

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



SYLLABI

M.STAT

From 2018-19 onwards

Question Paper Pattern

For all Core courses the Question Pattern is as follows.

Section - A (10 x 2 = 20)

Answer ALL the questions

Two questions from each unit of the syllabus.

Section - B (5 x 5 = 25)

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)

Answer any THREE questions

Five questions covering all the five units of the syllabus.

COURSE STRUCTURE FOR M.STAT (2018 – 2019 Onwards)

SL. No.		COURSE TITLE	Hrs.	Credits	Internal Exam	External Exam	
I - SEMESTER							
1	-	CORE - I	ADVANCED OPERATIONS RESEARCH	6	5	25	75
2	-	CORE - II	RELIABILITY AND STATISTICAL DECISION MAKING	6	5	25	75
3	-	CORE - III	DISTRIBUTION THEORY	6	4	25	75
4	-	CORE - IV	MEASURE AND PROBABILITY THEORY	6	4	25	75
5	-	CORE - PV	COMPUTER LAB FOR R PROGRAMMING	6	4	25	75
TOTAL				30	22	125	375
II - SEMESTER							
6	-	CORE - VI	STATISTICAL INFERENCE	6	5	25	75
7	-	CORE - VII	JAVA PROGRAMMING	6	5	25	75
8	-	CORE - VIII	REGRESSION ANALYSIS & TIME SERIES	6	5	25	75
9	-	CORE- IX	APPLIED MULTIVARIATE ANALYSIS	6	4	25	75
10	-	CORE- P X	COMPUTER LAB FOR JAVA PROGRAMMING	6	4	25	75
TOTAL				30	23	125	375
III - SEMESTER							
11	-	CORE - XI	STOCHASTIC PROCESSES	6	5	25	75
12	-	CORE -XII	REAL ANALYSIS & LINEAR ALGEBRA	6	5	25	75
13	-	CORE – P XIII	COMPUTER LAB FOR DATA ANALYSIS	6	5	25	75
14	-	CBE - I	SURVIVAL ANALYSIS	6	4	25	75
15	-	CBE - II	ACTURIAL STATISTICS	6	4	25	75
TOTAL				30	23	125	375
IV - SEMESTER							
16	-	CORE - XIV	ADVANCED SAMPLING THEORY	6	5	25	75
17	-	CORE- P XV	COMPUTATIONAL STATISTICS(BASED ON SAMPLING, DESIGN & TEST OF HYPOTHESIS)	6	5	25	75
18	-	CBE - III	LINEAR MODELS AND DESIGN OF EXPERIMENTS	6	4	25	75
19	-	CBE - IV	QUALITY ASSURENCE	6	4	25	75
20	-	PROJECT		6	4	25	75
TOTAL				30	22	125	375
GENERAL TOTAL				120	90	500	1500

CORE BASED ELECTIVE COURSES

1. SURVIVAL ANALYSIS
2. ACTUARIAL STATISTICS
3. LINEAR MODELS AND DESIGN OF EXPERIMENTS
4. QUALITY ASSURENCE
5. INTRODUCTION TO PYTHON
6. SIMULATION MODELING
7. DISCRETE MATHAMETICS
8. STATISTICAL DATA ANALYSIS USING SAS
9. DATA MINING

CORE - I

ADVANCED OPERATIONS RESEARCH

Semester – I

Hours : 6

Code:

Credits: 5

Objective: To impart knowledge on the various advanced topics of Operations Research and their usage in real life.

Unit - I

Linear Programming Problem (LPP) - Graphical Method, Algebraic solutions, Simplex method, Two-Phase Simplex, Duality in Linear Programming, Dual Simplex Method.

Unit – II

Integer Programming - Gomory's fractional cut method for all integer, fractional cut method for mixed integer and Branch and Bound method.

Unit - III

Goal Programming – Formulation of Linear Goal Programming Problem, Graphical method, Simplex method for Goal Programming Problem. Revised Simplex Method

Unit – IV

Dynamic Programming- Principle of optimality, the Recursive Equation Approach, Characteristics of Dynamic Programming Problem(DPP),Algorithm of DPP,Solution of Discrete DPP, Solution of LPP by DPP

Unit – V

Non-Linear Programming Problem (NLPP) - Formulating a non-linear programming problem, Kuhn-Tucker conditions for non-linear programming. Quadratic Programming - Wolfe's method and Beale's method.

Book for Study:

Kanti Swarup, P.K Gupta and Man Mohan, Operations Research, Sultan Chand,
New Delhi.

Books for Reference:

1. Hamdy A.Taha, An Introduction to Operations Research, Prentice Hall of India,
New Delhi.
2. Ravindran.A, Don.T.Phillips and James J.Solberg, Operations Research Principles
and Practice, John Wiley & Sons.
3. Pannervelam.R., Operations Research, Prentice Hall of India, New Delhi.
4. Prem Kumar Gupta, Hira. D.S., Operations Research, S.Chand & Company Ltd,
New Delhi.

CORE - II

RELIABILITY AND STATISTICAL DECISION MAKING

Semester - II

Hours : 6

Code :

Credit : 5

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

Unit – I

Reliability – Definition, basic elements of reliability, Failure pattern for complex product, Designing for Reliability, Methods for Improving Design Reliability and Measurement of reliability.

Unit – II

Maintenance and Reliability – Mean Time Between Failures, Failure Rate and Hazard Function – Constant Hazard Model, Linear-hazard model, Mean Time to Failure. System Reliability – Components connected in series and Components connected in parallel (Concepts only).

Unit – III

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

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

Unit – IV

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

CORE-III
DISTRIBUTION THEORY

Semester – I

Hours : 6

Code:

Credits: 4

Objective: To create awareness about important discrete and continuous distributions

Unit-I

Discrete Distributions- Binomial, Poisson and Geometric distributions- Derivation of the distributions and their constants, properties and problems.

Unit-II

Continuous distributions – Normal, Laplace, Exponential, Weibul and Cauchy distributions- Derivation of the distributions and their constants, properties and problems.

Unit-III

Bivariate Normal distribution – derivation of its Moment Generating Function, marginal and conditional distributions.

Unit-IV

Student's t, Chi-square and Snecdecor's F distributions – Derivation of the distributions, properties and relationship between 't', F and Chi-square distributions.

Unit-V

Order Statistics: Derivation of cumulative distribution function of a single order statistics, Probability density function of a single order statistics, Joint P.d.f – Two order statistics, K^{th} -Order Statistics, and n^{th} -order Statistics, Distribution of range and other systematic statistics.

Book for Study:

Gupta.S.C and Kapoor V.K. –Fundamentals of Mathematical Statistics, Sulthan Chand&Sons.

Books for Reference:

- 1.Rohatgi. V.K.,An introduction to probability theory and mathematical statistics , Wiley Eastern.
2. John and Kotz, Discrete distributions, John Wiley publications, New York.
3. John and Kotz, Continuos distributions, John Wiley publications, New York.

CORE – IV

MEASURE AND PROBABILITY THEORY

Semester – I

Hours : 6

Code :

Credits : 4

Objective: To impart the knowledge about the applications of measure theory and probability.

Unit – I

Events and Classes – Algebra of Set – Sequence, Limits. Field – Minimum Field, σ -field, and Borel Field. Intersection and Union of Fields, Monotone Fields and necessary properties. Minimum Monotone classes.

Unit – II

Functions and Inverse Functions, Measurable Function, Borel Function, Induced σ -field, Indicator Functions, Simple Function and Random Variables (Concept only).

Unit – III

Distribution Function – Properties, Jordan Decomposition Theorem, Distribution Function of a Random Vector, Marginal and Conditional Distributions. Inequality – Cramer Inequality, Schewartz Inequality and Holder Inequality.

Unit – IV

Convergence of Random Variables - Types of Convergence, Monotone Convergence Theorem, Dominated Convergence Theorem. Characteristic Function – Properties, Inversion Theorem.

Unit – V

Law of Large Numbers - Weak and Strong Law of Large Numbers, Bernoulli's Weak Law of Large Numbers, Khintchine's Weak Law of Large Numbers, Kolmogorov's Strong Law of Large Numbers. Central Limit Theorem - Lindeberg-Levy's, Liapouov's form and Lindberg – Feller Central Limit Theorem (Statement only).

Books for Study:

1. Basu, A.K. (1999) Measure theory and Probability, PHI.
2. Bhat, B. R. (2014) , Modern Probability Theory-An Introductory Text Book, Third Edition, New Age International.
3. Feller.W. (1968) Introduction to Probability and Application,
4. Rohatgi,V.K.(1985) An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd.Wiley Eastern Company.

Books for Reference:

1. De Barra, G. (1991) Measure theory and Integration, Wiley Eastern Ltd.,
2. Rohatgi V.K.(2002) : Introduction to Mathematical Statistics, Wiley.

CORE – PV
COMPUTER LAB FOR R PROGRAMMING

Semester – I

Hours : 6

Code :

Credits : 4

Objectives: To train students in R Software

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
6. Box Plot
7. Scatter Diagram

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:

1. Karl Pearson Coefficient of Correlation
2. Spearman's Rank Correlation
3. Simple Linear Regression
4. Multiple Regression

Testing of Hypothesis:

1. One Sample t test
2. Independent t test
3. Paired t test
4. Analysis of Variance – One way Classification
5. Analysis of Variance - Two way Classification
6. Chi Square Test : Independence of Attributes
7. Chi Square Test: Goodness of Fit

CORE – VI
STATISTICAL INFERENCE

Semester - II

Hours : 6

Code :

Credit : 5

Objective :

To give an exposure to a very vital part of Statistics – the Statistical Inference

Unit – I

Point Estimation – properties of estimators. Unbiasedness – properties. Consistency and Efficiency of an estimator. Minimum Variance Unbiased Estimator, Rao Blackwell theorem, Lehman -Scheffe's theorem - simple problems.

UNIT – II

Cramer – Rao Inequality. Methods of Estimation: Maximum Likelihood Estimation method – Asymptotic properties of MLE. Method of Moments- simple problems.

Unit – III

Statistical Hypothesis – Simple and Composite, Null and Alternative Hypothesis. Concept on Critical Region, Types of errors, Level of Significance, Power of a test. Optimum tests – Most Powerful Test, Uniformly Most Powerful Test and Neyman-Pearson Lemma - simple problems.

Unit – IV

Likelihood Ratio Test - Definition and properties - Likelihood ratio test for a mean of a normal population, equality of means of two normal population, variance of normal population, equality of variances of two normal populations.

Unit - V

Non – parametric tests - Advantages and Disadvantages – Sign test, Median test, Test for randomness, Wald–Wolfowitz run test, Kolmogrow–Smirnov (one and two samples) tests and Mann Whitney Wilcoxon U-test.

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.

Books 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 BASED ELECTIVE - VII

JAVA PROGRAMMING

Semester – II

Hours : 6

Code:

Credits : 4

Objective: To develop the students in programming in JAVA language.

Unit – I

Principles of Object Oriented Programming - Software evolution - Basic concepts of OOP, Features of OOP and Applications of OOP - Java Programming structure – Constants, Variables, Data types and Type Conversion.

Unit – II

Operators - arithmetic operators, relational operators, logical operators, assignment operators, conditional operators, bitwise operators and special operators. Arithmetic expression - evaluation of expression.

Unit – III

Decision making and branching: Simple if- statement, The if-else statement, Nesting of if...else, else...if ladder, The switch statement, The ? : operator. Decision making and looping: The while statement, The do statement and for statement (Jumps in loops and labeled loops).

Unit – IV

Class – Objects – Methods – Inheritance – Arrays – Strings – Interfaces – Packages - exception handling.

Unit – V

Applet - Introduction, building applet code, Designing a web page, Applet tag, Applet to HTML file, Graphics class-lines & rectangles, Circles and Ellipses -Drawing Arcs – Drawing Polygons.

Book for Study:

Balagurusamy.E., Tata McGRAW HILL.(2013)- Programming with Java A Primer, 4th Edition

Books for Reference:

1. Muthu.C,(2001): Programming with JAVA- Thomson Asia Pvt. Ltd, Singapore
2. Patrick Naughton &Herbert Schildt, (1999) The Complete Reference Java, Tata McGRAW HILL.

CORE: VIII

REGRESSION ANALYSIS AND TIME SERIES

Semester - II

Hours : 6

Code:

Credits : 5

Objective : To understand the practical applications of the various regression models and Time series.

Unit - I

Simple linear Regression model - Least square estimation of the parameters- Estimation of β_0 and β_1 - properties of the least square estimators - Estimation of σ^2 - Hypothesis testing on the slope and intercept. Estimation by Maximum likelihood method - Interval estimation in simple linear regression: Confidence Intervals on β_0, β_1 and σ^2 .

Unit - II

Multiple linear Regression models - Estimation of model parameters-Least Square estimation of the Regression coefficients-Properties of least square estimators- Estimation of σ^2 – Maximum Likelihood Estimation - Hypothesis testing in Multiple Linear Regression, Confidence interval in Multiple Regression coefficients.

Unit - III

Multicollinearity - Sources of Multicollinearity - Methods for dealing with Multicollinearity - Ridge Regression – Specification bias.

Unit - IV

Generalized and weighted least squares-Robust regression - Properties of Robust estimators - Non-linear regression models - Generalized linear models-Logistic regression model - Link function and linear predictors

Unit - V

Models of Time Series - Additive and Multiplicative models - Analysis and forecasting-Elimination of trend - Growth curve-modified exponential curve (Methods of three selected points only), Gompertz Curve, Logistic curve (Method of three selected points and Yule's method).

Book for Study:

Douglas C. Montgomery and Elizabeth A. Peck-Introduction to linear Regression Analysis- John Wiley & Sons, New York.

CORE - IX

APPLIED MULTIVARIATE ANALYSIS

Semester – II

Hours : 6

Code :

Credits : 5

Objective: To train the students to acquire theoretical background of Multivariate Statistical Tools and apply them in real life situation.

Unit – I

Aspects of Multivariate Analysis – Some basics of matrix and vector algebra – mean vectors and covariance matrices – Generalized variance – Multivariate normal distribution – multivariate normal density and its properties.

Unit – II

Hotelling T^2 Statistic: Introduction – derivation and its distributions – Uses of T^2 statistic – Properties of the T^2 test. Wishart distribution - Definition and properties only.

Unit – III

Principal components: Introduction – population principal components – summing sample variation by principal components – Graphing the principal components.

Unit – IV

Factor analysis and inference for structured covariance matrices: Orthogonal factor model – methods of estimation – Factor rotation – Factor scores.

Unit – V

Discrimination and classification - Separation and classification for two populations – Classification with two multivariate normal populations – Evaluating classification functions – Fisher's discriminant function – Fisher's method for discriminating among several populations.

Book for Study:

Richard A. Johnson and Dean W. Wichern (2003): Applied multivariate statistical analysis, Third Edition, Prentice – Hall of India Private Ltd, New Delhi.

Book for Reference:

Anderson T.W. (1957): An introduction to multivariate statistical analysis, Wiley Eastern Private Limited, New Delhi.

Core- P X

COMPUTER LAB FOR JAVA PROGRAMMING

Semester – II

Hours : 6

Code :

Credits : 4

Objective: To implement the Statistical Constants using JAVA Language.

List of Programs:

1. Currency Conversion
2. Counting number of digits
3. Sum of digits and reverse number
4. Prime number.
5. Mean & Standard Deviation
6. Correlation Coefficient
7. Sorting of numbers
8. Sorting of strings
9. Fibonacci series.
10. Program to implement objects and class: Students' result.
11. Graphic Class: Displaying a given message using Applet
12. Graphic Class: Drawing Lines and Rectangles
13. Graphic Class: Drawing Circles and Ellipses
14. Applet for drawing a Human Face
15. Applet for drawing Bar Chart.
16. Applet for drawing a Polygon

CORE – XI

STOCHASTIC PROCESSES

Semester: III

Hours : 6

Code :

Credit : 5

Objective: To study the importance of the stochastic processes and its applications.

Unit – I

Stochastic Processes: Definition and examples: Classification of Stochastic Processes. Markov Chains - Definition and examples: one and two dimensional random walk; Transition probabilities; Classification of States and chains.

Unit – II

Basic limit theorems of Markov Chains, determination of higher transition probabilities. Stability of a Markov system- limiting behavior : finite irreducible chain, computation of the stationary probabilities – simple problems.

Unit – III

Continuous time Markov Chains - Poisson Process - its derivation and properties. Pure birth processes : Yule furry process. Birth and death processes.

Unit – IV

Renewal processes – renewal function, renewal equation, stopping time : Wald's equation, renewal theorems. Branching process - generating function relation, mean and variance of generations.

Unit – V

Queueing processes - general description of M/M/I models with finite and infinite Capacities, Waiting time and busy period for both steady state and transient state behavior. Birth and Death processes in queueing theory. Multi-channel model of M/M/S. Non-Markovian Queues model (concept only).

Book for study :

Medhi. J. (2010), Stochastic Processes, New age international(p) limited publishers, NewDelhi.

Books for Reference:

1. Karlin, S. and Taylor. H.W (1975), A First Course in Stochastic Processes, Academic Press, 2nd Edn.
2. Karlin S. and Taylor. H.W (1979), A Second course in Stochastic Processes, Academic Press.
3. Basu A.K(2007), Introduction to Stochastic Processes, Narosa Publishing.
4. Srinivasan, S.K. (1976), Introduction to Stochastic processes and their Applications, Tata Mc Graw Hill Publishing Company Ltd., New Delhi.

CORE - XII

REAL ANALYSIS AND LINEAR ALGEBRA

Semester - III

Hours : 6

Code:

Credit : 5

Objective: To improve the mathematical skills among the post-graduate students

Unit - I

Functions - Real valued function, Equivalence, countability, least upper bounds. Sequence of real numbers - Definition, limit of a sequence, convergent sequence, divergent sequence, bounded sequence, monotone sequence, limit superior and limit inferior.

Unit - II

Calculus - Sets of measure zero, Definition of the Riemann integral, existence of the Riemann integral, Derivatives, Rolle's Theorem, the law of the mean, Fundamental theorems of calculus, improper integrals.

Unit - III

Rank of a matrix – elementary transformation of a matrix, Equivalent Matrices, Elementary matrices, Echelon Matrix – Hermite Canonical form, Sylvester's law, Frobenius inequality, certain results on the rank of an Idempotent matrix.

Unit -IV

Eigen values and Eigen vectors - properties, Cayley-Hamilton theorem, application of Cayley-Hamilton theorem - simple problems.

Unit - V

Generalized inverse of a matrix: definition, different classes of generalized inverse, properties of G-inverse - classes properties - application of Generalized inverse in the solution of system of linear equations. Quadratic forms - Definition, classification of the quadratic form, positive semi-definite quadratic form and Canonical reduction.

Books for Study:

1. Goldberg. R. (1963), Method of Real Analysis, Oxford & IBH publishers, New Delhi. (unit-I: Chapter –I :Page no.3-17,21-75, Unit-II:Chapter-7:Page no.156-194).
2. Biswas.S(1996), A Text book of Matrix Algebra, New Age International Publishers, NewDelhi.(Unit-III :Chapter-5,Unit-IV:Chapter-7:page no.185-198,208-209,213-227. Unit-V:Chapter-8: page no.228-245 and Chapter-9: page no.267-268,317-323).

Books for Reference:

1. Walter Rudin(2006), Real and Complex Analysis, Third Edition, Tata McGraw Hill.
2. Singal M.K. Asha Rani Singal , A First Course in Real Analysis, chand and Co, New Delhi.
3. Shanthi Narayanan(2009), A Text book of matrices, S.Chand & Co, New Delhi.

CORE - P XIII

COMPUTER LAB FOR DATA ANALYSIS

Semester - III

Code:

Hours : 6

Credit : 5

Objectives:

To expose the students to the analysis of statistical data using Statistical software.

List of Topics:

Measures of Central Tendency, Measures of Dispersion and Skewness and Kurtosis

- Arithmetic Mean, Median, Mode ,Geometric Mean and Harmonic Mean
- Range, Quartile Deviation, Mean Deviation and Standard Deviation
- Measures of Skewness and Kurtosis

Correlation and Regression:

- Karl Pearson Coefficient of Correlation
- Spearman's Rank Correlation
- Simple Linear Regression
- Logistic Regression
- R-square and Multicollinearity

Test for Normality

Parametric test

- **t test – one sample & two samples**
- **ANOVA – One way & Two way**

Non-parametric Tests

- Chi-square test
- Run test
- One sample K-S test
- Two independent sample
- Two related sample
- K- related sample
- McNemar test

Data Reduction (manual calculation not necessary)

- Factor Analysis
- Cluster Analysis
- Discriminant Analysis

CORE BASED ELECTIVE –I

SURVIVAL ANALYSIS

Semester - III

Hours : 6

Code:

Credit : 5

Objective: To give an exposure to students on the application of Statistics in biological studies.

Unit – I

Introduction to Survival Concepts: Survival Functions and Hazard Rates – Types of Censoring – Type I Censoring, Type II Censoring, Random Censoring, Other Types of Censoring.

Unit – II

Parametric Models: Distributions – Exponential, Gamma, Weibull and Lognormal; Estimation: Maximum Likelihood, Simple Problems.

Unit – III

Non Parametric Methods: One sample: Product-Limit(Kaplan-Meier) Estimator-Generalized Maximum Likelihood Estimator – Consistency – Asymptotic Normality. Hazard Function Estimators –Asymptotic Normality.

Unit – IV

Nonparametric Methods-Two Samples: Gehan test, Mantel-Haenszel test, Efron Test – Simple Problems.

Unit – V

Nonparametric Methods-Regression: Cox Proportional Hazards Model – Conditional Likelihood Analysis – Justification of the conditional likelihood – Justification of Asymptotic Normality – Estimation of $S(t;x)$ – Simple problems.

Book for Study:

1. Rupert G. Miller, JR. (2014). Survival Analysis, Wiley Classics Library Edition.

Books for Reference:

1. Ellisa T.Lee (1992): Statistical Methods For Survival Data Analysis
2. David G. Kleinbawn (1996) : Survival Analysis, Springer.

CORE BASED ELECTIVE - II

ACTUARIAL STATISTICS

Semester : III

Hours : 6

Code :

Credits : 4

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

Unit – I

Definition of vital statistics and vital events- uses of vital statistics, sources of vital statistics. Measurements of Fertility Rate-Crude Birth Rate, General Fertility Rate, Specific Fertility Rate, Total Fertility Rate, Gross Reproduction Rate and Net Reproduction Rate.

Unit – II

Measurement of Mortality- Crude Death Rate, Specific Death Rate, Infant Mortality Rate, Standardized Death Rates – Direct and Indirect method of standardization, Central Mortality Rate and Force of Mortality.

Unit – III

Life Table – Assumptions, Descriptions, Construction and Uses of Life Table. Definitions of l_x , d_x , npx , p_x , q_x , L_x and T_x . Expectation of life – Curate expectation and complete expectation of life. Basic theorems with proof.

Unit – IV

Life Assurance premiums: General considerations – Assurance benefits – Pure Endowment Assurance, Endowment Assurance, Temporary assurance, Whole life assurance – Commutation Functions D_x , C_x , M_x and R_x – Expressions for present values of Assurance benefits in terms of Commutation Functions. (Simple problems only)

Unit – V

Net Premiums for Assurance Plans – Natural Premiums – Level Annual Premium – Net Premium for Annuity Plans. Mathematical expression for level Annual Premiums (Simple problems only).

Books for Study:

1. Gupta,S.P. & Kapoor,V.K., Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi. (Unit I to Unit III)
2. Mathematical basis of life assurance IC-81, Insurance institute of India. (Unit IV-Lesson VIII & IX, Unit V – Lesson XI & XII).

Books for Reference:

1. Hansraj, Fundamentals of Demography, Surjeet Publications, New Delhi
2. Donald, DWA (1975): Compound interest and annuities certain, Heinemann, London.

CORE XIV

ADVANCED SAMPLING THEORY

Semester : IV

Hours : 6

Code :

Credits : 5

Objective: To study the various Sampling techniques and apply them practically.

Unit – I

Simple Random Sampling - procedure of selecting a random sample, estimation of mean , variance and proportions-SRS for variables-SRS for attributes. Estimation of sample size.

Unit – II

Stratified Random Sampling - Introduction, principles of stratification, advantages of stratification, notations, estimation of population mean and its variance, , allocation of sample size in different strata. formation of strata, determination of number of strata.post stratification-deep stratification.

Unit- II

New systematic Random Sampling - Introduction, comparison of systematic with simple and stratified random samples for some specified populations-population with periodic variations-auto – correlated populations-two-dimensional systematic sampling.

Unit - III

Cluster Sampling - Introduction, Notations, Equal Cluster Sampling, Estimator of Means and its Variance, Relative efficiency of Cluster Sampling and Optimum Cluster size.

Cluster sampling for proportions-unequal cluster sampling. Estimators of mean and their variances. Relative efficiency of unequal cluster sampling.

UNIT – IV

Multi Stage Sampling - Sampling procedure, Two-Stage Sampling with equal first-stage units, estimation of mean and its variance, Two-Stage Sampling with unequal first-stage Units and Estimators of Mean and their Variances.

UNIT-V

Multiphase Sampling – Introduction, Double Sampling for Stratification, Optimal Allocation, Double Sampling for difference estimator, Double Sampling for Ratio Estimator and Double Sampling for Regression Estimator.

Book for study:

Daroga Singh and F.S.Chaudhary, Theory and analysis of Sampling Survey Design, New Age International (P) Ltd., Chennai.

Books for Reference:

- 1.Cochran W.G. (1984), Sampling Techniques, Wiley Eastern Ltd.
2. Des Raj (1976): Sampling Theory, Tata-Mcgraw Hill.

CORE – PXV
COMPUTATIONAL STATISTICS
(BASED ON SAMPLING, DESIGN OF EXPERIMENTS AND TESTING OF
HYPOTHESIS)

Semester: IV

Hour: 6

Code:

Credit: 5

Objective: To impart the practical knowledge in the field of Sampling, Design and Testing of Hypothesis.

List of Topics:

- i. Simple Random Sampling with and without replacement.
- ii. Stratified Random Sampling.
- iii. Systematic Sampling.
- iv. Cluster Sampling.
- v. Design: CRD, RBD, LSD with one and two missing observations.
- vi. Factorial Experiments: $2^2, 2^3, 3^2$, Confounding & Partial Confounding with 2^3
- vii. Analysis of BIBD and PBIBD with two associate classes.
- viii. Large Sample: Mean, Difference of Means, S.D, Difference of S.D's, Proportion & Difference of Proportions.
- ix. Small Sample: Mean, Difference of Means, Paired t test, Correlation Coefficient.
- x. Non-Parametric Test: Sign, Median, Mann-Whitney Wilcoxon U-test, Kolmogorov-Smirnov (one and two samples) tests.

CHOICE BASED ELECTIVE – III

LINEAR MODELS AND DESIGN OF EXPERIMENTS

Semester: IV

Hours : 6

Code :

Credits : 4

Objective: To gain knowledge in the field of Design of Experiments.

Unit – I

General linear model - models with full rank and less than full rank -least square and maximum likelihood estimators of the parameters and properties Gauss-Markov theorem - testing linear hypothesis.

Unit – II

Introduction to design of experiments – Efficiency of CRD,RBD & LSD– Missing plot techniques for RBD and LSD with one (or) two missing observations.

Unit –III

Factorial Experiment: Main effects, Interaction effects, orthogonal, contrasts – Designs for 2ⁿ, 3ⁿ experiments. Total and Partial confounding in 2³ experiments – Analysis of Split Plot Design.

Unit – IV

General block designs- concepts of connectedness, balancedness and orthogonality. –

BIBD and its parametric relations – Information (C) matrix and criteria for connectedness of block designs - Intra and Inter block analysis of BIBD – concept of Youden square design.

Unit –V

PBIBD with 'm' associate classes – classifications and parametric relations of PBIBD – Intra block analysis of PBIBD – Need and scope of response surface experiments.

Books for Study:

1. Das, M.N. and Giri, N.C, (1997), Design and analysis of experiments, Wiley Eastern Ltd., New Delhi.
2. Graybill,F.A.: An Introduction to Linear Statistical Models, McGraw Hill, NewYork.
3. Gupta S,C and Kapoor V.K (1993): Fundamental of Applied Statistics. - Sultan Chand & Sons, New Delhi.
4. Montgomery. D.C.(1994) Design and Analysis of Experiments, 3rd edition, John Wiley.

Books for Reference:

1. Alope Day: Theory of Block Design, Wiley Eastern Ltd., New Delhi.
2. Joshi,D.D. Linear Estimations and Design and analysis of experiments, Wiley Eastern ltd., New Delhi.
3. Cochran & Cox. (1992) Experimental Designs, 2nd edn, John Wiley & Sons.

CORE BASED ELECTIVE – IV
QUALITY ASSURANCE

Semester - IV

Hours : 6

Code :

Credit : 4

Objective: To create the consciousness about the standards of quality.

Unit – I

Quality – Quality Improvement – Dimensions of Quality – Quality Engineering terminology – Statistical methods for Quality Control and Improvement – Management aspects of Quality Improvement: Quality Planning, Quality assurance, Quality control and improvement, Quality Philosophy and Management Strategies: Deming's 14 points, Total Quality Management, Quality Systems and Standards – Quality Costs.

Unit – II

Basic concepts of Six Sigma and Lean Six Sigma – DMAIC Problem solving process: Define step, Measure step, Analyse step, Improve step, Control step – Examples of DMAIC: Litigation documents, Improving on time delivery, Improving service quality in a Bank.

Unit-III

Statistical Process Control: Chance and assignable causes of Quality Variation – Statistical basis of the control charts – Average run length – Average time to signal – Rational subgroup – Analysis of patterns on control charts – Rest of the magnificent seven – Implementing SPC in a Quality Improvement Program.

Unit – IV

Process Capability Analysis(PCA) – PCA using Histogram or a probability plot – Process Capability Ratios (PCR) – PCR for an Off-Center Process – Normality and the PCR – Confidence intervals and tests on PCR – PCA using a Control Chart, PCA using Designed experiments – PCA with attribute data.

Unit – V

Cumulative Sum Control Chart: V Mask Procedure – Exponentially Weighted Moving Average Control Chart – Moving Average Control Chart – Modified and Acceptance Control Charts – Group Control Charts.

Book for Study :

Douglas C. Montgomery (2013), Statistical Quality Control. A Modern Introduction, John Wiley, 6th Edn..

Books for Reference:

1. Juran(1998) , Quality Control Handbook, McGraw Hill, 4th Edn.
2. Mahajan(1997), Statistical Quality Control, Dhanpath Rai & Sons.

CORE BASED ELECTIVE COURSES

INTRODUCTION TO PYTHON

Semester -
Code :

Hours : 6
Credit : 4

Objective: To introduce the software skills to apply the statistical tools.

Unit-I

Python Statements and Comments, Keywords and Identifier, Python Data types, Python I/O and Import, Python operators, If else statement, For loop, While loop, Break and Continue.

Unit-II

Function, Argument, Recursion, Modules, Python package, Data types, Numbers, List, Tuple, String, Set, Dictionary, File Operation, Directory.

Unit-III

Exception, Exception Handling, User-defined exception, Name space, Class, Inheritance, Multiple Inheritance, Operator overloading.

Unit-IV

Data visualization in Python, Fitting of Distributions – Graphical and Statistical Procedures, Statistical Measures.

Unit-V

User defined functions for parametric tests and Non parametric tests, Fitting Statistical Models – Simple Linear Regression and Multiple Linear regression.

Book for Study:

1. Python programming for Absolute Beginner, Third Edition By Michael Dawson – Cengage Learning

Books for Reference:

1. Python Data Analytics, Fabio Nelli – A press.
2. Python for Data Analysis, Wes McKinney – O'Reilly.

SIMULATION MODELLING

Semester -

Hours : 6

Code :

Credit : 4

Objective: To create the consciousness about the simulation and Modelling.

Unit – I

Introduction to Simulation- Advantagea and disadvantages of simulation-Area of Application. Systems-Components of System- Discrete and continuous systems- Model of a system-Types of Models- Discrete-Event System Simulation-Steps in a simulation study.

Unit – II

Statistical Models in Simulation- Discrete Distributions- Continuous Distributions- Poisson Process- Empirical Distributions.

Unit-III

Random Number Generation- Properties of Random Numbers- Generation of Pseudo-Random Numbers- Techniques for Generating Random Numbers- Tests for Random Numbers.

Unit – IV

Random Variate Generation- Inverse Transform Technique- Exponential, Uniform, Weibull Distributions. Direct Transformation for the Normal Distribution-Convolution Method-Acceptance-Rejection Tecnique.

Unit – V

Verification and Validation of Simulation Models- Model Building, Verification, and Validation-Verification of Simulation Models- Calibration and Validation of Models.

Book for Study :

Jerry Banks, John S. Carson ,II and Barry L. Nelson (1999),Discrete- Event System Simulation, Prentice-Hall of India Pvt. Ltd., 2nd Edn.

DISCRETE MATHEMATICS

SEMESTER -

HOURS : 6

CODE :

CREDIT : 4

OBJECTIVE: TO MOTIVATE THE KNOWLEDGE OF DISCRETE MATHEMATICS.

Unit I

Sets, Relations & Functions: Property of binary relations, equivalence, compatibility, partial ordering relations, Hasse diagram, functions, inverse functions, compositions of functions, recursive functions.

Unit II

Mathematical logic: Logic operators, Truth tables, Theory of inference and deduction, mathematical calculus, predicate calculus, predicates and qualifiers.

Unit III

Groups & Subgroups: Group axioms, permutation groups, subgroups, cosets, normal subgroups, semi groups, free semi-groups, monoids, sequential machines, error correcting codes, modular arithmetic grammars.

Unit IV

Lattices & Boolean Algebra: Axiomatic definition of Boolean algebra as algebra as algebraic structures with two operations , basic results truth values and truth tables, the algebra of propositional functions, Boolean algebra of truth tables.

Unit V

Combinatorics & Recurrence Relations: Disjunctive and sequential counting, combinations and permutations, enumeration without repetition, recurrence relation, Fibonacci relation, solving recurrence relation by substitution, solving non- recurrence relation by conversion to linear recurrence relation.

Book for study :

1. Trembly. J.P &Manohar. P., “ Discrete Mathematical Structures with Applications to Computer Science” McGraw Hill.

Book for References :

1. Seymour Lipschutz & March Lipson Tata McGraw Hill.
2. C.L.Liu “ Elements of Discrete mathematics “ Tata McGraw Hill.
3. Kolman, Busy & Ross “Discrete Mathematical Structures”, PHI
4. K.D Joshi, “Foundations of Discrete Mathematics”, Wiley Eastern Limited.

STATISTICAL DATA ANALYSIS USING SAS

Semester -
Code:

Hours :
Credits :

Objectives:

1. To enable students to use SAS for Data processing
2. To expose students on the applications of Statistical Analysis using SAS

Unit-I

Data step and Proc Step, SAS Data Libraries, Creating dataset using data lines, Importing data using INFILE statement, Importing data using Proc Import, Creating HTML Output, Sub setting observations using conditional statements, Sub setting variables using Keep/Drop, Creating variables using IF-THEN else statements, Retain statement, FIRST., LAST.

Unit-II

SAS procedures, Sub setting in Procedures with the WHERE Statement, Sorting Data with PROC SORT, Printing Data with PROC PRINT, Summarizing Your Data Using PROC MEANS, Writing Summary Statistics to a SAS Data Set, Counting Data with PROC FREQ, Producing Tabular Reports with PROC TABULATE, PROC SORT, PROC SUMMARY

Unit-III

Modifying a Data Set Using the SET Statement, Stacking Data Sets Using the SET Statement, Interleaving Data Sets Using the SET Statement, Combining Data Sets Using a One-to-One Match Merge, Combining Data Sets Using a One-to-Many Match Merge, Merging Summary Statistics with the Original Data.

Unit-IV

SAS Macro Concepts, Substituting Text with Macro Variables, Creating Modular Code with Macros, Adding Parameters to Macros, Writing Macros with Conditional Logic, Writing Data-Driven Programs with CALL SYMPUT. Proc SQL, Using Proc SQL to create tables, Modifying tables, Aggregating tables, Stacking and Merging tables

Unit-V

PROC UNIVARIATE, PROC MEANS, PROC CORR, PROC PLOT, PROC FREQ, PROC TTEST , PROC NPAR , PROC ANOVA, PROC REG.

Books for Study:

1. The Little SAS Book: A Primer, Fourth Edition, Lora D. Delwiche, Susan J. Slaughter

SAS Institute

2. Learning SAS by Example: A Programmer's Guide, Ron Cody, SAS Institute

DATA MINING

Semester -

Hours : 5

Code:

Credits : 4

Objective : This course introduces the fundamental concepts of Data Mining

Unit - I

Introduction:- Data mining – Functionalities – Classification –Data Preprocessing :Preprocessing the Data – Data cleaning – Data Integration and Transformation .

Unit- II

Data Mining Primitives:- Association Rules in large Data mining , KDD Process, Fuzzy sets and logic, , Classification and Prediction:- Information retrieval, Dimensional Modeling of Data, Pattern Matching.

Unit -III

Models based on Summarization:- Bayes Theorem, Chi squared Statistics Regression, Decision Tree. Neural Networks, Genetic Algorithms.

Unit- IV

Cluster Analysis: Introduction – Types of Data in Cluster Analysis, Partitioning Methods – Hierarchical Methods- Density Based Methods – GRID Based Method – Model based Clustering Method.

Unit- V

Web Mining:- Introduction, Web data, Web Knowledge Mining Taxonomy, Web Content mining, Web Usage Mining Research, Ontology based web mining Research, Web mining Applications.

Books For Study

1. J.Han and M. Kamber,2001,Data Mining Concepts and Techniques,Harcourt India Pvt. Ltd - New Delhi.
2. K.P. Soman , Shyam Diwakar, V.Ajay ,2006, Insight into Data Mining Theory and Practice, Prentice Hall of India Pvt. Ltd – New Delhi.