

**P.G. AND RESEARCH  
DEPARTMENT OF STATISTICS**  
*PERIYAR E.V.R. COLLEGE (AUTONOMOUS)*  
TIRUCHIRAPPALLI - 620 023.



**SYLLABI**

**B.STAT**

From 2018-2019 onwards

## **Question Paper Pattern**

**(For Part I, II, III and IV)**

For all Language, Core and Allied courses .

**Section - A ( 10 x 2 = 20 Marks )**  
**Answer ALL the questions**

Two questions are compulsory from each unit of the syllabus.

**Section - B ( 5 x 5 = 25 Marks )**  
**Answer ALL the questions**

Five questions in either or pattern with internal choice covering all the five units of the syllabus

**Section - C ( 3 x 10 = 30 Marks )**  
**Answer any THREE questions**

Three out of Five questions covering all the five units of the syllabus

**Part - IV - NME, SBE, Environmental Science and Value Education**

**Part - V - Gender Equality.**

Five out of Eight questions covering all the five units of the syllabus.

**(5 x 15 = 75 marks)**

**Duration for all Practical examinations: 3 Hours**

## COURSE STRUCTURE B.STAT ( 2018 onwards )

SL. No.	COURSE TITLE			Hrs.	Credits	Internal Exam	External Exam	Total
<b>I - SEMESTER</b>								
1	P - I	TAMIL - I		6	3	25	75	100
2	P - II	ENGLISH - I		6	3	25	75	100
3	P - III	CORE - I	DESCRIPTIVE STATISTICS	6	6	25	75	100
		CORE - P II	PRACTICAL - I (NS)	2	-	-	-	
4		FIRST ALLIED - I	MATHEMATICS - I	4	4	25	75	100
		FIRST ALLIED - II*	MATHEMATICS- II (Non-Sitting)	2	-	-	-	
5	P - IV	VE	VALUE EDUCATION	2	2	25	75	100
6		SBE - I	STATISTICAL SURVEY	2	2	25	75	100
<b>TOTAL</b>				<b>30</b>	<b>20</b>	<b>150</b>	<b>450</b>	<b>600</b>
<b>II - SEMESTER</b>								
7	P - I	TAMIL - II		6	3	25	75	100
8	P - II	ENGLISH - II		6	3	25	75	100
9	P - III	CORE - P* II	PRACTICAL -I (NS)	4	4	40	60	100
10		CORE - III	PROBABILITY AND RANDOM VARIABLES	6	6	25	75	100
11		FIRST ALLIED - II*	MATHEMATICS- II	2	2	40	60	100
12		FIRST ALLIED III	MATHEMATICS- III	4	4	25	75	100
13	P - IV	ES	ENVIRONMENTAL SCIENCE	2	2	25	75	100
<b>TOTAL</b>				<b>30</b>	<b>24</b>	<b>205</b>	<b>495</b>	<b>700</b>
<b>III - SEMESTER</b>								
14	P - I	TAMIL III		6	3	25	75	100
15	P - II	ENGLISH III		6	3	25	75	100
16	P - III	CORE IV	DISCRETE PROBABILITY DISTRIBUTIONS	4	4	25	75	100
		CORE - P* V	PRACTICAL -II : COMPUTER LAB USING BASIC SOFTWARES (NS)	2	-	-	-	
17		SECOND ALLIED - I	OPTIMIZATION TECHNIQUES - I	4	4	25	75	100
		SECOND ALLIED -II* P	OPTIMIZATION TECHNIQUES -II (NS)	2	-	-	-	
18		ME - I	ACTUARIAL STATISTICS	4	4	25	75	100
19	P - IV	SBE - II	OFFICIAL -STATISTICS	2	2	25	75	100

<b>TOTAL</b>				<b>30</b>	<b>20</b>	<b>150</b>	<b>450</b>	<b>600</b>
<b>IV - SEMESTER</b>								
20	P - I	TAMIL - IV		6	3	25	75	100
21	P - II	ENGLISH - IV		6	3	25	75	100
22	P - III	CORE - P* V	PRACTICAL -II : COMPUTER LAB USING BASIC SOFTWARES (NS)	4	4	40	60	100
23		CORE - VI	CONTINUOUS PROBABILITY DISTRIBUTIONS	6	4	25	75	100
24		SECOND ALLIED -II* P	OPTIMIZATION TECHNIQUES -II (Non-Sitting)	2	3	40	60	100
25		SECOND ALLIED - III	OPTIMIZATION TECHNIQUES -III	4	3	25	75	100
26	P - IV	NME - I	FUNDAMENTALS OF CARTOGRAPHY	2	2	25	75	100
<b>TOTAL</b>				<b>30</b>	<b>24</b>	<b>205</b>	<b>495</b>	<b>700</b>
<b>V - SEMESTER</b>								
27	P - III	CORE - VII	STATISTICAL INFERENCE - I	6	5	25	75	100
28		CORE - VIII	APPLIED STATISTICS	6	4	25	75	100
29		CORE - IX	STATISTICAL QUALITY CONTROL	6	4	25	75	100
30		CORE -X P	PRACTICAL - III	4	4	40	60	100
31		ME - II	SAMPLING THEORY	4	4	25	75	100
32	P - IV	NME - II	BASICS OF GIS AND GPS TECHNIQUES	2	2	25	75	100
33		SSD	SOFT SKILL DEVELOPMENT	2	2	25	75	100
34	P - V	EA	EXTENSION ACTIVITIES	-	1	25	75	100
<b>TOTAL</b>				<b>30</b>	<b>26</b>	<b>215</b>	<b>585</b>	<b>800</b>
<b>VI - SEMESTER</b>								
35	P - III	CORE - XI	STATISTICAL INFERENCE - II	6	5	25	75	100
36		CORE - XII	DESIGN OF EXPERIMENTS	6	6	25	75	100
37		CORE - XIII	C-PROGRAMMING	5	4	25	75	100
38		CORE - P XIV	PRACTICAL - III : COMPUTER LAB FOR C	5	4	40	60	100
39		ME - III	NUMERICAL ANALYSIS	5	4	25	75	100
40	P - IV	SBE - III	VITAL STATISTICS	2	2	25	75	100
41	P - V	GE	GENDER EQUALITY	1	1	25	75	100
<b>TOTAL</b>				<b>30</b>	<b>26</b>	<b>190</b>	<b>510</b>	<b>700</b>
<b>GRAND TOTAL</b>				<b>180</b>	<b>140</b>	<b>1115</b>	<b>2985</b>	<b>4100</b>

**Major Elective Courses offered**

1. ACTUARIAL STATISTICS
2. SAMPLING THEORY
3. NUMERICAL ANALYSIS
4. ECONOMETRICS
5. BIO-STATISTICS AND SURVIVAL ANALYSIS
6. DATA MINING
7. STATISTICAL DECISION THEORY
8. FORMAL LANGUAGES AND GRAPH THEORY

**Non-Major Electives Courses offered**

1. SPATIAL STATISTICS
2. APPLIED STATISTICS FOR GEOGRAPHY

**Skilled Based Elective courses offered**

1. STATISTICAL SURVEY
2. OFFICIAL STATISTICS
3. VITAL STATISTICS

**CORE - I**  
**DESCRIPTIVE STATISTICS**

**Semester – I**

**Hours : 6**

**Code:**

**Credits : 6**

**Objective: To give a clear idea to the under graduate Statistics Students about the basics of statistics**

**Unit - I**

Meaning and definition of Statistics, importance and scope of Statistics, functions of Statistics, uses and limitations of Statistics.

**Unit - II**

Diagrammatic representations of data - Bar diagrams, simple, component, multiple and percentage, Pie diagrams. Graphical representations - Histogram, Frequency curve, frequency polygon and O-gives (Construction and uses).

**Unit –III**

Measures of Central Tendency – Arithmetic Mean, Median, Mode, Geometric Mean and Harmonic Mean – Merits and Demerits, Inter Relationship between A.M, G.M and H. M - properties of a good Average and problems.

**Unit - IV**

Measures of Dispersion - Range, Quartile deviation, Mean Deviation, Standard Deviation and Coefficient of variation. Skewness - concept, Measures of Skewness – Karl Pearson’s and Bowley’s coefficient of skewness. Moments – Raw and Central. Kurtosis - Concept and measures of Kurtosis and problems.

**Unit - V**

Correlation - Definitions, Types and Properties of Correlation coefficient (statement and proof). Scatter diagrams, Karl Pearsons’s Co-efficient of Correlation and Spearman’s Rank Correlation. Regression- Linear Regression and its properties- Uses and problems.

**Book for Study:**

Gupta S.C, and Kapoor V.K (2013), Fundamental of Mathematical Statistics. - Sultan Chand & Sons, New Delhi.

**Book for Reference:**

Gupta S.P. (1995), Statistical Methods, Sultan Chand & Sons, New Delhi.

**CORE - P II**  
**PRACTICAL- I**

**Semester - I & II (NS)**  
**Code:**

**Hours : 6**  
**Credits : 4**

**Objective: To impart computational skills to the students**

**Unit - I**

Measures of Central Tendency - Calculation of Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean for Raw and Grouped Data.

**Unit - II**

Measures of Dispersion - Calculation of Quartile Deviation, Mean Deviation, Standard Deviation and their co-efficients. Measures of Skewness - Calculation of Karl Pearson's and Bowley's co-efficient of Skewness.

**Unit -III**

Calculation of Karl Person's co-efficient of correlation and Spearman's Rank Correlation co - efficient. Finding the two Regression Equations X on Y and Y on X and estimating unknown values of X and Y.

**Unit - IV**

Discrete and continuous random variables - Finding Probabilities, Distribution functions and moments.

**Unit -V**

Bivariate Distributions (Discrete Random Variables) - Finding Marginal Distributions, Conditional Distributions. Expectation of random variables, Conditional expectation, moments and correlation.

**Book for study:**

Gupta.S.C. and Kapoor.V.K(2013), Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.

**Book for Reference:**

Gupta.S.P(1995), Statistical Methods, Sultan Chand & Sons, New Delhi.

## SKILL BASED ELECTIVE - I

### STATISTICAL SURVEY

Semester – I

Hours : 2

Code:

Credits : 2

**Objective: To give a practical knowledge as to how to organize a statistical survey**

#### Unit - I

Organizing a statistical survey- Planning the survey, Executing the survey - Drafting an effective questionnaire, difference between questionnaire and schedule.

#### Unit - II

Survey techniques: Census and Sample. Principal steps in sample survey - Sampling and Non-sampling errors.

#### Unit - III

Collection of data - Primary data - methods of collecting primary data, Secondary data – sources of secondary data and precautions while using secondary data.

#### Unit - IV

Classification of data – Types of Classification - Chronological classification, Geographical classification, Quantitative classification and Qualitative classification. Formation of discrete frequency distribution and Formation of continuous frequency distribution.

#### Unit - V

Tabulation of data - Parts of a table and general rules of tabulation. Types of tables - simple and complex table, Machine tabulation and Cross tabulation.

#### **Book for study:**

R.S.N.Pillai and V.Bagavathi, Statistics, S.Chand & company, New Delhi

#### **Book for Reference:**

Gupta. S.P(1995), Statistical Methods , Sultan Chand & Sons, New Delhi.



### CORE - III

#### PROBABILITY AND RANDOM VARIABLES

Semester – II

Hours : 6

Code:

Credit : 6

**OBJECTIVE :** Enable the students to understand and study random phenomena mathematically.

##### Unit-I

Concept of Random experiment – Trial – Sample point – Sample space Event, Algebra of Events, Mutually Exclusive – Exhaustive events. Definition of probability, classical, statistical and Axiomatic approach – Properties of Probability, Theorems on Probability – Addition theorem of probability – Conditional probability – Multiplication theorem – Baye's theorem – simple problems.

##### Unit-II

Concept of Random variables – Discrete and continuous random variables, probability mass function- Probability density function. Distribution function – Properties – simple problems.

##### Unit-III

Bivariate distribution – Distribution function of bivariate random variable and its properties – joint probability function and joint probability density function - marginal and conditional distributions – Independence of random variable – simple problems.

##### Unit-IV

Mathematical expectation – discrete and continuous random variables – Properties – moments – variance – properties – covariance – simple problems.

##### Unit-V

Moment generating function – properties and uses – cumulants – characteristic functions – properties – simple examples – Inversion theorem and Uniqueness theorem – statement only.

##### Book for study :

S. C. GUPTA and V. K. KAPOOR (2007). “ FUNDAMENTALS OF MATHEMATICAL STATISTICS”, Sultan Chand and Sons Publications, New Delhi.

##### Books for reference:

1. J. N. KAPUR and H. C. SAXENA (1989) “MATHEMATICAL STATISTICS”, S. Chand and Company Ltd., New Delhi.
2. MAREK. FISZ, (1961). “PROBABILITY THEORY AND MATHEMATICAL STATISTICS”, John Wiley and Sons.

## CORE - IV

### DISCRETE PROBABILITY DISTRIBUTIONS

Semester – III

Hours :4

Code :

Credits :4

**Objective : To impart knowledge about discrete distributions to the undergraduate students.**

#### Unit – I

Binomial distribution – Definition, Concept and Derivation of Moments, Moment Generating Function, Additive property, Characteristic function and Recurrence relation for moments. Fitting of Binomial distribution – Simple problems.

#### Unit – II

Poisson Distribution – Definition, Concept, Derivation of Moments, Moment Generating Function, Recurrence relation for moments and Poisson Distribution as a limiting case of Binomial Distribution, Fitting of Poisson Distribution – Simple problems.

#### Unit – III

Negative Binomial Distribution – Definition, Derivation of constants and Poisson Distribution as a limiting case of the Negative Binomial Distribution. Logarithmic Series Distribution(Concept only).

#### Unit – IV

Geometric Distribution – Definition, Moments, Derivation of Moment Generating Function and Lack of memory property. Power series distribution (Concept only).

#### Unit – V

Hyper Geometric Distribution – Definition, Derivation of Mean and Variance approximation to Binomial distribution and Recurrence relation. Multinomial Distribution(Concept only).

#### **Book for Study:**

Gupta,S.C & Kapoor, V.K (2013), Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.

#### **Book for Reference:**

Gupta. S.P(1995): Statistical Methods, Sultan Chand & Sons, New Delhi.

**CORE – P V**

**PRACTICAL - II : COMPUTER LAB USING BASIC SOFTWARES**

**Semester – III & IV (NS)**

**Hours : 6**

**Code :**

**Credits : 4**

**Objective:**

**To expose the students to the analysis of statistical data using basic softwares.**

**List of Topics:**

**Diagrammatic and Graphical Representation:**

1. Simple Bar Diagram
2. Multiple Bar Diagram
3. Line Diagram
4. Pie Diagram
5. Histogram and Frequency Curve

**Frequency Distribution table**

**Measures of Central Tendency:**

1. Arithmetic Mean
2. Median
3. Mode
4. Geometric Mean
5. Harmonic Mean

**Measures of Dispersion:**

1. Range
2. Quartile Deviation
3. Mean Deviation
4. Standard Deviation

**Measures of Skewness and Kurtosis**

**Correlation and Regression:**

Karl Pearson Coefficient of Correlation  
Spearman's Rank Correlation  
Linear Regression Equations

**SECOND ALLIED - I**  
**OPTIMIZATION TECHNIQUES - I**

**Semester -III**

**Hours : 4**

**Code :**

**Credits : 4**

**Objective: To equip the students with Optimization Techniques and apply them to solve decision making problems.**

**Unit - I**

Operations Research - Meaning, Nature, History, Scope and Limitations. Linear Programming Problem(LPP) - General Form, Standard form and Canonical form, Basic Solution, Basic Feasible solution, Optimum solution. Linear Programming Problem: Introduction- Mathematical Formulation of LPP-Graphical Solution methods.

**Unit - II**

Simplex Method : Formation of LPP and its Solution by Simplex Method, Charnes Big-M Method and Two Phase Simplex Method.

**Unit -III**

Duality in Linear Programming: Concept of Duality-Fundamental Properties of Duality, Dual Problem when Primal Problem is in the standard Form-Dual Problem when Primal Problem is in the Mixed Form, Fundamental Theorem of Duality, Dual Simplex Method.

**Unit -IV**

Transportation Problem - Meaning, Balanced and Unbalanced Transportation Problem. Initial Basic Feasible Solution - North-West Corner Rule, Least Cost Method and Vogel's Approximation Method and MODI method to solve an Transportation Problem. Maximization case in Transportation Problem.

**Unit - V**

Assignment Problem - Meaning, Balanced and Unbalanced Assignment Problem - Hungarian method to solve an Assignment Problem. Maximization case in Assignment Problem.

**Book for Study:**

Kanti Swarup, Gupta,P.K. & Manmohan, Operations Research, Sultan Chand & Sons, NewDelhi.

**Book for Reference:**

Taha, H.A., An Introduction to Operations Research, Colliat Macmillan.

**SECOND ALLIED - II P**  
**OPTIMIZATION TECHNIQUES - II**

**Semester -III & IV (NS)**

**Hours : 4**

**Code :**

**Credits : 3**

**Objective: To equip the students with Optimization Techniques and solve them.**

**List of Problems:**

- i. Graphical Solution methods.
- ii. Simplex Method: Formation of LPP and its Solution by Simplex Method, Charnes Method of Penalties and Two Phase Simplex Method.
- iii. Duality and Dual Simplex Methods.
- iv. Transportation Problems:  
Minimization and Maximization Transportation Problem, Balanced and Unbalanced Transportation Problems.
- v. Assignment Problems.  
Minimization and Maximization v. Assignment Problems, Balanced and Unbalanced Assignment Problems.
- vi. Sequencing Problems: Processing 'n' jobs through two machines, three machines, Processing 'n' jobs through 'm' machines and processing two jobs through 'm' machines.
- vii. Network Scheduling by PERT and CPM.: Construction of PERT and CPM Networks, Probability of meeting the schedule Time.

**Book for Study:**

Kanti Swarup, Gupta, P.K. & Manmohan, Operations Research, Sultan Chand & Sons, New Delhi.

**Book for Reference:**

Taha, H.A., An Introduction to Operations Research, Colliat Macmillan.

**MAJOR ELECTIVE - I**  
**ACTUARIAL STATISTICS**

**Semester – III**

**Hours : 4**

**Code :**

**Credits : 4**

**Objectives: (i) To impart basic concepts in Actuarial Studies,  
(ii) To prepare students to take up a career in Quantitative Aptitude**

**Unit – I**

Compound Interest – Effective Rate of Interest  $i$  - Nominal Rate of Interest  $i^{(m)}$  - Varying rate of interest-effective rate corresponding to a Nominal rate and vice-versa- Present Value-Accumulated Value-Discounts-Simple Problem.

**Unit – II**

Annuities - Immediate Annuity - Annuity-due – Deferred Annuity - Accumulation and Present values of Annuities - Increasing and Decreasing annuities –Simple Problems.

**Unit – III**

Perpetuity- Immediate Perpetuity-Perpetuity due-Deferred Perpetuity-Accumulation and Present values of Perpetuity- Increasing and Decreasing Perpetuity-Simple Problems.

**Unit – IV**

Problems on Numbers- Problems on Ages-Percentage.

**Unit – V**

Profit & Loss- Ratio & Proportion – Time & Work – Time & Distance.

**Books for Study:**

Mathematical basis of life assurance IC-81, Insurance institute of India.

Unit I- Page 1-16

Unit II & III- Page 27-67

R.S.Aggarwal (2007): Quantitative Aptitude for Competitive Examinations

Unit IV- Page 161-181, 182- 194, 208-250

Unit V- Page 251 – 293, 294- 310, 341-370, 384- 404.

**Book for reference:**

Donald, DWA (1975): Compound interest and annuities certain, Heinemann, London.

## SKILL BASED ELECTIVE - II

### OFFICIAL STATISTICS

Semester - III

Hours : 2

Code :

Credits : 2

**Objective :** To impart knowledge about the various Statistical Organizations in India.

#### Unit - I

Official Statistics: Definition - Growth of Indian Statistics - Statistical organizations of India: Central Statistical Organisation (CSO) - Divisions of Central Statistical Organisation - Functions - Publications.

#### Unit - II

National Sample Survey Organisation (NSSO) - Divisions of NSSO - Functions of NSSO - Procedure for collection of information - Agriculture Statistics, Yield Statistics - Official series: Traditional method, Random Sampling Method - NSS Series - Forest Statistics, Fisheries Statistics - Defects in agricultural Statistics.

#### Unit - III

National income: Definition - Methods of estimating national income: The Income method, the Output method and the Expenditure method - Uses of National income estimates - Difficulties of estimation.

#### Unit - IV

Social accounting - Population statistics - Sources - Different methods of collecting population census - Methods of enumeration - Merits and demerits of De Facto method, Merits and demerits of the De Jure system.

#### Unit - V

Price Statistics: Wholesale prices, Retail prices, Uses and limitations of price statistics. Industrial Statistics: Main Sources of industrial Statistics - Limitations.

#### **Book for Study:**

R.S.N. Pillai and V. Bagavathi (1995), Statistics, Third Edition, S.Chand & Company, New Delhi - 110 055.

#### **Books for Reference:**

1. Central Statistical Organization (2011), Statistical Systems in India, Department of Statistics, Ministry of Planning, New Delhi.
2. Goon , A.M. Gupta, M.K and Das Gupta, B.(1986), Fundamentals of Statistics, Volume II, The World Press Private Limited, Calcutta.

## CORE – VI

### CONTINUOUS PROBABILITY DISTRIBUTIONS

Semester – IV

Hours : 6

Code :

Credits :4

**Objective : To impart the knowledge on continuous distributions and their applications in various fields.**

#### Unit – I

Normal Distribution – Introduction, Limiting form of Binomial Distribution. Characteristics of Normal Distribution, and its curve. Derivation of Mean, Mode, Median, Moments and Moment Generating Function .

#### Unit – II

Derivation of Cumulant Generating Function, Additive property of Normal Distribution, Mean Deviation about Mean, and Points of Inflection of Normal curve. Importance of Normal Distribution – Fitting of normal distribution – simple problems.

#### Unit – III

Beta Distribution of First and Second Kind – Derivation of Moments,  $\beta_1$ ,  $\beta_2$  and Harmonic Mean. Gamma Distribution – Definition and Derivation of Moment Generating Function, Cumulant Generating function, Moments and Additive property of Gamma Distribution.

#### Unit – IV

Rectangular Distribution-Introduction and derivation of Moments, Moment Generating Function and Mean Deviation about Mean. Exponential Distribution – Definition, Derivation of Moment Generating Function and Lack of Memory property. Concept of Weibul Distribution, Cauchy Distribution and Bivariate Normal Distribution.

#### Unit – V

Sampling Distribution - Concept of 't', ' $\chi^2$ ' and 'F' Distributions – Derivation of these distributions, Constants and Moment Generating Function – Relationship between 't', ' $\chi^2$ ' and 'F' Distribution.

#### **Book for Study:**

Gupta. S.C and Kapoor V.K (2013), Fundamental of Mathematical Statistics.

#### **Book for Reference :**

Johnson and Kotz, Discrete Distribution John Wiley Publication, New York.



## SECOND ALLIED - III

### OPTIMIZATION TECHNIQUES - III

**Semester -IV**

**Hours : 4**

**Code :**

**Credits : 3**

**Objective: To equip the students with Optimization Techniques and apply them to solve real life problems.**

#### **Unit -I**

Sequencing Problem - Meaning, Procedure for solving sequencing problems - Processing 'n' jobs through two machines, Processing 'n' jobs through three machines, Processing 'n' jobs through 'm' machines and Processing of two jobs through 'm' machines and Graphic Solutions.

#### **Unit - II**

Theory of Games: Introduction-Two-Persons Zero Sum Games, the Maximin Minimax Principle, Games without Saddle Points-Mixed Strategies, Graphical Solution of  $2 \times n$  and  $n \times 2$  Games. Dominance Property, the Modified Dominance Property, Reducing the Game Problem to a L.P.P.

#### **Unit -III**

Network Scheduling By PERT/CPM: Introduction, Nodes, Network, Critical Path, Rules for Construction of the Network diagram. PERT: Time estimates, Probability of meeting the schedule time.

#### **Unit - IV**

Queueing Theory: Introduction, Queueing System, Characteristics of Queueing Systems, The Input Process, The Queue Discipline, The Service Mechanism, The capacity of the system, Service Channels, Symbols and Notations, Classification of Queues, The M/M/1 Queueing Systems with finite and infinite capacity.

#### **Unit -V**

Inventory Control: Techniques of Inventory control with selective control, ABC Analysis, Economic Lot Size Problems, The fundamental problem of EOQ, Problem of EOQ with shortage and without shortages. Multi-item Deterministic Problem. Limitation on Inventories and Limitations of the Floor Space.

#### **Book for study:**

Kanti Swarup, Gupta,P.K. & Manmohan, Operations Research, Sultan Chand & Sons, NewDelhi.

#### **Book for Reference:**

Taha, H.A., An Introduction to Operations Research, Colliat Macmillan.

**CORE - VII**  
**STATISTICAL INFERENCE – I**

**Semester –V**  
**Code :**

**Hours : 6**  
**Credits : 5**

**Objective :** To focus and have a clear idea on theory of Estimation

**Unit – I**

Introduction to estimation theory – definition of parameter space, estimate and estimator. Characteristics of estimator – unbiasedness – definition and simple problems. Consistency – definition, problem based on Normal and Poisson distribution. Invariance property of consistency, sufficient condition for consistency.

**Unit – II**

Efficient estimators – definition of efficiency, most efficient estimator, minimum variance unbiased estimator. Sufficiency – definition, Rao Blackwell theorem, Crammer-Rao inequality, statement of Neymann factorization theorem, Invariance property of sufficient estimator (simple problems).

**Unit – III**

Methods of estimation : Method of Maximum likelihood estimation – definition of likelihood function and M.L.E., properties of M.L.E( simple problems). Statement of Crammer Rao theorem and Hazoor Bazar's theorem.

**Unit – IV**

Methods of minimum variance, Methods of moments and Methods of least squares-simple problems.

**Unit – V**

Interval estimation – definition of confidence limits, confidence co-efficient, confidence interval and Confidence intervals for large samples (simple problems).

**Book for Study:**

1. Gupta.S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons.
2. Rohatgi.V.L, "An introduction to probability theory and Mathematical Statistics", Wiley Eastern limited.

**Book for Reference:**

1. Radhakrishna Rao C., "Linear Statistical Inference and its Applications", Wiley Eastern limited.
2. Lehmann.E.L, Testing of Statistical Hypothesis, John Wiley.
3. Gibbons.J.D , Non – Parametric Statistical Inference, Duxbury.

**CORE VIII  
APPLIED STATISTICS**

**Semester – V**

**Hours : 6**

**Code:**

**Credits : 4**

**Objective:** To give an exposure to the students as to how statistics can be applied for framing policies.

**Unit – I**

Analysis of Time Series – Its definition and uses, Additive and Multiplicative Models in Time Series, Components of Time Series - Secular Trend, Seasonal variation, Cyclic Variations and Irregular fluctuations- Definition and Concepts. Measurement of Trend – Graphic method, Method of Semi-Averages, Method of Moving Averages and Method of Least Squares. Fitting of Straight line trend.

**Unit – II**

Measurement of Seasonal Variations – Method of Simple Averages, Ratio to Moving Average method by additive and multiplicative model , Ratio to Trend Method and Link Relative Method - Simple Problems.

**Unit – III**

Index Numbers – Definition and Uses, Types of Index Numbers, Problems involved in the construction of Index Numbers. Construction of Simple Index Numbers. – Simple aggregate method and Simple average of Price Relatives using A.M & G.M. Construction of Weighted Index Numbers – Laspeyre’s, Paasche’s, Dorbish Bowley, Marshall Edge worth and Fisher’s Ideal Index Numbers - Simple Problems.

**Unit – IV**

Definition of Deflation, Splicing, Inflation, and Real wages. Construction of Weighted Average of Price relatives Index Numbers using A.M & G.M. Fixed Base Index Numbers and Chain Base Index Numbers. Tests of adequacy of a good Index Number – Time Reversal Test, Factor Reversal Test, Unit test and Cyclic test - Simple Problems.

**Unit – V**

Demand Analysis: Introduction-Definition of Demand and Supply- Laws of Demand and Supply- Equilibrium Price-Giffen’s Paradox. Price Elasticity of Demand and Price Elasticity of Supply: Definition, Interpretation and Simple problems.

**Book for Study:**

Gupta S,C and Kapoor V.K (1993): Fundamental of Applied Statistics. - Sultan Chand & Sons, New Delhi.

**Books for Reference:**

1. Gupta S.P (1995) , Statistical Methods, Sultan Chand & Sons, New Delhi.
2. Goon A.M, Gupta M.A and Das Gupta (1987) , Fundamentals of Statistics, Sultan Chand & Sons, New Delhi.

**CORE- X P**  
**PRACTICAL - III**

**Semester - V**

**Hours : 4**

**Code :**

**Credits : 4**

**Unit - I**

Time series - Fitting of linear, Quadratic and Exponential trend by the method of least squares. Finding trend values by the method of moving averages.

**Unit - II**

Calculation of Laspeyre's, Paasche's, Fisher's, Dorbish - Bowley's and Marshall-Edgeworth Index Numbers. Calculation of weighted average of price relatives using Arithmetic Mean and Geometric Mean.

**Unit - III**

Control chart for Variables – X-Bar and R- Chart – Control Chart for Attributes – Control Chart for Fraction Defective (p-Chart) – Control Chart for Number of Defectives (d-chart, for fixed and variable sample size) – Control Chart for Number of Defects per unit (c - Chart).

**Unit - IV**

Simple Random Sampling - Estimation of Mean and Variance of the population, variance of the estimator of the mean. Stratified random sampling with Proportional Allocation and Optimum Allocation - Estimation of Mean and Variance of the population, variance of the estimator of the mean.

**Unit - V**

Estimation of mean and variance of population using Systematic Random sampling, Ratio estimator and Regression estimators.

**CORE IX**  
**STATISTICAL QUALITY CONTROL**

**Semester - V**

**Hours : 6**

**Code :**

**Credits : 4**

**Objectives: i) To devise statistical techniques to separate the assignable causes from the chance causes**  
**ii) To ensure quality all along the arrival of materials through each of their processing to the final delivery of goods.**

**Unit - I**

Introduction to SQC - Chance and Assignable Causes of Variation - Benefits of SQC - Process and Product Control - Tools for SQC- Control chart for Variables - X-Bar and R- Chart .

**Unit - II**

Control Chart for Attributes - Control Chart for Fraction Defective (p-Chart) - Control Chart for Number of Defectives (d-chart, for fixed and variable sample size) - Control Chart for Number of Defects per unit (c- Chart) - Natural Tolerance Limit and Specification Limits.

**Unit -III**

Acceptance sampling by Attributes - Acceptance Quality Level (A.Q.L) - Lot Tolerance Proportion or Percent Defective (LTPD) - Process Average Fraction Defective (p) - Consumer's Risk( $\beta$ ) - Producer's Risk( $\alpha$ ) - Rectifying Inspection Plan - Average Outgoing Quality Level (AOQL)

**Unit - IV**

Operating Characteristic Curve (OC-curve) - Average Sample Number (ASN) - Average Amount of Total Inspection (ATI) - Single Sampling Plan - Determination of 'n' and 'c', AOQL, OC-curve - Double Sampling Plan - ASN and ATI of Double Sampling Plan - Single sampling Vs Double Sampling plan.

**Unit -V**

Sequential Sampling - Sequential Probability Ratio Test (SPRT) - ASN Function of Sequential Sampling Plan.

**Book for Study:**

Gupta,S.C. & Kapoor,V.K (2014), Fundamentals of Applied Statistics, 4<sup>th</sup> Edition, Sultan Chand & Sons, New Delhi.

**Book for Reference:**

Mahajan, M., Statistical Quality Control, Dhanpat Rai & Co.

## MAJOR ELECTIVE - II

### SAMPLING THEORY

Semester - V  
Code:

Hours : 4  
Credits : 4

**Objective :** To develop the knowledge about the sampling theory and its application

#### Unit - I

Basic concept of sample survey - Introduction, definitions and preliminaries, fields of application of sampling techniques and limitations, Census and sample surveys, their advantages and disadvantages, principles of sampling theory, principal steps in a sample survey. Probability and non-probability sampling, sampling unit, sampling frame, sampling and non-sampling errors.

#### Unit - II

Simple random sampling, procedures of selecting a random sample, estimation of population parameters, estimation of population proportion, Estimation of sample size.

#### Unit - III

Stratified random sampling - Introduction, principles of stratification, Advantages of stratification, Estimation of population mean and its variance. Estimation of variance, Allocation of sample size in different strata - Equal allocation, Neyman allocation, optimum allocation and proportional allocation. Relative precision of stratified random sampling with simple random sampling.

#### Unit - IV

Systematic sampling - Introduction, sample selection procedures, Advantages and Disadvantages, Estimation of mean and its sampling variance, comparison of simple random sampling and stratified random sampling with systematic sampling.

#### Unit - V

Ratio estimators-Introduction, definitions and notations, Bias of Ratio estimators, comparison of the ratio estimate with the mean per unit. Regression estimators - Introduction, difference estimator, regression estimator, comparison with the mean per unit and ratio estimators.

#### **Book for study:**

Daroga Singh and Choudry F.S(1986), Theory and Analysis of Sample Survey Design, Wiley Eastern Ltd: New Delhi.

#### **Books for Reference:**

- 1.Murthy M.N.(1976), Sampling theory and methods- statistical publishing society, Calcutta.
- 2.Cochran W.G. (1984), Sampling Techniques, Wiley Eastern Ltd.
3. Des Raj (1976): Sampling Theory, Tata-Mcgraw Hill.

## CORE - XI

### STATISTICAL INFERENCE – II

Semester – VI

Hours : 6

Code:

Credits : 5

**Objective: To enable the students to frame suitable hypothesis for testing and drawing right inference to solve many social, economic and biological real life problems.**

#### Unit – I

Statistical hypothesis – simple and composite, Null and Alternative hypothesis, Critical region, Level of significance, type of errors and Power of test (simple problems). Steps involved in testing of hypothesis. Neymann Pearson Lemma (statement and proof).

#### Unit – II

Large sample test – Test for single proportion, difference between proportions, single mean, difference between means and difference between standard deviation.

#### Unit – III

Small sample test – student's 't' test – test for single mean, difference between means, paired 't' test and observed sample correlation co-efficient.

#### Unit –IV

Snedecor's F test – test for equality of two population variance – Testing the significance of an observed multiple correlation co-efficient, observed sample correlation ratio and linearity of regression (concepts only).

#### Unit – V

Non-parametric test - Chi-square test - Independence of attributes and goodness of fit. One sample tests – Sign test and Run test for randomness, Two sample tests – Sign, median and Mann Whitney U- test – Simple Problems.

#### **Books for Study:**

1. Gupta.S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
2. Rohatgi.V.L, "An introduction to probability theory and Mathematical Statistics", Wiley Eastern limited.

#### **Book for Reference:**

1. Radhakrishna Rao C., "Linear Statistical Inference and its Applications", Wiley Eastern limited.
2. Lehmann.E.L, Testing of Statistical Hypothesis, John Wiley.
3. Gibbons.J.D , Non – Parametric Statistical Inference, Duxbury.

**CORE - XII**  
**DESIGN OF EXPERIMENTS**

**Semester - VI**

**Hours :6**

**Code :**

**Credit : 6**

**Objective : To focus on the design and analysis of variance techniques in field experiments.**

**Unit - I**

Analysis of Variance: Definition and assumptions. Cochran's theorems (statement only) ANOVA - One way and Two way classifications (with one observation per cell). Experimental error.

**Unit - II**

Design of Experiment: Need, terminology. Randomization, Replication and Local control; Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD) - Estimation of missing values in RBD and LSD (one and two).

**Unit - III**

Factorial experiment - main effects and interactions; definitions of contrast and orthogonal contrast; Analysis of  $2^2$  and  $2^3$  experiments.

**Unit - IV**

Confounding in factorial design –Total Confounding and Partial confounding in  $2^3$  experiments.

**Unit - V**

Analysis of co-variance for a one way layout with one concomitant variable and RBD with one concomitant variable.

**Book for Study:**

S.C. Gupta and V.K. Kapoor (2013), Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi.

**Books for Reference:**

1.Douglas C.Montgomery (2010), Design and Analysis of experiment, Wiley International Edition, India.

2.Cochran.W.G. & G.M.Cox(1957), Experimental designs, Wiley International edition, India.



**CORE - XIII**  
**PROGRAMMING IN C**

**Semester - VI**

**Hours : 5**

**Code:**

**Credits : 4**

**Objective : To introduce the C- language and programming skills for Statistical concepts.**

**Unit - I**

Introduction to C - Character set - Key words and identifiers -Data types- Constants & Variables and their declarations – Operators: Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Increment and Decrement Operators, Conditional Operator, Bitwise Operators- Expressions: Arithmetic Expressions, Evaluation of Expressions, Precedence of Arithmetic Operators.

**Unit - II**

Input & output operations – Reading a Character, Writing a character – Formatted Input: Inputting Integer Numbers, Inputting Real Numbers, Inputting Character Strings-Formatted Output: Output of Integer Numbers, Output of Real Numbers – Printing of a Single Character and Printing of Strings.

**Unit - III**

Decision making and branching: Decision Making with IF Statement, Simple IF statement , IF-ELSE statement – Nesting of IF-ELSE statements, the ELSE-IF ladder, The Switch Statement, The ?: Operator, The GOTO Statement.

**Unit – IV**

Decision making and looping: The WHILE statement , the DO statement, the FOR statement – Arrays: One-dimensional Arrays, Declaration of One-dimensional Arrays, Initialization of One-dimensional Arrays, Two-dimensional Arrays, Initializing Two-dimensional Arrays. Character Arrays and Strings: Declaring and Initializing string Variables, Reading Strings from Terminal, Writing Strings to Screen, Arithmetic Operations on Characters, Putting Strings Together, Comparison of Two Strings.

**Unit – V**

User-defined Functions: Introduction, Elements of User-defined Functions, Definition of Functions, Return Values and their Types, Function Calls, Function Declaration, Category of Functions, Arguments with Return Values, Nesting of Functions, Recursion, Passing Arrays to Functions. Structures and Unions.

**Book for study:**

Balagurusamy, E,“Programming in ANSI-C”, (Fourth Edition), Tata Mc Graw Hill publishing Company. New Delhi

**Book for Reference:**

Byrons Gottfried , “Theory and Practice of programming with C”, Schaum Outline Series, McGraw Hill publishing company.

## CORE –P XIV

### PRACTICAL- IV: COMPUTER LAB FOR C

Semester - VI

Hours : 5

Code:

Credits : 4

Objective : To implement the different Statistical Techniques using C Programming.

#### Unit - I

Program for arranging a given set of n numbers in ascending order, descending order, finding the smallest value of given n-values, finding the largest value given n-values, finding n-factorial, finding  ${}^N C_r$  value and solving Quadratic equations.

#### Unit - II

Program to find the value of Range and Co-efficient of Range of 'n' given values, Arithmetic Mean, Median, Mode, Geometric Mean and Harmonic Mean, Standard deviation, Co-efficient of Standard deviation, Variance and Co-efficient of Variation.

#### Unit - III

Program to find correlation co-efficient, Regression co. efficient, Regression equations. Fitting of Binomial and Poisson distributions.

#### Unit - IV

Program for testing its population mean, difference of population means, population standard deviation, difference of population standard deviations and Correlation co-efficient tests(Large Samples).

#### Unit - V

Program for testing the significance of population mean, difference of population means(independent samples), paired t test, population standard deviation, difference of population standard deviations and Correlation co-efficient (Small Samples).

**MAJOR ELECTIVE - III**  
**NUMERICAL ANALYSIS**

**Semester - VI**  
**Code:**

**Hours : 5**  
**Credits : 4**

**Objective:** To enable the students to have knowledge about interpolation, Numerical differentiation and Integration and to enhance the numerical skills.

**Unit-I**

Solution of algebraic and transcendental equations-Bisection method, Newton's Raphson method. Finite differences – Newton's forward and backward interpolation formula (Problems only)

**Unit-II**

Central differences interpolation formulae – Gauss forward, Gauss Backward, Stirlings formulae and Bessel's formula (Problems only).

**Unit-III**

Numerical differentiation - Newton's forward and Newton's Backward formulae (Upto 2<sup>nd</sup> order) - (Problems only).

**Unit-IV**

Numerical integration – Trapezoidal rule, Simpson's 1/3<sup>rd</sup> rule, Simpson's 3/8<sup>th</sup> rule (Problems only).

**Unit-V**

Numerical solution of Ordinary Differential Equation – Taylor series method, Modified Euler's method and Second and Fourth order Runge-Kutta method (Problems only).

**Book for study:**

A.Singaravel, 'Numerical method', Meenakshi publications, Chennai.

**Books for Reference:**

1. S.S. Sastry (2000), Introduction methods of Numerical Analysis, Prentice- Hall of India Pvt- India III Editions.
2. P.Kandasamy, K. Thilagavathy, and K.Gunavathy (2005), Numerical Methods.
3. E. Balagurusamy (2004), Numerical Methods, Tata McGraw Hill Publishing Company Limited, New Delhi.

## SKILL BASED ELECTIVE - III

### VITAL STATISTICS

**Semester - VI**

**Hours : 2**

**Code :**

**Credits : 2**

**Objective:** To enable the students to have an idea about Vital Statistics and Demography

#### **Unit - I**

Definition of vital statistics and demography – uses of vital statistics, Methods of collecting Vital Statistics.

#### **Unit - II**

Measurement of Mortality – Crude Death Rate, Specific Death Rate, Infant Mortality Rate, Standardized Death Rates – Direct and Indirect method of standardization ( Concept only).

#### **Unit - III**

Mortality Table or Life table - Stationary and Stable population – Central Mortality Rate, Force of Mortality.

#### **Unit - IV**

Life Table – Assumptions, Descriptions, Construction and Uses of Life Table.

#### **Unit - V**

Fertility – Crude Birth rate, General Fertility rate, Specific Fertility rate, Total Fertility rate.

#### **Books for Study:**

1. Gupta,S.P. & Kapoor,V.K., Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi. ( Unit I to Unit V)
2. Peter R Cox, Demography, Fifth edition, Vikas Publishing House, New Delhi. ( Unit I and Unit II)

#### **Book for Reference:**

Hansraj, Fundamentals of Demography, Surjeet Publications, New Delhi

**NON - MAJOR ELECTIVE - I**  
**SPATIAL STATISTICS**

**Semester - VI**

**Hours : 2**

**Code :**

**Credits : 2**

**Unit - I**

Spatial Statistics - meaning, definitions, origin, importance, scope, functions and limitations. Collection of data - primary and secondary-sources.

**Unit - II**

Classification - objectives -Types of classification. Tabulation - objectives, parts of the table and types of tables.

**Unit -III**

Presentations of data: Diagrams- Bar diagrams, simple, component, multiple, percentage and Pie diagrams. Graphical representations - Histogram, Frequency curve and frequency polygon.

**Unit - IV**

Measures of Central Tendency - Arithmetic Mean, Median, Mode and quartiles - Merits ,Demerits and problems (based on Geo Statistics).

**Unit - V**

Measures of Dispersion - Range, Quartile deviation, Standard Deviation and Coefficient of variation- Merits, Demerits and problems (based on Geo Statistics ).

**Book for study:**

R.S.N.Pillai and V.Bgagavathi, Statistics, S.Chand & company, New Delhi

**Books for reference:**

Gupta. S.P, Statistical Methods , Sultan Chand & Sons, New Delhi.

Alan E. Gelfand, Peter Diggle, Peter Guttorp: Handbook of Spatial Statistics

Yongwoan Chun and Daniel A Griffith :Spatial Statistics and Geo Statistics

**NON - MAJOR ELECTIVE - II**  
**APPLIED STATISTICS FOR GEOGRAPHY**

**Semester - VI**

**Hours : 2**

**Code :**

**Credits : 2**

**Unit - I**

Skewness - concept, Measures of Skewness - Karl Pearson's and Bowley's coefficient of skewness - problems (based on Geographical data). Kurtosis - measures of Kurtosis. (concept only).

**Unit - II**

Correlation - Definitions, Types and Properties (without proof)- Scatter diagrams -Karl Pearson's and Spearman's Rank Correlation coefficient-problems (based on Geographical data).

**Unit -III**

Regression - Definitions - properties(without proof) -regression equations-simple problems (based on Geographical data).

**Unit - IV**

Time series-definitions and uses. Components of time series-measurement of trend - semi average method, moving average method and least square method.

**Unit - V**

Index numbers-definitions-uses -types. Unweighted Index numbers-simple aggregate method-weighted index numbers -Laspere's, Paasche's and Fisher's index number.

**Book for study:**

R.S.N.Pillai and V.Bgagavathi, Statistics, S.Chand& company, New Delhi

**Book for reference:**

Gupta. S.P, Statistical Methods , Sultan Chand & Sons, New Delhi.

**ALLIED – I**  
**MATHEMATICAL STATISTICS - I**  
**( For B.Sc Mathematics)**

**SEMESTER – I**

**Hours : 4**

**Code :**

**Credit : 4**

**Objective:** To enable the students to know the importance of Statistics and its applications in Mathematics.

**Unit - I**

Measures of central tendency- Mean, Median, Mode, Geometric Mean Harmonic Mean and Quartiles - Inter Relationship between A.M, G.M and H. M - properties of a good Average.

**Unit - II**

Measures of Dispersion- Range, Quartile deviation, Mean Deviation, Standard Deviation and Coefficient of variation, Measures of Skewness and Kurtosis.

**Unit - III**

Correlation –Definition, Types of Correlation, Scatter diagram, Karl Pearson’s Co-efficient of correlation, Rank Correlation Co-efficient – Linear Regression Equation.

**Unit - IV**

Probability- Axiomatic and Classical Probability – Simple problems. Addition and Multiplication Theorem of Probability – Baye’s Theorem- Simple problems .

**Unit – V**

Concept of Random Variable –Discrete and Continuous , Distribution Functions, Probability Mass Function, Probability Density Function and Mathematical Expectations, Moment Generating Function.

**Book for Study:**

Gupta S.C and V.K. Kapoor, Fundamental of Mathematical Statistics, Sultan & Sons, New Delhi.

**ALLIED - P II**  
**MATHEMATICAL STATISTICS – II**  
**( For B.Sc Mathematics)**

**SEMESTER – I & II (NS)**

**Hours : 6**

**Code :**

**Credit : 4**

**Objective:** To develop the computational skills in Statistics.

**Unit - I**

Calculation of Arithmetic Mean, Median, Mode, Geometric Mean and Harmonic Mean (Numerical problems only) and Quartiles.

**Unit - II**

Computation of M.D , S.D., and Co-efficient of Variation - Karl Pearson's and Bowley's Co-efficient of Skewness (Numerical Problem only).

**Unit- III**

Karl Pearson's co-efficient of Correlation, Spearman's rank correlation, Regression line. (Numerical Problems only)

**Unit - IV**

Fitting of Binomial and Poisson distributions. Fitting of Normal distribution (Area method only)

**Unit - V**

Test of significance based on Normal distribution and Student's t-distribution for mean. Proportions and simple correlation. Chi-square test for independence of attributes.

**Book for Study:**

Gupta, S.C. and V.K. Kapoor, Fundamental of Mathematical Statistics, Sultan & Sons. New Delhi

**Book for Reference:**

Kapoor and Saxena, Mathematical Statistics, Chand & Co, New Delhi



## ALLIED – III

### MATHEMATICAL STATISTICS - III ( For B.Sc Mathematics)

SEMESTER – II

Hours : 4

Code :

Credits : 4

**Objective:** To impart knowledge on the very imperative part of Statistics –  
Discrete and Continuous Distributions and Tests of Significance.

#### Unit - I

Introduction to Binomial distribution – moments- recurrence relation for the moments-M.G.F-Additive property – simple problems.

#### Unit - II

Introduction to Poisson distribution – moments- recurrence relation for the moments-M.G.F-Additive property – simple problems.

#### Unit - III

Normal distribution – Definition and derivation of MGF. 't', F and chi-square distributions- Definition, Derivations of the distributions and M.G.F – Inter relationship between t, F and  $\chi^2$  distributions.

#### Unit - IV

Test of Significance for large Samples- Single Mean, difference between mean, Single proportion and difference between proportion.

#### Unit - V

Test of significance for Small Sample- 't' test for single mean, Difference between means, Paired 't' test. Chi-square test for independence of attributes

#### **Book for Study:**

Gupta S.C. and V.K. Kapoor, Fundamental of Mathematical Statistics, Sultan & Sons. New Delhi

#### **Book for Reference:**

Kapoor and Saxena, Mathematical Statistics, Chand & Co, New Delhi

## MAJOR ELECTIVES

### ECONOMETRICS

**Semester -** **Hours : 5**

**Code:** **Credits : 4**

**Objective:** To equip the students with the knowledge of application of statistics in Economics.

#### **Unit – I**

Econometrics: Definition and Scope – Introduction; Origin – Objectives – Characteristics and scope of Econometrics – Basic concepts of Econometrics – Limitations.

#### **Unit – II**

Methodology: Tools and Models: Tools and methods of study; Raw materials of Econometrics; Economic and Econometric Models; Time series and cross-section models – Physical and Social Sciences Model.

#### **Unit –III**

Functions and diagrams in Economic Theory – Demand Functions and Curves – Total Revenue Function and Curves – Cost Functions and Curves – other functions and curves in Economic Theory

#### **Unit – IV**

Demand and Supply – Law of Supply and Demand – Price Elasticity of Demand – Significance of Elasticity of Demand – Demand Function with Constant Price Elasticity – Partial Elasticities of Demand (Income Elasticity, Cross Elasticity)

#### **Unit –V**

Methods of Estimating Demand Function – Leontif’s Method (From time series data) – Pigous’s method (from time series data & from Family Budget data) – Engel’s Law & Engel’s Curve – Pareto’s Law of Income Distribution.

#### **Books for Study:**

**For Unit I & II :** Singh, Parashav & Singh , Economics and Mathematical Economics

**For Unit III :** Allen, R.G.D., Mathematical Analysis for Economics, Macmillan, New Delhi.

**For Unit IV & V:** Gupta,S.P. & Kapoor,V.K., Fundamentals of Mathematical Statistics, Sultan Chand & sons, NewDelhi.

#### **Books for Reference:**

1. Chiang, A.C. (2000), Mathematical Economics, McGrawHill book.Co., New Delhi.
2. Henderson, Quandt, (1980), Micro-economic Theory - A Mathematical Approach to Economics, McGrawHill, Kogakusha, Tokyo.

**MAJOR ELECTIVES**  
**BIO-STATISTICS AND SURVIVAL ANALYSIS**

Semester -  
Code:

Hours : 5  
Credits : 4

**Objective:** To introduce the applications of Bio-Statistics to the students.

**Unit-I**

Introduction to Study Designs - Different Types of Observational Studies – Experimental Studies. Epidemiology – Odds - Odds Ratio - Confidence Interval for Odds Ratio- Relative Risk.

**Unit-II**

Chi-Square test: Diagnostic Procedures with Threshold model. Measuring the accuracy of diagnosis – Sensitivity, Specificity, ROC curve.

**Unit-III**

Clinical Trials: Introduction – Different Phases of Clinical Trials - Purpose – Duration Cost - Drug Regulatory Bodies.

**Unit-IV**

Survival Time, Survival Distributions- Hazard Function- Exponential – Gamma – Type I and Type II Censoring, Progressive Censoring – Estimation of Parameters with Numerical Examples.

**Unit-V**

Estimating Survival Function and Variance Using Kaplan Meier Method - Comparison Of Survival Distribution – Log Rank Test For Comparing 2 Groups.

**Books For Study:**

1. Dawson, Beth & Robert, G (2001) ; Basic & Clinical Biostatistics, Mcgraw-Hill
2. Ellisa T.Lee (1992): Statistical Methods For Survival Data Analysis
3. Friedman, L.M, Forbes, C.D, And Demats, D.L(TT): Fundamental Of Clinical Trials, Springer.

**Book For Reference:**

1. David G. Kleinbawn (1996) : Survival Analysis, Springer.
2. Mathews, J.N.S. (2006) : Introducing To Randomized Controlled Clinical Trials, Chapman And Hall.
3. Steven Diantadosi (2000): Clinical Trials – A Methodological Perspective, John Willey.
4. Stephan Sann (2000) : Statistical Issues In Drug Development, John Wiley

**MAJOR ELECTIVES**  
**STATISTICAL DECISION THEORY**

**Semester -**

**Hours : 5**

**Code :**

**Credit : 4**

**Objective :** To enable the students to decide on choosing the best course of action out of several alternatives.

**Unit - I**

Meaning, Scope and elements of decision making problems. Meaning of Pay off, Payoff table and Opportunity Loss or Reject Table.

**Unit - II**

Types of decision making situations: Under Certainty, Under Uncertainty, Under Condition of Risk and Under Perfect Information – problems.

**Unit - III**

Expected Monetary value, Expected Opportunity Loss, Expected value of perfect information, working rule and problems.

**Unit - IV**

Bayesian Decision Theory – Baye’s Theorem of Inverse probability and simple problems.

**Unit - V**

Decision Tree Analysis - Steps and Advantages and Limitations of Decision Theory.

**Books for Study:**

1. M.Mahajan, Statistical Quality Control, (2009), Dhanpat Rai & Co.( Unit – I and II)
2. Arora, P.N., Sumeet Arora and Arora, S., Comprehensive Statistical Methods, S.Chand and Company Ltd. New Delhi. ( Unit – III to V).

**Book for Reference:**

T.Veerarajan, Probability, Statistics and Random Processes, Tata McGraw-Hill, New Delhi.

**MAJOR ELECTIVES**  
**FORMAL LANGUAGES AND GRAPH THEORY**

**Semester -**  
**Code :**

**Hours : 5**  
**Credit : 4**

**Unit - I**

Phrase-Structure languages, Closure properties: Four types of grammars, Chomskian hierarchy, Closure operations, Derivation trees, Ambiguity.

**Unit – II**

Normal form of CFG, Property of CFL: Auxiliary lemmas, Chomsky Normal form, u-v theorem.

**Unit – III**

Finite State Automata: Finite Automaton, Non-Deterministic Finite Automaton, Finite Automata and Regular sets, Closure properties of Regular sets, Characterization of the family of Regular sets.

**Unit – IV**

Introduction, Paths and Circuits: Graphs, Incidence and degree of a vertex, Walks, Paths and Circuits, Euler graphs, Operations on graphs, Hamiltonian paths and circuits, Travelling Salesman Problem

**Unit – V**

Trees, Fundamental Circuits, Cut-sets and Cut-vertices: Trees, Properties of trees, On counting trees, Spanning trees, Fundamental circuits, Cut-sets, Properties of cut-sets, Connectivity and separability.

**Books for Study:**

1. Rani Siromoney, CLS, (1984), Formal Languages and Automata.
2. Narsingh Deo (2005), Graph Theory with Applications to Engineering and Computer Science. Prentice Hall of India Pvt. Ltd.,.

**Books for Reference:**

1. Kamala Krithivasan and R. Rama (2011), Introduction to Formal Languages, Automata Theory and Computation, Pearson, Chennai.
2. S.P. Rajagopalan and R. Sattanathan (2009), Graph Theory, Margham Publications, Chennai, 2009.

3. S. Arumugam and S. Ramachandran (2002), Invitation to Graph Theory, SCITECH Publications (India) Pvt. Ltd., Chennai,.
4. S.A. Choudum(1999), A First Course in Graph Theory, Macmillan India Ltd., New Delhi.
5. D.P. Acharjya (2010), Theory of Computation, MJP Publications,.