introduction to Factorial Experiments ♦ Illustrations, Main Effects, Interactions and Analysis in 2ⁿ experiments in the set up of RBD.

25 hrs

Total 90 hours

Books for study

- Design and Analysis of Experiments 2/e (1986) M.N. Das and N.C. Giri, Wiley Eastern Limited,
Chapter ♦ 1; Sections 1.1-1.9, Chapter ♦ 2; Sections 2.1-2.5
Chapter ♦ 3; Sections 3.1-3.7
- Linear Estimation and Design of Experiments (1987) D.D. Joshi, Wiley Eastern Limited.
Chapter ♦ 4; Sections 4.1-4.7, Chapter ♦ 5; Sections 5.1-5.6
Chapter ♦ 6; Sections 6.1-6.5, Chapter ♦ 7; Sections 7.1-7.7
Chapter ♦ 8; Sections 8.1-8.6, Chapter ♦ 9; Sections 9.1-9.7
Chapter ♦ 10; All Sections Except 10.3, Chapter ♦ 14; Sections 14.1-14.6
Chapter ♦ 15; Sections 15.1-15.6, Chapter ♦ 17; Sections 17.1-17.6

Reference

- Design and Analysis of Experiments 5/e (2001) D.C. Montgomery, John Wiley and Sons, Inc.
Chapter ♦ 1; Sections 1.1-1.6, Chapter ♦ 2; Sections 2.1-2.3

Chapter 3; Sections 3.1-3.3, Chapter 4; Sections 4.1-4.2

Chapter 5; Sections 5.1-5.3.2, Chapter 6; Sections 6.1-6.4

Chapter 7; Sections 7.1-7.5, Chapter 14; Sections 14.1-14.6

Chapter 15; Sections 15.1-15.6, Chapter 17; Sections 17.1-17.6

VI Semester Core Course XII

Core 6.12 Statistical Quality Control

Module I

Meaning of the term Statistical Quality Control, Process Control and Product Control Assignable and Chances Causes, Definition of Quality Control and Statistical Quality Control. Need for Statistical Quality Control Techniques in Industry, Causes of Quality Variation. Control Charts, Operation and uses of Control Charts, Probability limits, Specification limits, Tolerance limits, 3 Sigma limits and Warning limits.

15 hrs

Module II

Control Charts for Variables: \bar{X} Chart, R Chart, Purpose of the Charts, Basis of Subgrouping, Plotting of \bar{X} and R Charts, Determining the Trial Control Limits and out of Control Situations, Interpretation of Control Charts.

25 hrs

Module III

Control Chart for attributes: P Chart, np Chart, C Chart and U Charts. Construction of p, np, c and U Charts, Choice between p, np, and c charts.

20 hrs

Module IV

Product Control: Principles of Acceptance Sampling, Stipulation of good and bad lots, Producers and Consumers risks, Simple and Double Sampling Plans, their O.C. Functions, Concepts of AQL, LTPD, AOQL, Average amount of Inspection and ASN function, Rectifying Inspection Plans and Sampling Inspection Plans.

30 hrs

Total 90 hrs

Books for study

1. S.C. Gupta and V.K. Kapoor: Fundamentals of Applied Statistics, Sultan Chand and Sons.
2. M. Mahajan: Statistical Quality Control
3. R.C. Gupta: Statistical Quality Control

References

1. Grant E.L. Statistical Quality Control, MC Graw Hill
2. Montgomery D.C. Introduction to Statistical Quality Control, John Wiley and Sons.
3. Duncan A.J. Quality Control and Industrial Statistics, Tarapore Wala and Sons.

VI Semester Choice Based Elective I

Core 6.13 Operations Research

Module I

Operations Research: Origin and Development of OR, Objectives of OR, Modeling and types of models in OR. 10 hrs

Module II

Linear Programming: Mathematical formulation of LPP, Graphical and Simplex methods of solving LPP
Duality in Linear Programming. 25 hrs

Module III

Transportation and Assignment Problems: North West Corner Rule, Row Column and Table Minima Method
Vogel's Approximation Method. Assignment Problem, Hungarian Algorithm of Solution. 20 hrs

Module IV

Network Analysis: Drawing the Network Diagram
Analysis of Network, Calculation of Critical Path
PERT, Expected Completion Time and its Variance. 17 hrs

Total 72 hrs

Books for study

1. Kanti Swarup, Gupta P.K., Manmohan: Operations Research, Sultan Chand and Sons, New Delhi.
2. Gupta R.K.: Operations Research, Krishna Prakashan Mandir, Meerut.
3. Schaum's Outline Series: Operation Research.

References

1. Hadley G.: Linear Programming, Addison Wesley.
2. Gupta and Manmohan: Linear Programming, Sultan Chand & Sons, New Delhi.
3. Taha: Operations Research, Macmillan.
4. Goel & Mittal: Operations Research, Pragati Prakashan, Meerut.
5. V.K. Kapoor: Operations Research, Sultan Chand & Sons, New Delhi.

VI Semester Core Choice Based Elective II

6.13 Stochastic Process

Module I

Concept of Stochastic Process
Definition, Classification with egs, Markov Chains
Transition Probabilities
Transition Probability Matrix
Properties, Chapman Kolmogorov equations, Examples and Computation. 20 hrs

Module II

First Passage Probabilities, Probability Generating Functions Relationship between First Passage and Transition Probabilities, Classification of States \blacklozenge Recurrent, Transient Ergodic State, Accessibility, Communication, Periodic Stationary Distribution.

18 hrs

Module III

Random Walk \blacklozenge Absorbing Elastic and Reflecting Barriers \blacklozenge Gambler's Ruin Problem. Ultimate Ruin Probability, Brownian Motion.

14 hrs

Module IV

Poisson Process \blacklozenge Axiomatic derivation, Interarrival distribution, relation to binomial, geometric and gamma distribution. Pure Birth Process \blacklozenge Difference Differential Equation Yule Process [as example].

20 hrs

Total 72 hours

Books for study

1. J. Methi: Stochastic Processes
2. Feller, W: An Introduction in Probability and its Application.

VI Semester Core \blacklozenge choice based Elective \blacklozenge III**Core 6.13 Mathematical Economics****Module I**

Demand and supply analysis: Concept of demand, demand function, elasticity of demand, elasticity of substitution, relation between elasticity of demand, price, average revenue, total.

12 hrs

Module II

Consumer behaviour: Concept of utility, cardinal and ordinal utility, maximization of utility, budget constraint and equilibrium of consumer, income and substitution effects of a price change, Slutsky equation.

20 hrs

Module III

Production theory: Output and input relation, total, average, marginal products in case of production with single variable input, production isoquants and economic region of production. Meaning and nature of production functions, returns to scale, linearly homogeneous production functions and its properties, Euler's theorem and its applications for various standard production functions.

20 hrs

Module IV

Markets: Price determination in perfect competition, in monopoly, discriminating monopoly, duopoly and oligopoly. Production cost, optimum combination of inputs, constrained cost minimization, profit maximization.

20 hrs

Total 72 hrs

Books for study

1. A.K. Koutsoyiannis: Modern Micro Economics, Macmillan publishers
2. Allen R.G.D.: Mathematical Analysis for Economists

References

1. Henderson and Quaint: Micro Economic Theory, A Mathematical approach
2. H.S. Agarwal: Mathematical Analysis of Price Theory
3. Mehta B.C. and G.M.K. Madhani: Mathematics for Economists, Sultan Chand & Sons, New Delhi.

VI Semester Core Choice based Elective - IV

Core 6.13 Computer Aided Statistical Data Analysis

Objective: To orient the students to do data analysis by using spread sheet programs

Module I

Data handling in Excel: Data entry on the work sheet, Calculations on the worksheet, Usage of built in functions, construction of graphs and diagrams (Bar diagrams, Pie Diagram, Line diagram, Scatter plot etc).

16 hrs

Module II

Descriptive Statistics Using Excel: Introduction to data analysis tool pack, Frequency distribution and histogram, Computation of summary measures, cross tabulation and pivot tables.

16 hrs

Module III

Statistical Inference using Excel: Statistical tests concerning means (One sample Z test for mean, One sample t test for mean, Two sample Z test for means, Two sample t test for means, Paired t test), The F test for variance, Analysis of Variance (One way ANOVA, Two way ANOVA with and without replication) The Chi-square test for goodness of fit and independence.

20 hrs

Module IV

Regression and Trend Analysis: Correlation Analysis, Simple Regression analysis, Multiple Regression, Diagnostic analysis of Regression., Fitting of Trend line, Polynomial Trends, Logarithmic, Power and Exponential Trends, Moving Averages, Exponential Smoothing.

20 hrs

Total 72 hours

Books for Study

1. Sarma KVS (2001), Statistics Made Simple Do It Yourself on PC, Prentice Hall of India.
2. Richard Johnson (2006), Miller & Freund s Probability and Statistics for Engineers

References

1. Ken Black, Kenneth Urban Black and David L. Eldredge (2001), Business and Economic Statistics Using Microsoft Excel, Thomson Learning, ISBN 032401726X, 9780324017267
2. Microsoft Office  Online Help
3. Ramesh Bangia (2006), Straight to the Point M S Office 2000, Firewall Media

MODEL II COMPLEMENTARY COMPONENT FIRST SEMESTER STATISTICS - COURSE I

Hours per week:6

MODULE I

Introduction to statistics, population and Sample, Collection of data, Various methods of data collection, Census Sampling methods of sampling - Simple random sampling (with and without replacement) - stratified sampling - Systematic sampling (Method only). Diagrammatic representation - histogram, frequency polygon, frequency curve, ogives.

MODULE II

Measures of Central Tendency - Mean, Median, Mode, Geometric mean, Harmonic mean and properties Absolute and relative measures of Dispersion - Range, Quartile deviation, Percentiles, Deciles, Mean deviation, Standard deviation, Coefficient of variation.

MODULE III

Raw Moments, Central Moments, Absolute Moments, Inter relationship (First four moment), Skewness - Measures - Pearson, Bowley and Moment Measure, Kurtosis Measures of Kurtosis - Moment Measure.

MODULE IV

Idea of Permutations and combinations, Probability concepts - Random Experiment, Sample space, Events, probability measure, Approaches to probability - Classical, Statistical and Axiomatic, Addition Theorem (Up to 3 events). Conditional probability, Independence of events, Multiplication Theorem (Up to 3 events), Bayes Theorem and its application.

MODULE V

Index Numbers - Definition. Simple Index Numbers, Weighted Index Numbers - Laspeyres, Paasche and Fisher index numbers. Test of Index Numbers, Construction of Index Numbers, Cost of living Index Numbers - Family Budget method, Aggregate Expenditure Method.

Core - Reference

S.P Gupta: Statistical Methods (Sultan Chand & Sons Delhi)

S.C and V.K Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand & Sons.

MODEL II

COMPLEMENTARY COMPONENT SECOND SEMESTER STATISTICS - COURSE 1

Hours per Week 6

MODULE I

Random variable - Discrete and continuous, Probability Distribution - Probability mass function ; Probability Density function and Cumulative (distribution) function and their properties change of variables (Univariate Only) Bivariate Random variables - Definition - Discrete and continuous, Joint Probability Density function, Marginal and Conditional Distributions Independence of Random Variables.

MODULE II

Mathematical Expectations - Expectation of a random variable, Moments in terms of Expectation, Moment generating Function (m.g.f) and its properties. Characteristic Function and its Simple Properties, Conditional Expectation.

MODULE III

Introduction to bivariate data - Method of Least Squares - Curve Fitting - Fitting of Straight Lines, Second Degree Equation, Exponential Curve, Power Curve, Linear Correlation - Methods of Correlation - Covariance Method, Rank Correlation (Equal ranks). Linear regression - Regression Equation - Fitting and identification, properties.

MODULE IV

Discrete Distribution - Uniform: Geometric Bernoulli; Binomial; Poisson; Fitting of Distributions (Binomial and Poisson). Properties - Mean, Variance, m.g.f, Additive property; recurrence relation for moments (Binomial and Poisson) Memory lessness property of Geometric distribution.

MODULE V

Continuous distributions - Uniform; Exponential; Gamma; Beta (type I and type II); Normal; Standard Normal - definition, Mean Variance, m. g. f Additive property, Memory lessness property of exponential distribution Fitting of Normal, Use of standard Normal Tables for Computation of Various Probabilities.

CORE REFERENCE

1. S.P Gupta: Statistical Methode (Sultan Chand & Sons Delhi)
2. S.C Gupta and V.K Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons.

MODEL II COMPLEMENTARY COMPONENT

THIRD SEMESTER STATISTICS - COURSE I

Hours per week:6

MODULE I

Law of Large Numbers - Chebyshev's inequality, Concept of convergence in probability - Bernoulli law of large Numbers, Lindberge - Levy form of Central Limit theorem (Statement and Proof), Simple application.

MODULE II

Sampling Distributions - Deviation of distribution of the mean of sample from a normal population - Statement of the form of the distribution of the mean and variance of sample from a normal distribution, Definition and statement of the form of the distribution of t , F and chi-square - Inter relations - use of tables.

MODULE III

Point Estimation - Desirable properties-unbiasedness- consistency -efficiency and sufficiency Fisher Neyman Factorisation theorem of sufficiency (without proof) and condition for its attainment - Method of Estimation - Maximum Likelihood - Method of Moments - Method of minimum variance.

Interval Estimation - Interval estimation of mean and variance of normal population.

MODULE IV

Two type of Errors- Critical region - Significance level, power, Neyman - Pearson theorem for testing of simple hypothesis against a single alternative (without proof) - applications.

Large sample tests - Testing mean and equality of means - testing a proportion and equality of proportion goodness of fit

Small sample tests-tests based on normal, t , chi-square and F tests for equality of correlations.

MODULE V

Linear regression-Partial and multiple correlation.

Lorenz Curve and Lognormal Distribution and their application

Core - Reference

S.p Gupta : Statistical Methods (Sultan Chand & Sons Delhi)

S.C and V.K Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand & Sons.

MODEL II
COMPLEMENTARY COMPONENT
FORTH SEMESTER
STATISTICS - COURSE I

Hours per week:5

MODULE I

Analysis of Time Series Data - Free hand method, method of moving averages, the method of least squares. changing the unit value and shifting the origin Seasonal and Cyclical movement - seasonal variation- the method of sample averages, Ratio to trend method, Ratio to moving average method, link relative method, seasonally adjusted data, Cyclical fluctuation

MODULE II

Analysis of Variance-One way analysis of variance, one way analysis of variance with unequal sample size, Two way analysis of variance, Two way analysis of variance with interaction

Design of Experiments - Principles of designing - randomization, replication and local control, completely randomized design, Randomized block design, and Latin Square design - including missing observations

MODULE III

Elements of surveys - General principles of Sampling - census versus sample enumeration, Limitation of Sampling, principle steps in sample survey, Sampling and non-sampling errors, type of sampling - purposive Sampling, Probability Sampling, mixed sampling, simple random sampling (without replacement), Selection of simple random sampling, Stratified sampling, Systematic sampling - Formula for estimating the mean of the population and variance of the estimate in simple random sampling

MODULE IV

Statistical Quality Control

Control charts, 3-a Control limits, Tool for SQC, Control Chart for variable, Control chart for mean or \bar{x} chart, Control chart for range or R-Chart, Control chart for SD, Attributes, Fraction defective, P Chart for variable sample six, Control Chart for number of defectives or np-Chart, Control chart for defects per unit - c - chart, acceptance sampling plan, double sampling plans, Sequential sampling plan, Curves for sampling plans

CORE REFERENCE

S.p Gupta : Statistical Methods (Sultan Chand & Sons Delhi)

2.S.C and V.K Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand & Sons.

COMPLEMENTARY COURSE TO B.SC. COMPUTER APPLICATIONS

I Semester Complementary Statistics - (Optional) -Course I

Basic Statistics

Hours per week  4

Module I

Introduction to Statistics, Population and Sample, Collection of Data, Various methods of data collection, Census and Sampling Methods of Sampling  Simple Random Sampling (with and without replacement) 

stratified sampling ♦ systematic sampling (Method only), Types of data ♦ quantitative, qualitative, Classification and Tabulation, Diagrammatic representation ♦ Bar diagram, pie diagram; pictogram and cartogram, Graphical representation ♦ histogram; frequency polygon; frequency curve; ogives and stem and leaf chart.

Module II

Measures of Central Tendency ♦ Mean; Median; Mode; Geometric Mean; Harmonic Mean and Properties, Absolute and Relative measures of Dispersion ♦ Range, Quartile Deviation, Percentiles, Deciles, Box Plot, Mean Deviation, Standard Deviation, Coefficient of Variation.

Module III

Idea of Permutations and Combinations, Probability Concepts ♦ Random Experiment, Sample Space, Events, Probability Measure, Approaches to Probability ♦ Classical, Statistical and Axiomatic, Addition Theorem (upto 3 events) Conditional Probability, Independence of events, Multiplication theorem (upto 3 events), Total Probability Law, Baye's Theorem and its applications.

Module IV

Index Numbers ♦ definition, Simple Index Numbers; Weighted Index Numbers ♦ Laspeyer's Paasche's and Fisher's Index Numbers, Test of Index Numbers, Construction of Index Numbers, Cost of Living Index Numbers ♦ Family Budget Method, Aggregate Expenditure Method.

Core Reference

1. S.P. Gupta: Statistical Methods (Sultan Chand & Sons Delhi).
2. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
3. B.L. Agarwal: Basic Statistics, New Age International (p) Ltd.

Additional References

1. Parimal Mukhopadhyaya: Mathematical Statistics, New Central Book Agency (p) Ltd, Calcutta
2. Murthy M.N.: Sampling theory and Methods, Statistical Publishing Society, Calcutta.

Complementary Course to B.Sc. Computer Applications

II Semester ♦ Complementary ♦ Statistics - (Optional) -Course II

Theory of Random Variables

Hours per week ♦ 4

Module I

Random Variables ♦ Discrete and Continuous, Probability Distributions ♦ Probability Mass Function; Probability Density Function and Cumulative (distribution) function and their properties, change of variables (Univariate only), Bivariate random variables ♦ Definition ♦ Discrete and Continuous, Joint Probability Density Functions, Marginal and Conditional Distributions, Independence of Random Variables.

Module II

Mathematical Expectations ♦ Expectation of a Random Variable, Moments in terms of Expectations, Moment Generating Functions (m.g.f.) and its properties. Characteristic Functions and its Simple Properties, Conditional Expectation

Module III

Raw Moments, Central Moments, Absolute Moments, Inter Relationships (First Four Moments), Skewness Measures Pearson, Bowley and Moment Measure Kurtosis- Measures of Kurtosis Moment Measure, Measure based on partition values.

Module IV

Introduction to bivariate data Method of Least Squares Curve Fitting Fitting of Straight Lines, Second Degree Equation, Exponential Curve, Power Curve, Linear Correlation Methods of Correlation Scatter Diagram, Covariance Method, Rank Correlation (equal ranks). Linear Regression Regression Equations Fitting and identification, properties.

Core Reference

1. John E. Freund: Mathematical Statistics, Prentice Hall of India
2. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons
3. S.P. Gupta: Statistical Methods, , Sultan Chand and Sons, New Delhi

Additional References

1. V.K. Rohatgi: An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
2. Mood A.M., Graybill F.A. and Boes D.C. Introduction to Theory of Statistics, McGraw Hill.
3. B.R. Bhat, Modern Probability Theory, New Age International (p) Ltd.

Complementary Course to B.Sc. Computer Applications

III Semester Complementary Statistics - (Optional) -Course III

Probability Distributions

Hours per week 5

Module I

Discrete Distribution Uniform: Geometric Bernoulli; Binomial; Poisson; Fitting of Distributions (Binomial and Poisson). Properties Mean, Variance, m.g.f., Additive property; recurrence relation for moments (binomial and Poisson) Memory lessness property of Geometric distribution.

Module II

Continuous distributions Uniform; Exponential; Gamma; Beta (type I and II); Normal; Standard Normal definitions, Mean, Variance, m.g.f., Additive property, Memory lessness property of exponential distribution Fitting of Normal, Use of Standard Normal Tables for Computation of Various Probabilities.

Module III

Law of large Numbers, Tchebycheff's Inequality, Weak Law of Large Numbers, Bernoulli's Law of Large Numbers, Central Limit Theorem (Lindberg-Levy form) without proof.

Module IV

Sampling Distributions definition, Statistic, Parameter, Standard Error, Sampling Distributions of Mean and Variance, χ^2 , t and F (without derivation), properties, Inter relationships.

Core Reference

1. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons
2. Hogg, R.V. and Craig A.T. (1970). Introduction to Mathematical Statistics, Amerind Publishing Co, Pvt. Ltd.

Additional References

1. V.K. Rohatgi: An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
2. Mood A.M., Graybill F.A. and Boes D.C. Introduction to Theory of Statistics, McGraw Hill.
3. Johnson, N.L, Kotz, S. and Balakrishnan N. (1994). Continuous Univariate Distribution, John Wiley, New York.
4. Johnson, N.L, Kotz, S. and Kemp, A.W. : Univariate Discrete Distributions, John Wiley, New York.

Complementary Course to B.Sc. Computer Applications**IV Semester \blacklozenge Complementary \blacklozenge Statistics - (Optional) -Course IV****Statistical Inference**Hours per week \blacklozenge 5**Module I**

Concepts of Estimation, Types of Estimation \blacklozenge Point Estimation; Interval Estimation, Properties of Estimation \blacklozenge Unbiasedness, Efficiency; Consistency; Sufficiency.

Module II

Methods of Estimation \blacklozenge MLE, Methods of Moments, Method of Minimum Variance, Cramer Rao Inequality (without proof), Interval Estimation for Mean, Variance and Proportion.

Module III

Testing of hypothesis- Statistical hypothesis, Simple and composite hypothesis Null and Alternate hypothesis, Type I and Type II errors, Critical Region, Size of the test, P value, Power, Neyman Pearson approach, Large Sample test \blacklozenge Z test, Chi-Square test-goodness of fit, test of independence.

Module IV

Small sample tests \blacklozenge Normal, t test, Chi-square test, F test, analysis of Variance (one way classification).

Core Reference

1. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons
2. Richard Johnson (2006): Probability and Statistics for Engineers (Miller and Freund). Prentice Hall.

Additional References

1. S.C Gupta : Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
2. V.K. Rohatgi: An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
3. Mood A.M., Graybill F.A. and Boes D.C. Introduction to Theory of Statistics, McGraw Hill.

Complementary Course to B.Sc. Computer Applications**IV Semester \blacklozenge Complementary \blacklozenge Statistics - (Optional) -Course V****Sample Survey Designs**Hours per week \blacklozenge 4**Module I**

Basic concepts: Census and Sampling, Types of Sampling ♦ Subjective, judgement, Probability, mixed, Advantages and disadvantages, Principal steps in a sample survey, sampling and Non-sampling error, organizational aspects of sample survey.

Module II

Simple random sampling: Simple random sampling with and without replacement, procedures of selecting a sample, unbiased estimates of the population mean and population total-their variances and estimates of the variances, confidence interval for population mean and total, simple random sampling for attributes, estimation of sample size based on desired accuracy for variables and attributes.

Module III

Stratified random sampling: Estimation of the population mean and population total-their variances and estimates of the variances, proportional allocation and Neyman allocation of sample sizes, cost function ♦ optimum allocation, comparison with simple random sampling.

Module IV

Systematic Sampling: Linear and Circular Systematic Sampling, estimates of the population mean and population total, Comparison of Systematic Sampling with simple random sampling, Cluster sampling ♦ clusters with equal sizes ♦ estimation of population mean and total ♦ their variances and estimates of the variances.

Total 90 hours

Core Reference

1. D. Singh and F.S. Choudhary: Theory and Analysis of sample survey Designs, Wiley Eastern Ltd.
2. S.C. Gupta and V.K. Kapoor: Fundamentals of Applied Statistics, Sultan Chand & Co. New Dlehi.
3. Cochran W.G.: Sampling Techniques, Wiley Eastern Ltd.

Additional References

1. Murthy M.N.: Sampling Theory and Methods, Statistical Publishing Society, Calcutta.
2. Sukhatme and Sukhatme: Sample survey methods and its applications, Indian Society of Agricultural Statistics.

COMPLEMENTARY COURSE TO PSYCHOLOGY

III Semester ♦ Complementary -Statistics- Course I

STATISTICAL METHODS AND ELEMENTARY PROBABILITY

Hours per week ♦ 6

Module-1

Introduction to Statistics. Need and importance of Statistics in Psychology. Variables and attributes, Levels of Measurement: Nominal, Ordinal, Interval and Ratio. Population and Sample, frequency distribution, grouped and ungrouped frequency tables, graphical representation of frequency distribution, Histogram, Ogives, Bar diagrams and pie diagrams, Lorenz curve.

Module-2

Measures of Central Tendency Mean, Median, Mode, calculation, properties without proof- merits and demerits, suitability, examples and applications.

Dispersion: Range, Quartile deviation, Standard deviation, Mean deviation, Coefficient of variation, Skewness and Kurtosis.

Module-3

Probability: Basic concepts, different approaches, conditional probability, independence, addition theorem, multiplication theorem (with out proof) for two events, simple examples.

Module-4

Random variables, Discrete and Continuous, p.m.f and p.d.f. c.d.f of discrete r.v. Mathematical Expectation of a discrete r.v. Mean and Variance of a discrete r.v.

Core Reference:

1.Gupta.S.P., Statistical Methods. Sulthan Chand and Sons New Delhi.

Additional References

1. Aron, A., Aron. R., & Coups, E. J. (2006). *Statistics for Psychology*. (4th ed). New Delhi: Pearson Education (ISBN: 81-317-1464-20).
2. Mangal, S. K. (2002). *Statistics in Psychology and Education*. (2nd ed). New Delhi: Prentice-Hall of India Private Limited. (ISBN: 978-81-203-8).
3. Hentry E Garrett ♦ Statistics in Psychology & Education
4. Guilford J.F., Fundamentals of Statistics in Psychology & Education-McGraw-Hill

Complementary Course to Psychology

IV Semester ♦ Complementary-Statistics- Course II

STATISTICAL TOOLS

Hours per week ♦ 6

Module-1

Census and Sampling. Different methods of sampling . Requisites of a good sampling method. Advantages of sampling methods. Simple random sampling, Stratified sampling. Cluster sampling, Systematic sampling.

Module-2

Meaning, Karl Pearson ♦s Coefficient of Correlation, Scatter Diagram, Interpretation of Correlation Coefficient, Rank Correlation, Regression, Regression Equation, Identifying the Regression Lines.

Module-3

Binomial distribution- mean and variance, simple examples. Normal distribution-definition, p.d.f. simple properties, calculation of probabilities using standard normal tables, simple problems.

Module-4

Elementary ideas of testing of hypothesis, simple and composite, null and alternate hypothesis, acceptance region and rejection region, p value, significance level and power, Test for mean, and equality of means, (large and small samples), Chi - Square test for independence. Non Parametric tests-Sign test, Wilcoxon ♦s Rank sum test, Run test.

Core Reference:

1. Gupta.S.P., Statistical Methods. Sulthan Chand and Sons New Delhi.

Additional References

1. Aron, A., Aron. R., & Coups, E. J. (2006). *Statistics for Psychology*. (4th ed). New Delhi: Pearson Education (ISBN: 81-317-1464-20).
2. Mangal, S. K. (2002). *Statistics in Psychology and Education*. (2nd ed). New Delhi: Prentice-Hall of India Private Limited. (ISBN: 978-81-203-8).
3. Hentry E Garrett ♦ Statistics in Psychology & Education
4. J.F. Guilford Fundamentals of Statistics in Psychology & Education-McGraw-Hill

Complementary Course to Sociology

I Semester- Complementary ♦ Statistics ♦ Course I

Basic Statistics

Hours per week-6

Module I

Introduction to Statistics- Collection of data-primary and secondary, census and sampling, classification and tabulation, grouped and ungrouped frequency table.

Module II

Diagrammatical and graphical representation of data- bar diagram, pie diagram, frequency polygon and curve, histogram, ogives.

Module III

Measures of central tendency- mean, median and mode- properties, merits and demerits.

Module IV

Measures of dispersion-Range, quartile deviation, mean deviation, standard deviation-properties, merits and demerits, coefficient of variation.

Core reference:

1. S. P. Gupta: Statistical Methods, Sultan Chand and Sons, New Delhi.

Additional Reference:

2. B.N. Asthana : Elements of Statistics

3. Meyer : Introduction to Probability and Statistical Application

4. Croxton and Cowden : Applied general Statistics.

Complementary Course to Sociology

II Semester- Complementary \diamond Statistics \diamond Course I

Statistical Tools

Hours per week-6

Module I

Random Experiment- sample space, event, -Algebra of events- classical and Statistical definition of probability- simple problems-Addition theorem of two events-statement only-conditional probability- Independence of events-elementary applications- random variables-probability density function- Binomial and normal distributions.

Module II

Testing of hypothesis-Null and alternate hypothesis, significance level, power of the test, Z tests for means and proportion (one sample and two sample).

Module III

Scatter diagram, principle of least squares, fitting of straight lines, Regression lines, correlation between two variables- rank correlation.

Module IV

Index numbers- definition, uses, problems in construction of index numbers, weighted index numbers- Laspeyer \diamond s , Paasche \diamond s and Fisher \diamond s index numbers, tests for good index numbers, Fixed base and chain base index numbers -conversion.

Core reference:

1. S. P. Gupta: Statistical Methods, Sultan Chand and Sons, New Delhi.

Additional Reference:

1. S.C. Gupta and V.K. Kapoor : Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
2. Fundamentals of Statistics: DN Elhance, Kitab Mahal , Allahabad.

Complementary Course to BCA

I Semester Complementary Statistics - Course I

BCA 103 : Basic Statistics

Module I

Introduction to Statistics, Population and Sample, Collection of Data, Census and Sampling, Methods of Sampling  Simple Random Sampling (with and without replacement)  stratified sampling  systematic sampling (Method only), Types of data  quantitative, qualitative, Classification and Tabulation, Diagrammatic representation  Bar diagram, pie diagram; Graphical representation  histogram; frequency polygon; frequency curve; ogives and stem and leaf chart.

Module II

Measures of Central Tendency  Mean, Median, Mode, Geometric Mean, Harmonic Mean, Percentiles, Deciles. Measures of Dispersion  Range, Quartile Deviation, Box Plot, Mean Deviation, Standard Deviation, Coefficient of Variation.

Module III

Idea of Permutations and Combinations, Probability Concepts  Random Experiment, Sample Space, Events, Probability Measure, Approaches to Probability  Classical, Statistical and Axiomatic, Addition Theorem (upto 3 events) Conditional Probability, Independence of events, Multiplication theorem (upto 3 events), Total Probability Law, Bayes Theorem and its applications.

Module IV

Random variables and distribution functions Random variables, probability density(mass) function, distribution function, mean and standard deviation of different probability density function, moment generating function.

Core Reference

1. S.P. Gupta: Statistical Methods (Sultan Chand & Sons Delhi).
2. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
3. B.L. Agarwal: Basic Statistics, New Age International (p) Ltd.

Additional References

1. Parimal Mukhopadhyaya: Mathematical Statistics, New Central Book Agency (p) Ltd, Calcutta
2. Murthy M.N.: Sampling theory and Methods, Statistical Publishing Society, Calcutta.

SEMESTER 3

BCA301 : Advanced Statistical Methods

Module I

Theoretical distributions. Discrete distribution(binomial and Poisson), mean, variance, moment generating functions and fitting of data. Continuous distribution- normal distribution only. Area under the normal curve-related problems,.

Module II

Sampling Distributions ♦ definition, Statistic, Parameter, Standard Error, Sampling Distributions of Mean and Variance, χ^2 , t and F (without derivation), properties, Inter relationships.

Module III

Concepts of Estimation, Types of Estimation ♦ Point Estimation, Properties of Estimation ♦ Unbiasedness, Efficiency; Consistency; Sufficiency; Interval Estimation, Interval Estimation for Mean, Variance and Proportion

Module IV

Testing of hypothesis- Statistical hypothesis, Simple and composite hypothesis Null and Alternate hypothesis, Type I and Type II errors, Critical Region, Size of the test, P value, Power, Neyman Pearson approach, Large Sample test ♦ Z test, Chi-Square test-goodness of fit, test of independence.

Book of study :

Fundamentals of Mathematical Statistics -S C Gupta and V K Kapoor

SEMESTER 4

BCA401: Stochastic and Deterministic Optimization Techniques

Module I

Stochastic and deterministic models, Exponential distribution, lack of memory property of exponential distribution. Basics of operations research, The nature and uses of OR ♦ Main concepts and approaches of OR-Advantages of a model phases of OR

Module II

Linear programming problems; Mathematical formulation of a L.P.P General linear programming problems, solution of a L.P.P, graphical method for solving a L.P.P., Simplex Method: slack and surplus variables- reduction of any feasible solution to a basic feasible solution, dual problems, artificial variable techniques-Big M method.

Module III

Unit-4: Transportation problems: transportation model- solution by simplex method-north west corner lowest cost entry Vogel ♦s and MODI method-Degeneracy Assignment problems.

Module IV

Stochastic processes (Definition and examples), Pure birth process, Poisson process, pure death process, birth and death process, Application of birth and death process-M/M/1 and M/M/s queues (Definitions only).

Book of study:

Stochastic Processes: Sheldon M.Ross

Operations Research : Kanti Swaroop

I Semester ❖ Complementary ❖ Statistics - Course I**Basic Statistics**

Hours per week ❖ 4

Module I

Introduction to Statistics, Population and Sample, Collection of Data, Various methods of data collection, Census and Sampling Methods of Sampling ❖ Simple Random Sampling (with and without replacement) ❖ stratified sampling ❖ systematic sampling (Method only), Types of data ❖ quantitative, qualitative, Classification and Tabulation, Diagrammatic representation ❖ Bar diagram, pie diagram; pictogram and cartogram, Graphical representation ❖ histogram; frequency polygon; frequency curve; ogives and stem and leaf chart.

Module II

Measures of Central Tendency ❖ Mean; Median; Mode; Geometric Mean; Harmonic Mean and Properties, Absolute and Relative measures of Dispersion ❖ Range, Quartile Deviation, Percentiles, Deciles, Box Plot, Mean Deviation, Standard Deviation, Coefficient of Variation.

Module III

Idea of Permutations and Combinations, Probability Concepts ❖ Random Experiment, Sample Space, Events, Probability Measure, Approaches to Probability ❖ Classical, Statistical and Axiomatic, Addition Theorem (upto 3 events) Conditional Probability, Independence of events, Multiplication theorem (upto 3 events), Total Probability Law, Baye❖s Theorem and its applications.

Module IV

Index Numbers ❖ definition, Simple Index Numbers; Weighted Index Numbers ❖ Laspeyer❖s Paasche❖s and Fisher❖s Index Numbers, Test of Index Numbers, Construction of Index Numbers, Cost of Living Index Numbers ❖ Family Budget Method, Aggregate Expenditure Method.

Core Reference

1. S.P. Gupta: Statistical Methods (Sultan Chand & Sons Delhi).
2. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
3. B.L. Agarwal: Basic Statistics, New Age International (p) Ltd.

Additional References

1. Parimal Mukhopadhyaya: Mathematical Statistics, New Central Book Agency (p) Ltd, Calcutta
2. Murthy M.N.: Sampling theory and Methods, Statistical Publishing Society, Calcutta.

Complementary Course to Mathematics & Physics**II Semester ❖ Complementary ❖ Statistics - Course II****Theory of Random Variables**

Hours per week ❖ 4

Module I

Random Variables ♦ Discrete and Continuous, Probability Distributions ♦ Probability Mass Function; Probability Density Function and Cumulative (distribution) function and their properties, change of variables (Univariate only), Bivariate random variables ♦ Definition ♦ Discrete and Continuous, Joint Probability Density Functions, Marginal and Conditional Distributions, Independence of Random Variables.

Module II

Mathematical Expectations ♦ Expectation of a Random Variable, Moments in terms of Expectations, Moment Generating Functions (m.g.f.) and its properties. Characteristic Functions and its Simple Properties, Conditional Expectation

Module III

Raw Moments, Central Moments, Absolute Moments, Inter Relationships (First Four Moments), Skewness ♦ Measures ♦ Pearson, Bowley and Moment Measure Kurtosis- Measures of Kurtosis ♦ Moment Measure, Measure based on partition values.

Module IV

Introduction to bivariate data ♦ Method of Least Squares ♦ Curve Fitting ♦ Fitting of Straight Lines, Second Degree Equation, Exponential Curve, Power Curve, Linear Correlation ♦ Methods of Correlation ♦ Scatter Diagram, Covariance Method, Rank Correlation (equal ranks). Linear Regression ♦ Regression Equations ♦ Fitting and identification, properties.

Core Reference

1. John E. Freund: Mathematical Statistics, Prentice Hall of India
2. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons
3. S.P. Gupta: Statistical Methods, , Sultan Chand and Sons, New Delhi

Additional References

1. V.K. Rohatgi: An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
2. Mood A.M., Graybill F.A. and Boes D.C. Introduction to Theory of Statistics, McGraw Hill.
3. B.R. Bhat, Modern Probability Theory, New Age International (p) Ltd.

Complementary Course to Mathematics & Physics

III Semester ♦ Complementary ♦ Statistics - Course III

Probability Distributions

Hours per week ♦ 5

Module I

Discrete Distribution ♦ Uniform: Geometric Bernoulli; Binomial; Poisson; Fitting of Distributions (Binomial and Poisson). Properties ♦ Mean, Variance, m.g.f., Additive property; recurrence relation for moments (binomial and Poisson) Memory lessness property of Geometric distribution.

Module II

Continuous distributions ♦ Uniform; Exponential; Gamma; Beta (type I and II); Normal; Standard Normal ♦ definitions, Mean, Variance, m.g.f., Additive property, Memory lessness property of exponential distribution Fitting of Normal, Use of Standard Normal Tables for Computation of Various Probabilities.

Module III

Law of large Numbers, Tchebycheff's Inequality, Weak Law of Large Numbers, Bernoulli's Law of Large Numbers, Central Limit Theorem (Lindberg-Levy form) without proof.

Module IV

Sampling Distributions definition, Statistic, Parameter, Standard Error, Sampling Distributions of Mean and Variance, χ^2 , t and F (without derivation), properties, Inter relationships.

Core Reference

1. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons
2. Hogg, R.V. and Craig A.T. (1970). Introduction to Mathematical Statistics, Amerind Publishing Co, Pvt. Ltd.

Additional References

1. V.K. Rohatgi: An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
2. Mood A.M., Graybill F.A. and Boes D.C. Introduction to Theory of Statistics, McGraw Hill.
3. Johnson, N.L, Kotz, S. and Balakrishnan N. (1994). Continuous Univariate Distribution, John Wiley, New York.
4. Johnson, N.L, Kotz, S. and Kemp, A.W. : Univariate Discrete Distributions, John Wiley, New York.

Complementary Course to Mathematics & Physics

IV Semester Complementary Statistics - Course IV

Statistical Inference

Hours per week 5

Module I

Concepts of Estimation, Types of Estimation Point Estimation; Interval Estimation, Properties of Estimation Unbiasedness, Efficiency; Consistency; Sufficiency.

Module II

Methods of Estimation MLE, Methods of Moments, Method of Minimum Variance, Cramer Rao Inequality (without proof), Interval Estimation for Mean, Variance and Proportion.

Module III

Testing of hypothesis- Statistical hypothesis, Simple and composite hypothesis Null and Alternate hypothesis, Type I and Type II errors, Critical Region, Size of the test, P value, Power, Neyman Pearson approach, Large Sample test Z test, Chi-Square test-goodness of fit, test of independence.

Module IV

Small sample tests Normal, t test, Chi-square test, F test, analysis of Variance (one way classification).

Core Reference

1. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons
2. Richard Johnson (2006): Probability and Statistics for Engineers (Miller and Freund). Prentice Hall.

Additional References

1. S.C Gupta : Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
2. V.K. Rohatgi: An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
3. Mood A.M., Graybill F.A. and Boes D.C. Introduction to Theory of Statistics, McGraw Hill.

COMPLEMENTARY COURSE TO ECONOMICS

I Semester- Complementary \blacklozenge Statistics \blacklozenge Course I

Statistical Tools

Hours per week-6

Module I

Introduction to Statistics-Population and sample, collection of data-primary and secondary, Preparation of questionnaire, census and sampling, methods of sampling-simple random sampling, stratified sampling and systematic sampling, classification and tabulation

Module II

Measures of central tendency \blacklozenge mean, median and mode \blacklozenge properties, merits and demerits.

Module III

Measures of dispersion \blacklozenge Range, quartile deviation, mean deviation and standard deviation, partition values, coefficient of variation.

Module IV

Moments-raw and central, relationships (statement only), measures of skewness and kurtosis, Lorenze curve, Gini index.

Core reference:

1. S.P. Gupta : Statistical Methods, Sultan Chand and Sons, New Delhi
2. Taro Yamane : Mathematics for Economists, Prentice Hall.

Additional Reference:

1. Fundamentals of Statistics : DN Elhance, Kitab Mahal, Allahabad
2. S.C. Gupta and V.K. Kapoor : Fundamentals of Mathematical Statistics, Sultan Chand and Sons.

Complementary Course to Economics

II Semester- Complementary \diamond Statistics \diamond Course I

Statistical Tools

Hours per week-6

Module I

Random Experiment- sample space, event, classical and Statistical definitions of probability- simple problems- Addition and multiplication theorems, Baye \diamond s theorem (statement only)-simple applications.

Module II

Random variables- discrete and continuous, probability density function, distribution function, mathematical expectation- mean and variance of a random variable, Binomial, Poisson and Normal distributions- simple problems, fitting.

Module III

Scatter diagram, principle of least squares- fitting of straight lines, Regression lines, correlation \diamond Pearson \diamond s coefficient of correlation and rank correlation.

Module IV

Linear programming-mathematical formulation and graphical method of solution, Primal and dual, Input output analysis.

Core reference:

3. S.C. Gupta and V.K. Kapoor : Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
4. Taro Yamane : Mathematics for Economists, Prentice Hall.

Additional Reference:

3. DN Elhance : Fundamentals of Statistics , Kitab Mahal , Allahabad.
4. Taro Yamane : Mathematics for Economists, Prentice Hall.

