# VIJAYANAGAR SRI KRISHNADEVARAYA UNIVERSITY, BELLARY

## SYLLABUS (2016 -17 ONWORDS)

## B. Sc STATISTICS (SEMESTER SCHEME)

Theory teaching hours: 4 hrs per week — Practical: 6 hrs per week

Theory Examination: 70 Marks — Duration: 3 hrs

Theory Internal Assignment: 30 Marks

Practical Examination: 40 Marks — Duration: 3 hrs

Practical Internal Assignment: 10 Marks

| **Descriptive Statistics: First Semester (Paper I) 4 hrs per week** | | | | | |
|---|---|---|---|---|---|
| **Unit** | **Topics (Theory)** | **Teaching Hours** | **No. of Questions to be asked** | | |
| | | | 1 Mark | 5Marks | 10Marks |
| I | Introduction of Statistics | 3 | 1 | 1 | -- |
| II | Population and Sample | 3 | 2 | 1 | -- |
| III | Presentation of Data | 10 | 1 | 1 | 1 |
| IV | Measures of Central Tendency | 15 | 2 | 1 | 2 |
| V | Measures of Dispersion | 15 | 2 | 1 | 2 |
| VI | Moments, Skewness and Kurtosis | 10 | 1 | 2 | 1 |
| | Total | 56 | 10 | 6 | 6 |
| **Practical (Paper I) 6 hrs per week** | | | | | |
| | Problems based on paper I. | 3x2=6 per Week | | | |

| **Probability Theory & Descriptive Statistics: Second Semester (Paper II) 4 hrs per week** | | | | | |
|---|---|---|---|---|---|
| **Unit** | **Topics** | **Teaching Hours** | **No. of Questions to be asked** | | |
| | | | 1 Mark | 5Marks | 10Marks |
| I | Theory of Probability | 12 | 1 | 1 | 1 |
| II | Random Variables, Probability Distributions | 12 | 2 | 1 | 2 |
| III | Mathematical Expectation | 12 | 1 | 1 | 1 |
| IV | Moment generating function and cumulants | 8 | 2 | 1 | 1 |
| V | Correlation and Regression Analysis | 12 | 4 | 2 | 1 |
| | Total | 56 | 10 | 6 | 6 |
| **Practical (Paper II) 6 hrs per week** | | | | | |
| | Problems based on paper II | 3x2=6 per Week | | | |

| Probability Distributions & C Language: Third Semester (Paper III) 4 hrs per week | | | | | |
|---|---|---|---|---|---|
| **Unit** | **Topics (Theory)** | **Teaching Hours** | **No. of Questions to be asked** | | |
| | | | 1 Mark | 5Marks | 10Marks |
| I | Discrete Probability Distributions | 20 | 4 | 3 | 2 |
| II | Continuous Probability Distributions | 20 | 4 | 2 | 2 |
| III | C Language | 16 | 2 | 1 | 2 |
| | Total | 56 | 10 | 6 | 6 |
| **Practical (Paper III) 6 hrs per week** | | | | | |
| | Problems based on paper III | 3x2=6 per Week | | | |
| **Statistical Inference: Fourth Semester (Paper IV) 4 hrs per week** | | | | | |
| **Unit** | **Topics** | **Teaching Hours** | **No. of Questions to be asked** | | |
| | | | 1 Mark | 5Marks | 10Marks |
| I | Theory of Estimation | 18 | 4 | 2 | 2 |
| II | Interval Estimation | 10 | 2 | 1 | 1 |
| III | Testing of Hypothesis | 18 | 2 | 1 | 2 |
| IV | Non – parametric Methods | 10 | 2 | 1 | 1 |
| | Total | 56 | 10 | 6 | 6 |
| **Practical (Paper IV) 6 hrs per week** | | | | | |
| | Problems based on paper IV | 3x2=6 per Week | | | |
| **Small and Large Sample Tests & SQC: Fifth Semester (Paper V) 3 hrs per week** | | | | | |
| **Unit** | **Topics** | **Teaching Hours** | **No. of Questions to be asked** | | |
| | | | 1 Mark | 5Marks | 10Marks |
| I | Small and Large Sample tests | 8 | 2 | 2 | 1 |
| II | Exact Sampling Distributions | 22 | 4 | 2 | 3 |
| III | Statistical Quality Control | 18 | 4 | 2 | 2 |
| | Total | 48 | 10 | 6 | 6 |
| **Practical (Paper V) 3 hrs per week** | | | | | |
| | Problems based on paper V | 3X1=3 per Week | | | |

| Sample Survey & Design of Experiments<br>Fifth Semester (Paper VI) 3 hrs per week | | | | | |
|---|---|---|---|---|---|
| **Unit** | **Topics** | **Teaching Hours** | **No. of Questions to be asked** | | |
| | | | 1 Mark | 5Marks | 10Marks |
| I | Design of Sample Survey | 22 | 4 | 3 | 3 |
| II | Analysis of Variance | 8 | 2 | 1 | 1 |
| III | Design of Experiments | 18 | 4 | 2 | 2 |
| | Total | 48 | 15 | 7 | 6 |
| **Practical (Paper VI) 3 hrs per week** | | | | | |
| | Problems based on paper VI | 3 x1=3 per Week | | | |
| **Multiple Correlation & Applied Statistics<br>Sixth Semester (Paper VII) 3 hrs per week** | | | | | |
| **Unit** | **Topics** | **Teaching Hours** | **No. of Questions to be asked** | | |
| | | | 1 Mark | 5Marks | 10Marks |
| I | Multiple, Partial Correlation and Regression | 12 | 2 | 2 | 1 |
| II | Time Series | 12 | 3 | 1 | 2 |
| III | Index Numbers | 12 | 3 | 1 | 2 |
| IV | Demography | 12 | 2 | 2 | 1 |
| | Total | 48 | 10 | 7 | 6 |
| **Pratical (Paper VII) 3 hrs per week** | | | | | |
| | Problems based on paper VII | 3x1=3 per Week | | | |
| **Operations Research Sixth Semester (Paper VIII) 3 hrs per week** | | | | | |
| **Unit** | **Topics** | **Teaching Hours** | **No. of Questions to be asked** | | |
| | | | 1 Mark | 5Marks | 10Marks |
| I | Linear Programming Problem | 20 | 3 | 2 | 2 |
| II | Concept of Duality | 4 | 2 | 1 | 1 |
| III | Transportation and Assignment Problem | 14 | 3 | 1 | 1 |
| IV | Game Theory | 10 | 2 | 1 | 2 |
| | Total | 48 | 10 | 7 | 6 |
| **Practical (Paper VIII) 3 hrs per week** | | | | | |
| | Problems based on topics I to V | 3x1=3 per Week | | | |

Note:

1. Students must complete all the practicals to the satisfaction of the teacher concerned.

2. Students must produce the laboratory journal along with the completion certificate signed by the Head of the Department at the time of practical examination.

3. Structure of the evaluation of Practical Paper

(A) Continuous internal evaluation:

(i) Journal 5 marks

(ii) Attendance in the practicals 5 marks

(B) Practical examination:

Duration: 3 hours + additional 5 minutes for viva during practical examination.

(i) Questions on MS-EXCEL to be performed on computer during examination - 5 marks

(ii) Questions based on other practicals to be performed using calculators - 30 marks

(iii) Viva-voce - 5 marks

Total: 40 marks

## FIRST SEMESTER (PAPER I)

## Paper - I: Descriptive Statistics

Objectives:

The main objective of this course is to acquaint students with some basic concepts in Statistics. They will be introduced to some elementary statistical methods of analysis of data.

At the end of this course students are expected

(i) to tabulate statistical information given in descriptive form.

(ii) to use graphical techniques and interpret them.

(iii) to compute various measures of statistical constants.

(iv) to analyze data pertaining to attributes and to interpret the results.

(v) to summarize and analyze the data using computer.

(vi) to apply statistics in the various fields.

### 1. Introduction to Statistics: (2hrs)

1.1 Meaning and definition of Statistics.

1.2 Limitation of Statistics

### 2. Population and Sample: (4hrs)

2.1 Characteristics of data: Attributes: Nominal scale, ordinal scale, Variables: Discrete and continuous variables,

2.2 Types of data: (a) Primary data, Secondary data.

2.3 Notion of a statistical population: Finite population, infinite population, Notion of random sample.

2.4 Methods of sampling (Description only): Simple random sampling with and without replacement (SRSWR and SRWOR) stratified random sampling, systematic sampling, cluster sampling and two-stage sampling.

## 3. Presentation of Data (10hrs)

3.1 Classification: Raw data and its classification, discrete frequency distribution, Sturge's rule, continuous frequency distribution, inclusive and exclusive methods of classification, Open end classes, cumulative frequency distribution and relative frequency distribution.

3.2 Graphical Presentation of Data: Histogram, frequency curve, frequency polygon, Ogive curves, stem and leaf chart, Pie-Chart

3.3 Pareto diagram.

3.4 Examples and Problems.

## 4. Measures of Central Tendency (14hrs)

4.1 Concept of central tendency of statistical data: Statistical average, characteristics of a good statistical average.

4.2 Arithmetic Mean (A.M.): Definition, Properties of Arithmetic Mean, merits and demerits, trimmed arithmetic mean, weighted arithmetic mean.

4.3 Mode: Definition, formula for computation (with derivation) graphical method of determination of mode, merits and demerits.

4.4 Median: Definition, formula for computation (with derivation) graphical method of determination of median, merits and demerits.

4.5 Empirical relation between mean, median and mode.

4.6 Partition Values: Quartiles, Deciles and Percentiles.

4.7 Geometric Mean (G.M.) Definition, Properties of G.M, merits and demerits.

4.8 Harmonic Mean (H.M.) Definition, merits and demerits. Order relation between arithmetic mean, geometric mean, harmonic mean (proof for n = 2).

4.9 Weighted Mean: Weighted A.M., G.M. and H.M.

4.10 Examples and Problems.

## 5. Measures of Dispersion (16hrs)

5.1 Concept of dispersion, characteristics of good measure of dispersion.

5.2 Range: Definition, merits and demerits.

5.3 Semi-interquartile range (Quartile deviation).

5.4 Mean deviation: Definition, merits and demerits, minimality property (without proof).

5.5 Mean square deviation: Definition, minimality property of mean square deviation (with proof), Variance and standard deviation: Definition, merits and demerits, effect of change of origin and scale, combined variance (derivation for 2 groups), combined standard deviation, generalization for n groups.

5.6 Measures of dispersion for comparison: coefficient of range, coefficient of quartile deviation and coefficient of mean deviation, coefficient of variation

5.7 Examples and Problems.

## 6. Moments, Skewness and Kurtosis (10hrs)

6.1 Raw moments ( ) for grouped and ungrouped data.

6.2 Moments about an arbitrary constant for grouped and ungrouped data ( ).

6.3 Central moments ( ) for grouped and ungrouped data, Effect of change of origin and scale, Sheppard's correction.

6.4 Relations between central moments and raw moments (upto 4-th order).

6.5 Concept of skewness of frequency distribution, positive skewness, negative skewness, symmetric frequency distribution.

6.6 Bowley's coefficient of skewness: Proof of Bowley's coefficient of skewness lies between −1 to 1, interpretation using Box plot.

6.7 Karl Pearson's coefficient of skewness.

6.8 Measures of skewness based on moments( , ).

6.9 Concepts of kurtosis, leptokurtic, mesokurtic and platykurtic frequency distributions.

6.10 Measures of kurtosis based on moments, ( , )

6.11 Examples and Problems.

Practical (16 Experiments)

Part A: Manual Calculation

1. Presentation of Data: Frequency Table (Univariate and Bivariate data), Graphs: Stem and Leaf curve, Pie-diagram, Histogram, frequency curve, frequency polygon, cumulative frequency curves (Ogives) Interpretation of data
2. Measures of Central tendency: Arithmetic mean, Geometric mean, Harmonic mean, Weighted Arithmetic Mean, Combined Mean, Median, mode and other partition values. (Ungrouped and Grouped data)
3. Measures of Dispersion: Quratile Deviation, Mean Deviation, Standard deviation and Coefficient of Variation (Ungrouped and Grouped data)
4. Moments (First four) about origin and mean (Ungrouped and Grouped data)
5. Coefficient of skewness and Kurtosis (Karl – Pearson, Bolwey's and based on Moments)
6. Box Plot.

Part B: Using Microsoft Excel

1. Introduction to MS Excel – functions and statistical Data analysis
2. Classification, tabulations and frequency tables
3. Histogram, frequency curves, ogives, Pareto diagram
4. Two way tables and Box plots
5. Descriptive Statistics.

Note: 1. It is mandatory to have statistics laboratory, equipped with computers, MSoffice, Calculators.

2. Students are required to perform practical using Data analysis pack and functions of MS Excel as well as they are required to attach print outs of work done.
3. The proposed batch size of statistics practical is not more than 10 students per batch.
4. Every student should acess to computer individually.

Reference Books


1. Goon Gupta and Das Gupta: Fundamentals of Statistics, Vol. 1. The World Press Pvt. Ltd., Kolkata.
2. Mukhopadhyay, P.: Mathematical Statistics (1996), MacMillan Publishing Co. New York.
3. S.C.Gupta and V.K.Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
4. Spiegel M.R. (1967): Theory and problem of Statistics, Schaum's Publishing Series.
5. Amir D. Aczel and Jayael Soundarpandiyan, Complete Business Statistic: McGraw Hill Education (6th Edition).
7. K. V. S. Sarma: Statistics Made Simple: Do it yourself on PC. Prentice Hall of India Pvt. Ltd., New Delhi.
8. Palli and Bagavathi: Statistics

## SECOND SEMESTER (PAPER – II)

# Paper - II: Probability Theory and Descriptive Statistics

Objectives : The main objective of this course is to introduce to the students the basic concepts of probability, axiomatic theory of probability, concept of random variable, probability distribution (univariate and bivariate) discrete random variables, expectation and moments of probability distribution.

By the end of the course students are expected

1. to distinguish between random and non-random experiments.

2. to find the probabilities of events.

3. to obtain a probability distribution of random variable (one or two dimensional)

4. to apply standard discrete probability distribution to different situations.

5. to compute the relationship between the two variables and anyalysis.

Prerequisite: Permutation and Combination, Binomial theorem, Algebra of sets.

## 1. Introduction of Probability (12hrs)

1.1 Basic terminology

1.2 Mathematical Probability and its limitations, Problems on it.

1.3 Concept of Statistical Probability and its limitations.

1.4 Axiomatic approach to probability(only definition).

1.5 Theorems on probabilities events.

1.6 Concept of Conditional Probability

1.7 Multiplication theorem of Probability for dependent and independent two events (with proof) and generalization to three events, Problems on it.

1.8 Concept of Total Probability and Bayes's Theorem (with Proof)

1.9 Examples and Problems.

## 2. Univariate Probability Distributions (Discrete and continuous Sample Space) (12hrs)

2.1 Concept and definition of a discrete and continuous random variable.

2.2 Probability mass function (p.m.f.) and probability density function (p.d.f) cumulative distribution function (c.d.f.), $F(\cdot)$ of discrete and continuous random variable, properties of (c.d.f.).

2.3 Two – Dimensional Random Variables, Joint probability mass function, Marginal probability function, Conditional probability function, Distribution function, Marginal Distribution functions, Joint Probability Density function, Marginal Probability density function, Conditional probability density function, Conditional Distribution function

2.4 Examples and Problems using descrite and continuous random variables.

## 3. Mathematical Expectation (Univariate & Bivariate Random Variables) (12hrs)

3.1 Definition.

3.2 Theorems on expectations of sum and product of two jointly distributed random variables.

3.3 Concept of conditional expectation.

3.4 Definitions of conditional mean and conditional variance.

3.5 Definition of raw and central moments.

3.6 Definition of covariance.

3.7 Variance of linear combination of variables.

3.8 Examples and Problems.

## 4. Moment Generating Function and Cumulants (8hrs)

4.1 Definition of moment generating function

4.2 Limitations of moment generating function

4.3 Properties of moment generating function (without proof)

4.4 Definition of cumulants and Properties of cumulants

4.6 Examples on moment generating function and cumulants.

## 5. Correlation and Regression Analysis (12hrs)

5.1 Bivariate data, bivariate frequency distribution.

5.2 Concept of correlation between two variables, positive correlation, negative correlation, zero correlation.

5.3 Scatter diagram, conclusion about the type of correlation from scatter diagram.

5.4 Covariance between two variables: Definition, computation, effect of change of origin and scale.

5.5 Karl Pearson's coefficient of correlation (r): Definition, computation for grouped and ungrouped data and interpretation. Properties: (i) $-1 \; r \; 1$ (with proof), (ii) Effect of change of origin and scale (with proof).

5.6 Spearman's rank correlation coefficient: Definition, computation and interpretation (without ties), Spearman's rank correlation coefficient (derivation of formula in case of without ties). In case of ties, compute Karl Pearson's correlation coefficient between ranks. (Spearman's rank correlation coefficient formula with correction for ties not expected.)

5.7 Examples and Problems.

5.8 Concept of regression, lines of regression, fitting of lines of regression by the least squares method, interpretation of slope and intercept.

5.9 Properties of regression lines and coefficients (with proof)

5.10 Examples and Problems.

Practical (16 Experiments)

Part A: Manual Calculation

1. Computation of Probabilities (using mathematical probability)
2. Computation of probabilities using addition and multiplation theorems
3. Computation of conditional probabilities by using Baye's theorem
4. Computation of probability mass functions of discrete random variables
5. Computation of probability density functions of continuous random variables.
6. Computation of joint, marginal probability distribution for discrete and continuous random variables.
7. Computation of Mean, standard deviation, variance, covariance for discrete and continuous random variables.

8. Fitting of linear and non linear curves reducible to linear form (two variable only)

9. Karl Pearson’s coefficient of correlation, Spearman’s coefficient of rank orrelation,

10. Regression analysis: Lines of regression (linear case only) and other related problem.

Part B: Using Microsoft Excel

1. above experiments using Microsoft excel.

**Reference Books**


1. Miller and Fruend: Modern Elementary Statistics.

2. Mukhopadhyay, P.: Mathematical Statistics (1996), New Central Book Agency, Calcutta, Introduction to Mathematical Statistics, Ed. 4 (1989), MacMillan Publishing Co. New York.

3. S.C.Gupta and V.K.Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.

4. E.J.Dudewicz and Satya N Mishra: Modern Mathematical Statistics, John Wiley & Sons Singapore.

5. Amir D. Aczel and Jayael Soundarpandiyan, Complete Business Statistics: McGraw Hill Education (6th Edition).

6. K. V. S. Sarma: Statistics Made Simple: Do it yourself on PC. Prentice Hall of India Pvt. Ltd., New Delhi.

8. Spiegel M.R. (1967): Theory and problem of Statistics, Schaum's Publishing series

## THIRD SEMESTER (PAPER III)

## Probability Distributions & C Language

### 1. Discrete Probability Distributions (16hrs)

1.1 Uniform discrete distribution on integers 1 to n: p.m.f., c.d.f., mean variance, real life situations, Moment Generating function, first four moments using m.g.f

1.2 Bernoulli Distribution: p.m.f., mean, variance, moments, Moment Generating function, first four moments using m.g.f

1.3 Binomial Distribution: p.m.f. Recurrence relation for successive probabilities, computation of probabilities of different events, mode of the distribution, mean, variance, moments, Mean Deviation about mean, skewness (comments when $p = 0.5$, $p > 0.5$, $p < 0.5$), Moment Generation function, first four moments using m.g.f. Cummulants and its Recurrence relation, skewness and kurtosis, Fitting of Binomial Distribution.

1.4 Hypergeometric Distribution: p.m.f., Computation of probability, situations where this distribution is applicable, Binomial approximation to hypergeometric probabilities, mean and variance of the distribution.

1.5 Poisson Distribution: p.m.f. Derivation of Poisson distribution as a limiting case of binomial distribution. Moments, Mode, Recurrence Relation for the moments, Moment Generating Function, Cumulants, first four moments using m.g.f. skewness and kurtosis, Additive Property of Independent Poisson Variates, Fitting of Poisson Distribution.

1.6 Negative Binomial Distribution: Definition, moment generating function, Cumulants, first four moments using m.g.f, skewness and Kurtosis, Fitting of Negative Binomial distribution.

1.7 Geometric Distribution, Lack of Memory, Moments of Geometric distribution, Moment Generating Function of Geometric distribution.

1.8 Examples and Problems on the discrite distributions.

### 2. Continuous Probability Distributions (20hrs)

2.1 Rectangular or Uniform distribution, its moments, its m.g.f, skewness and kurtosis, Mean deviation about mean.

2.2 Normal (Statandard) distribution, its chief characteristics and normal probability curve. Its mode and median, its m.g.f, & c.g.f, first four moments of normal distribution, skewness and

kurtosis, Mean deviation from the mean of normal distribution, Area property of normal probability curve, fitting of normal distribution.

2.3 Gamma distribution, its m.g.f and c.g.f. first four moments, skewness and kurtosis, additive property of Gamma distribution.Limiting form of Gamma distribution.

2.4 Beta distribution of First Kind, its constants, Beta distribution of Second kind, its constants, Examples and problems on Beta distribution of first and second kind.

2.5 Exponential Distribution, its m.g.f and first four moments, examples on it.

2.6 Cauchy's Distribution, its moments if exists.

## 3. Programming in C – Language. (20hrs)

3.1 Introduction to C, variables, Data types - Declarations, Type conversions, increment and decrement operators, Bitwise, Logical and Assignment operators.

3.2 Expression and Conditional Expressions, Control structures, If-Else, SWITCH, WHILE, FOR and DO WHILE Loop structures. Break continue, GO o's and Label Statements. Function, function returning, Non-integers. Function arguments - Static and register variables.

3.3 Arrays and. Strings - Array Declaration Multi dimensional Arrays Strings / Character Arays, Array initialization - Pointers and Addresses. Pointers and Arrays - Pointer to functiois.

3.4 Structures and functions, Arrays of structures, Fields, Unions - type definiton standard input and output - formatted output - output - Access to the standard library.

Practical

Part A: Manual Calculation

1. Computation of probabilities using Binomial distribution
2. Fitting of Binomial Distribution
3. Computation of probabilities using Poisson distribution
4. Fitting of Poisson distribution
5. Computation of probabilities using Hypergeometric distribution.
6. Fitting of Negative Binomial distribution.
7. Computation of probabilities using Normal distribution

8. Fitting of Normal distribution

9. Write algorithm flow chart and c programming to the following

1. Calculation of A.M, G.M and H.M for ungrouped data
2. Calculation of A.M, G.M and H.M for discrete frequency distribution
3. Calculation of A.M, G.M and H.M for continuous frequency distribution
4. Calculation of median and quartiles for discrete frequency distribution
5. Calculation of median and quartiles for continuous frequency distribution
6. Calculation of Mean deviation about mean for discrete frequency distribution
7. Calculation of Mean deviation about mean for continuous frequency distribution
8. Calcuation of mean and standard deviation for ungrouped data
9. Calculation of mean and standard deviation for discrete frequency distribution
10. Calculation of mean and standard deviation for continuous frequency distribution

Part B: Using Microsoft Excel

1. Fitting of Binomial, Hypergeometric, Poisson, Normal distribution.

**Reference Books**


1. Hogg, R. V. and Craig R. G.: Introduction to Mathematical Statistics, Ed. 4. (1989), MacMillan Publishing Co., New York.
2. Hoel, P. G.: Introduction to Mathematical Statistics (1962), John Wiley and Sons, New York.
3. Feller, W.: Introduction to Probability Theory and Its Applications, Vol.I (1963), Asian Publishing House Bombay.
4. Mood, A. M. and Graybill, F. A. and Boes D.C. E.: Introduction to Theory of Statistics, Ed. 3 (1974), McGraw Hill and Kagakusha Ltd. London.
5. Mayer, P. N.: Introduction to Probability and Statistical Applications, Addison Wesley Publishing Co., Massachusetts).
6. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
7. Ross: Probability theory, Pearson Publishers.
8. K. V. S. Serma: Statistics Made Simple: Do it yourself on PC.
9. E.Balaguruswamy: Programming in ANSI C", Tata McGraw – Hill.
10. Yashwant kanetkar: "Let us C" BPP Publications.
11. P.B.Kotur: Computer Concepts and C programming, Sapna Book House, Bangalore.

## FOURTH SEMESTER (PAPER – IV)

## Statistical Inference

### 1. Theory of Estimation (18hrs)

1.1 Point Estimation - Problem of Point estimation - Properties of estimators- Consistency and Efficiency of an estimator. Sufficiency of a statistic - Neyman- Fisher factorization theorem (discrete case) - Simple problems.

1.2 Unbiasedness - Properties, MVUE, BLUE, Cramer- Rao inequality - simple problems.

1.3 Methods of estimation: Method of Moments, Method of Maximum Likelihood, properties of estimators obtained by these methods -simple problems.

### 2. Interval Estimation (6hrs)

2.1 Interval Estimation - Confidence Interval for proportions, mean(s), variance, and variance ratio based on chi square, student's t, F and Normal distributions.

### 3. Testing of hypothesis (18hrs)

3.1 Statistical Hypothesis, Problem of testing of hypothesis, Definition and illustrations of i) Simple hypothesis ii) composite hypothesis, Null and Alternative Hypothesis, type I error type II errors, critical region probabilities of type I error and type II errors, simple problems

3.2 Definition and illustrations of i) level of significance ii) observed level of significance (p-value) iii) size of test iv) power of a test

3.3 Definition of most powerful (M.P) level test of simple null hypothesis against simple alternative. Statement of Neyman – Pearson (N-P) lemma for constructing the most powerful level test of simple null hypothesis against alternative hypothesis, Illustrations.

3.4 Power function of a test, power curve, definition of uniformly most powerful (UMP) level test for one sided alternative, Illustrations.

### 1. Non-parametric test (8hrs)

1.1 Idea of non-parametric problems. Distinction between a parametric and a non-parametric problem. Concept of distribution free statistic. One tailed and two tailed test procedure of i) Sign test ii) Wilcoxon signed rank test iii) Mann-Whitney U test, iv) run test for

randomness, one sample and two sample problems. Solmogorov-Smirnov test for completely specified uni-variate distribution (one sample problem only) for two sided alternative hypothesis. Median test.

**Practical Part A: Manual Calculation**

1. Method of Maximum likelihood estimators
2. Method of Moments
3. Confidence interval for sample mean, sample proportion
4. Determination of Probability of type I and type II errors, power of test
5. Construction of most powerful(M.P) test
6. Construction of uniformly most powerful(UMP) test

Part B: Using Microsoft Excel

Above experiments which are applicable.

Reference Books


1. Lindgren, B.W.: Statistical Theory (third edition) collier Macmillan International Edition, Macmillan publishing Co., Inc. New York.
2. Mood, A.M., Graybill, F. and Bose, D.C.: Introduction to the theory of Statistics (third edition) International Student Edition, McGraw Hill Kogakusha Ltd.
3. Hogg, P.V. and Craig, A.J.: Introduction to Mathematical Statistics (fourth edition), Collier Macmillan International Edition, Macmillan Publishing Co. Inc., New York.
4. Siegel, S.: Nonparametric methods for the behavioural sciences, International Student Edition, McGraw Hill Kogakusha Ltd.
5. Hoel, Port, Stone: Introduction to statistical Theory, Houghton Mifflin Company (International) Dolphin Edition.
6. J.D. Gibbons: Non parametric Statistical Interence, McGraw Hill Book Company, New York.
7. Daniel: Applied Nonparametric Statistics, Houghton Mifflin Company, Roston.
8. V.K. Rohatgi: An introduction to probability theory and mathematical statistics, Wiley Eastern Ltd., New Delhi.
9. Kendall and Stuart: The advanced Theory of Statistics, Vol 1, Charles and company Ltd., London.

10. Dudeweitz and Mishra: Modern Mathematical Statistic, John Wiley and Sons, Inc., New York.
11. Kale, B.K.: A First Course In parametric Inference.
12. Kunte, S., Purohit, S.G. and Wanjale, S.K.: Lecture Notes on Nonparametric Tests.
13. B.L. Agarwal: Programmed Statistics: New Age International Publications, Delhi.
14. Sanjay Arora and Bansi Lal: New Mathematical Statistics (Ist Edition), Satya Prakashan16/17698, New Market, New Delhi,5(1989).

## FIFTH SEMESTER (PAPER – V)

## Small and Large Sample Tests & SQC

### 2. Small and Large Sample Tests (8hrs)

2.1 Introduction of sampling, Parameter and statistic, Sampling distribution, standard error, unbiased estimator,

2.2 Tests of significance, Null hypothesis, alternative hypothesis, errors in sampling, critical region and level of significance, one tailed and two tailed tests, critical or significant values, procedure of testing of hypothesis

2.3 Test of significance for large samples: Sampling of attributes, test for single proportion, test of significance for difference of proportions, Sampling of Variables, test of significance of single mean, test of significance of difference of means, test of significance of difference of standard deviations

### 3. Exact Sampling Distributions (22hrs)

3.1 Chi-square Variate: Derivation of the chi-square distribution, m.g.f and c.g.f of chi-square distribution, constants of chi-square distribution, limiting form of chi-square distribution, mode and skewness of chi-square distribution, Additive property of chi-square variates, Theorems of chi-square variates, Conditions for the validity of chi-squre test, Application of chi-square distribution.Chi-square test for population variance, goodness of fit, independence of attributes.

3.2 Student's "t", Derivation of student's t- distribution, Fisher's "t", Distribution of Fisher's "t", Constants of t-distribution, Limitting form of t-distribution, Application of t-distribution, t-test for single mean, difference of means, sample correlation coefficient, regression coefficient.

3.3 F-statistic, derivation of Snedecor's F – distribution, constants of F-distribution, Mode and Points of inflexion of F-distribution, Application of F-distribution: F-test for equality of population variances, Relation between t and F distribution, F and chi-square distribution.

### 4. Statistical Quality Control (18hrs)

4.1 Need for Statistical Quality Control techniques in Industry - Causes of Quality variation control charts - Use of the Shwhart - control chart - Specification and tolerance limits - 3 sigma limits - warning limits - application of theory of runs in quality control.

4.2 Control chart for variables - X Chart - R chart - purpose of the charts - Basis of subgrouping - plotting X and R results - determining the trial control limits Interpretation of control charts X and R

4.2 Control chart for attributes - purpose of the chart - P chart - np chart - construction of P and np chart - choice between chart for P and chart for np - construction of c-chart.

4.3 Acceptance of sampling plans for attributes - Producer's risk and consumer's risk - concepts of AQL, LTPD, AOQ, AOQL, ATI and ASN - single, double and Multiples sampling plans OC, AOQ, ATI curves for single and double sampling plans.

Practical

Part A: Manual Calculation

1. Test of mean and difference of means for large samples
2. Test of proportion and difference of proportion for large samples
3. Test of difference of standard deviations for lagre samples
4. Tests based on chi-square distribution i) goodness of fit ii) independence of attributes iii) population variance
5. Tests based on t – distribution i) single mean ii) difference of two sample means iii)sample correlation and regression coefficient
6. Tests based on F – distribution equality of population variance
7. Non – parametric tests: Sign, Wilcoxon's signed rank test, Mann – Whitney U test, Run test, median test, Kolmogorov – Smirnov test
8. Construction of Mean and Range charts
9. Construction of Mean and Standard deviation charts
10. Construction of p – chart
11. Construction of np – chart
12. Construction of c – chart
13. Construction of OC curve, AOQ, AOQL, ATI for Single sampling plan
14. Construction of OC curve, AOQ, AOQL, ATI for double sampling plan

Part B: Using Microsoft Excel

Above all experiments using Microsoft excel

Reference Books


1. Hogg, R. V. and Craig R. G.: Introduction to Mathematical Statistics, Ed. 4. (1989), MacMillan Publishing Co., New York.
2. Hoel, P. G.: Introduction to Mathematical Statistics (1962), John Wiley and Sons, New York.
3. Feller, W.: Introduction to Probability Theory and Its Applications, Vol.I (1963), Asian Publishing House Bombay.
4. Mood, A. M. and Graybill, F. A. and Boes D.C. E.: Introduction to Theory of Statistics, Ed. 3 (1974), McGraw Hill and Kagakusha Ltd. London.

5. Mayer, P. N.: Introduction to Probability and Statistical Applications, Addison Wesley Publishing Co., Massachusetts).
6. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
7. Ross: Probability theory, Pearson Publishers.
8. M. B. Kulkarni and S. B. Ghatpande: Discrete Probability and Probability Distributions, SIPF Academy, Nashik.
9. K. V. S. Serma: Statistics Made Simple: Do it yourself on PC.
10. Kapoor, V.K. and Gupta, S.P. (1978): Fundamentals of applied statistics, Sultan Chand & Sons.
11. Gupta, R.C (1974): Statistical Quality Control.
12. Montgomery, D.C. (1983): Introduction to Statistical Quality Control, John Waley & Sons.

## FIFTH SEMESTER (PAPER – VI)

## Sample Survey & Design of Experiments

### 1. Design of Sample Survey: (22hrs)

1.1 Concepts of population and sample. Need for sampling. Complete enumeration vs Sample surveys. Non probability and probability sampling- meaning, need and illustrations; Use of random numbers; Principal steps in a sample survey. Requisites of a good questionnaire; Pilot surveys; Sampling and non sampling errors.

1.2 Simple random Sampling from finite population of size (N) i) with replacement (SRSWR) ii) without replacement(SRSWOR) definitions, population mean and population total as parameters, Sample mean as an estimator of population mean derivation of expectation and standard error of sample mean in case of SRSWR and SRSWOR. Sampling for proportion as an application of a simple random sample, sample proportion as an estimator of population proportion of units possessing a certain attribute, Estimator of standard error of sample proportion in case of SRSWR and SRSWOR.

1.3 Stratified Random Sample: Stratification, basis of stratification, real life situation, stratified random sampling as a sample drawn from individual strata using SRSWOR in each stratum. Stratified sample mean as an estimator of population mean, its expectation and standard error. Problem of allocation, proportional allocation, Neyman's allocation derivation of the expressions for the standard errors of the above estimators when these allocations are used. Gain in precision due to stratification, comparison amongst SRSWOR, stratification with proportional allocation and stratification with Neyman's allocation. Cost and Variance analysis in stratified random sampling; minimization of variance for fixed cost, minimization of cost for fixed variance, optimum allocation, Neyman's allocation as a particular case of optimum allocation in cost and variance analysis.

1.4 Systematic Sampling: Real life situations where systematic sampling is appropriate, Techniques of drawing a sample using systematic sampling. Estimation of the population mean and population total; standard error of these estimators; Comparison of systematic sampling with SRSWOR and Stratified sampling; Comparison of systematic sampling with SRSWOR and stratified sampling in the presence of linear trend.

### 2. Analysis of Variance (8 hrs)

1.1 Meaning and assumptions. Analysis of variance (fixed effects model) - Analysis of one-way, two-way classified data. Least significant difference. Case of multiple but equal number of observations per cell in two-way classification (with interaction).

## 3. Design of Experiments: (18hrs)

3.1 Basic terms of design of experiments

3.2 Basic principles of design of experiments: Randomization, replication and local control.

3.3 Completely Randomized Design (CRD): Layout, model (fixed effect) assumptions and interpretations, Breakup of total sum of squares into components, preparation of ANOVA table, testing equality of treatment effects, test for equality of two specified treatment effects using critical difference (C.D).

3.4Randomized Block Design (RBD): Layout, model (fixed effect) assumptions and interpretations, Breakup of total sum of squares into components, preparation of ANOVA table, testing equality of treatment and block effects, test for equality of two specified treatment effects using critical difference (C.D). Efficiency of RBD over CRD

3.5 Latin square designs: Layout, model(fixed effect) assumptions and interpretations, Breakup of total sum of squares into components, preparation of ANOVA table, testing equality of treatment, row and columns effects, test for equality of two specified treatment effects using critical difference (C.D). Efficiency of LSD over i) CRD ii) RBD

3.6 Missing plot technique for RBD and LSD-Estimation for single missing observation.

Practical

Part A: Manual Calculation

1. Analysis of variance for one – way classification
2. Analysis of variance for two – way classification one observation per cell
3. Analysis of variance for two – way classification more than one observation per cell
4. Analysis of CRD
5. Analysis of RBD and Efficiency of RBD w.r.t CRD
6. Analysis of LSD and Efficiency of LSD w.r.t RBD and CRD
7. Analysis of RBD and LSD after estimation of missing values.
8. Simple random Sampling (Estimation of population mean,population total with standard error i) with replacement ii) without replacement)
9. Simple random sampling (Estimation of population proportion, population total with standard errors)
10. Stratified random sampling: Proportional and Neyman allocation, comparison with SRSWOR
11. Stratified random sampling: cost and variance analysis
12. Systematic sampling: Comparision with SRSWOR and Stratified random sampling. Reference Books

1. Federer , W.T. : Experimental Design : Oxford and IBH Publishing Co., New Delhi.
2. Cochran W.G. and Cox, C.M. : Experimental Design, John Wiley and Sons, Inc., New - York.
3. Montgomery , D.C.: Design and Analysis of Experiments, and sons, Inc., New - York.
4. Dass, M.N. and Giri, N.C.: Design and Analysis of Experiments, Wiley EasternLtd., New Delhi.
5. Goulden G.H. : Methods of Statistical Analysis, Asia Publishing House Mumbai
6. Kempthorne, O: Design of Experiments. Wiley Eastern Ltd., New Delhi.
7. Snedecor, G.W. and Cochran, W.G.: Statistical Methods, Affiliated East – West Press, New Delhi. (for 1.8)
8. Goon, Gupta, Dasgupta: Fundamentals of Statistics, Vol.II, The world Press Pvt.Ltd. Kolkatta.
9. Gupta S.C. and Kapoor V.K.: Fundamentals of Applied Statistics, S.Chand Sons, New Delhi.
10. C.F. Jeff Wu, Michael Hamda: Experiments, Planning, Analysis and Parameter Design Optimization.
11. Miller and Freund : Probability and Statistics for engineers, Pearson Education, Delhi (for 1.8)

## SIXTH SEMESTER (PAPER – VII)

## Multiple Correlation & Applied Statistics

### 1. Multiple, Partial correlation and regression: (12hrs)

1.1 Notion of multiple linear regressions, Yule's notation (trivariate case – sample data only).

1.2 Fitting of regression planes by the method of least squares; obtaining normal equations, solutions of normal equations.

1.3 Definition and interpretation of partial regression coefficient bij.k, units of bij.k definition of multiple correlation coefficients $R_{i.jk}$.

1.4 Interpretation of coefficient of multiple determination $R^2_{i.jk}$ as (i) proportion of variation explained by the linear regression (ii) $R_{i.jk} = 1$, (iii) $R_{i.jk} = 0$. Adjusted $R^2_{i.jk}$. Residual plots, problem of multicolinearity introduction, introduction to stepwise regression.

1.5 Definition of partial correlation coefficient $r_{ij.k}$.

### 2. Time Series: (12hrs)

2.1 Meaning and utility of time series

2.2 Components of time series; trend, seasonal variations, cyclical variations, irregular fluctuations

2.3 Methods of trend estimation and smoothing: i) moving average, ii) curve fitting by least square principle iii) exponential smoothing

2.4 Measurement of seasonal variations i) simple average method ii) rato to moving averages method.

### 3. Index Numbers: (12hrs)

3.1 Index Numbers - uses, classification of index numbers - Problems in the construction of index numbers - Methods of constructing index numbers - Unweighted index numbers - weighted index numbers.

3.2 Quantity index numbers - Fixed and chain base index numbers - Optimum test for index numbers - Time reversal test - factor reversal test

3.3 Cost of living index numbers. Considerations in its construction i) family budget method ii) aggregate expenditure method, its uses

### 4 Demography (12hrs)

4.1 Vital events, vital statistics, method of obtaining vital statistics, rates of vital events, sex ratios, dependency ratio.

4.2 Mortality rates: Crude death rates, specific (age, sex etc) death rate, standardized death rate (direct and indirect) infant mortality rate.

4.3 Fertility rate: Crude birth rates, general fertility rate, specific (age, sex etc) fertility rates, total fertility rates

4.4 Growth/Reproduction rates: Gross reproduction rate, net reproduction rate.

4.5 Life table - Structure - Construction - Relationship between the function of a life table - abridged life table and its use.

Practical

Part A: Manual Calculation

1. Estimation of Trend values by moving average method
2. Estimation of Trend values by least square principle
3. Estimation of seasonal indices by ratio to trend
4. Estimation of seasonal indices by link relatives.
5. Construction of Price Index Numbers
6. Construction of Quatatitive Index Numbers
7. Construction of Cost of living Index Numbers
8. Estimation of Mortality Rates
9. Estimation of Fertility Rates
10. Estimation of Growth Rates
11. Construction of Life Tables
12. Fitting of trivariate regression plane
13. Computation of Multiple, Partial correlation coefficients Reference Books


1. Gupta S.C. and Kapoor V.K.: Fundamentals of Applied Statistics, S.Chand Sons, New Delhi.
2. Gupta S.C and V.K.Kapoor: Fundamentals of Mathematical Statistics, S. Chand sons, New Delhi.
3. Montgomery, D.C. and Johnson L.A. (1976). Forecasting and Time Series Analysis, McGraw Hill.
4. Farmum, N.R. and Stantorr, L.W. (1989). Quantitative Forecasting Methods, PWS Kent Publishing Company, Boston

## SIXTH SEMESTER (PAPER – VIII)

## Operations Research

### 1. Linear Programming Problem (20 hrs)

1.1 Statement of the linear Programming Problem (LPP), Formulation of problem as Linear Programming Problem. (i) Canonical form, (ii) standard form.

1.2 Definition of i) a solution ii) a feasible solution iii) a basic feasible solution, iv) a degenerate and non –degenerate solution v) an optimal solution vi) basic and non-basic variables .

1.3 Solution of L.P.P by i) Graphical Method: solution space, unique and non-unique solutions, obtaining an optimal solutions. ii) Simplex Method

1.4 Examples and simple problems

### 2. Dual (4 hrs)

2.1 Duality Theory: Writing dual of a primal problem, solution of a L.P.P. by using its dual problem.

2.2 Examples and simple problems.

### 3. Transportation and Assignment Problem (14 hrs)

3.1 Transportation problem (T.P.), statement of T.P., balanced and unbalanced T.P.

3.2 Methods of obtaining basic feasible solution of T.P. i) North-West corner rule
ii) Method of matrix minima (least cost method),
iii) Vogel's approximation method (VAM).

2.3 u-v method of obtaining Optimal solution of T.P., uniqueness and non- uniqueness of optimal solutions,

2.4 Assignment problems: statement of an assignment, balanced and unbalanced problem, relation with T.P., optimal solution of an assignment problem, using Hungarian method.

2.5 Examples and problems.

### 4. Game Theory (10 hrs)

4.1 Description of games

4.2 Solution of Two person zero sum games, by i) minimax and maximin principle, ii) Saddle point approach iii) Dominance property

4.3 Games without saddle points (Mixed strategies): i) 2X2 games without saddle point ii) Graphical solution of 2xn and nx2 games iii) solution of a game by linear programming approach.

Practical

Part A: Manual Calculation

1. Formulation of L.P.P
2. Solving L.P.P by Graphical method
3. Solving L.P.P by simplex Method
4. Estimation of Initial Basic Feasible Solution for T.P
5. Testing of optimality of T. P
6. Solving Assignment Problems
7. Problems of Game Theory

Reference Books


1. Gass E.: Linear Programming Method and Applications, Narosa Publishing House, New Delhi.
2. Taha, R. A.: Operation Research – An Introduction, Fifth Edition, Prentice Hall of India, New Delhi.
3. Saceini Yaspan, Friedman: Operation Research Method and Problems, Wiley International Edition.
4. Shrinath L.S.: Linear Programming, AffiliatedEast-West Press Pvt. Ltd. New Delhi.
5. Phillips, D.T., Ravindra, A., Solberg, J. : Operations Research Principles and Practice, John Wiley and Sons Inc.
6. Sharma J. K.: Mathematical Models in Operations Research, Tata McGraw Hill Publishing Company Ltd., New Delhi.
7. Kapoor, V. K.: Operation Research, Sultan Chand and Sons, New Delhi.
8. Gupta, P. K. and Hira, D.S.: Operations Research, S. Chand and company Ltd., New Delhi.
9. Shrinath, L.S.: PERT-CPM Principles and Applications Affiliated East-West Press Pvt. Ltd., New Delhi.
10. S.D.Sharma: Operations Research, Kedar Nath Ram Nath & Co. Meerut.
11. B.S Goel and S.K. Mittal, Pragati Prakashan Meerut.
12. Kantiswaroop, Man Mohan and P.K Gupta (2003): Operations Research- Sultan Chand & Co.
13. Churchman C.W, Ackoff R.L and Arnoff E.L (1957): Introduction to Operations Research- John Wiley.
14. Shenoy,G.V.,Srivatsava,U.K and Sharma,S.C.: Operations Research for Management,New Age International.
10. www.math.uah.edu/stat (Virtual laboratories in Statistics)
11. www.amstat.org/publications/stats (STATS: the magazine for students of Statistics)

**MODEL QUESTION PAPER FOR SEMESTER EXAMINATION**
**B.Sc Statistics: Title of the paper**

**Time: 3 hours** **Max. Marks: 70**

**SECTION – A**

I. Choose the correct answer for the following each carry 1 mark 1 X 10 = 10

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

**SECTION – B**

II. Answer any four of the following, each carry 5 marks 4 x 5 = 20

11.
12.
13.
14.
15.
16.

**SECTION – C**

III. Answer any four of the following each carry 10 marks 4 x 10 = 40

17.
18.
19.
20.
21.
22.

Xxxxxxxxxxxxxxxxxxxx END xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx