GOVERNMENT ARTS COLLEGE (Autonomous)
COIMBATORE – 18
DEPARTMENT OF STATISTICS
M.Sc. STATISTICS

SCHEME OF EXAMINATION (2015 – 2016 onwards)

Semester	Subject	I MM (Hrs)	Exam (Hrs)	Marks					
				SE	CA	Total	SE-Min.	TPM	No. of Credits
I	Core I : Real Analysis & Linear Algebra	6	3	75	25	100	38	50	5
	Core II : Probability Theory	6	3	75	25	100	38	50	5
	Core III : Distribution Theory	6	3	75	25	100	38	50	5
	Core IV : Computer Programming with C++	6	3	75	25	100	38	50	5
	Core Practical I : Statistics Practical - I	3							-
	Core Practical II : Statistics Practical - II	3							-
II	Core V: Sampling Theory	6	3	75	25	100	38	50	5
	Core VI : Statistical Inference - I	6	3	75	25	100	38	50	5
	Core VII : Statistical Quality Control & Reliability	6	3	75	25	100	38	50	5
	Elective - I : Stochastic Processes	6	3	75	25	100	38	50	2
	Core Practical I : Statistics Practical - I	3	3	60	40	100	30	50	5
	Core Practical II : Statistics Practical - II	3	3	60	40	100	30	50	5
III	Core VIII : Statistical Inference - II	6	3	75	25	100	38	50	5
	Core IX : Design of Experiments	6	3	75	25	100	38	50	5
	Core X : Multivariate Analysis	6	3	75	25	100	38	50	5
	Elective II : Numerical Analysis	6	3	75	25	100	38	50	2
	Core Practical III : Statistics Practical - III	2							-
	Core Practical IV : Statistics Practical – IV (Using R-Software)	2							-
	Project / Dissertation	2							
IV	Core XI : Advanced Operations Research	6	3	75	25	100	38	50	5
	Core XII : Applied Regression Analysis	6	3	75	25	100	38	50	5
	Elective III : Econometrics	6	3	75	25	100	38	50	2
	Core Practical III : Statistics Practical - III	4	3	75	25	100	38	50	5

Core Practical IV : Statistics Practical – IV (Using R-Software)	4	3	60	40	100	30	50	5
Project / Dissertation	4	3	80	20	100	40	50	4
Total	**120**							**90**

GOVERNMENT ARTS COLLEGE

(Autonomous – Affiliated to Bharathiar University, Coimbatore)

DEPARTMENT OF STATISTICS

M.Sc. STATISTICS

SYLLABI

2015-2016 onwards

Semester – I

Core I : REAL ANALYSIS AND LINEAR ALGEBRA

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

Objective : This paper enables the student to get a good and advance knowledge in mathematical analysis.

UNIT - I

Limit, Continuity and derivability of a real valued function – Uniform Continuity – Pointwise convergence of sequence and series of functions – Uniform convergence.

UNIT - II

Limit, Continuity and Derivability of functions of two variables - Maxima and Minima of functions of two variables only

UNIT - III

Riemann Integral – Partitions and Sums –Upper and Lower R – Integrals – Riemann Integrability – Riemann's necessary and sufficient conditions for R – Integrability – Algebra of Integrable functions - Fundamental theorem of Integral Calculus – First and Second Mean value theorems. Riemann – Stieltjes integral – Partitions – Lower and Upper R-S sums and integrals – Some classes of R-S integrable functions – Algebra of R-S integral functions

UNIT - IV

Vector Spaces-Introduction- Definition-sub spaces- Linear Combinations-Linear equations and vector spaces- Examples of vector spaces- Inner Product- Orthogonality- Hermitian inner products- Linear transformations- linear product applications.

UNIT - V

Hermitian form - Quadratic form – Canonical representation of Quadratic forms and Hermitian forms – G inverse – properties – Method of finding G- inverse (No problems).

Text Books:

1. R. Goldberg, Method of Real Analysis, Oxford & IBH publishers, New Delhi.
2. Walter Rudin., Real and Complex Analysis, Third Edition, Tata McGraw Hill.
3. P. Bhimsankran and Rmachandra, Rao Linear Algebra , Hindustan Publications 2000.

Reference Books:

1. Tom M. Apostol., Calculus, Second edition, John Wiley and sons, New York.
2. J.N. Sharma and A.R.Vashista., Real Analysis, Krishna Series.
3. Seymour Lipschutz., Shuam's out line Series of Linear Algabra, McGrew Hill, New york

Semester – I

Core II : PROBABILITY THEORY

Hours : 6

Code : **Credits : 5**

Objective: To impart the knowledge and applications of Probability theory in the field of Statistics.

UNIT – I

Probability space – Random Variable – Random Vector; Distribution function of random variable – Mathematical Expectation – Properties of Expectation – Inequalities based on Expectation – Basic Inequality - Holder's inequality – Markov inequality.

UNIT – II

Convergence of Random Variables – Convergence in Probability – Almost sure Convergence – Convergence in Distribution – Convergence in r^{th}mean – Relation between different modes of Convergence.

UNIT – III

Characteristic Function – Definition and Properties – Inversion Theorem – Khinchine – Bochner's Theorem – Uniqueness Theorem –Simple problems only.

UNIT – IV

Stochastic Independence – Independent classes of sets and of random variables – Equivalent definition of independent events and random variable – Borel – Cantelli lemma – Kolmogorov 0-1 law – Borel 0-1 law.

UNIT – V

Law of Large Numbers – Weak and Strong Law of Large numbers – Bernoulli's Weak Law of Large Numbers – Kolmogorov's SLLN – Central Limit Theorem – Lindeberg Levy theorem - Liaponov's form of Central Limit Theorem – Lindberg – Feller Central Limit Theorem – (Statement only)-Simple problems

Text Book:

1. B.R. Bhat : Modern Probability Theory – An Introductory Text Book, Second Edition, John Wiley & Sons, Inc.

Reference Books :

1.V.K. Rohatgi: Introduction to Mathematical Statistics, Wiley Eastern Ltd, New Delhi
2. W. Feller : Introduction to Probability Theory and its Applications, Vol.I, Third Edition, Wiley Eastern

Semester – I

Core III : DISTRIBUTION THEORY

Hours : 6
Code : Credits : 5

Objective : To gain knowledge about the advanced probability distributions that are applied in real time situation.

UNIT – I

Probability Distribution of a random variable – Distribution functions of random variables – Properties – Distributions of sum, difference, product, quotient, range, maximum and minimum of random variables – Simple Problems.

UNIT – II

Discrete Distributions: Geometric, Hyper-geometric, Negative Binomial, Multinomial distributions – Properties – Power Series and Compound distributions – Particular cases - Properties.

UNIT – III

Continuous Distributions: Exponential, Laplace, Cauchy, Log normal, Logistic, Weibull, Pareto distributions – properties.

UNIT - IV

Sampling distributions: t, F and χ^2 Statistics – Central and Non-central distributions – t, F and χ^2 distributions – Relationships - Distribution of Simple correlation co-efficient for null case. Distribution of Quadratic forms – Fisher - Cochran's Theorem.

UNIT – V

Order statistics – distribution of order statistics – joint distribution of order statistics – Distribution of the smallest and largest order statistics –asymptotic distribution of r^{th} order statistics - Distribution of range, mid-range and median – Simple Problems.

Text Books:

1. A.M. Mood, F.A. Greybill & D.C. Boes, Introduction to the Theory of Statistics, Tata McGrraw–Hill Education Pvt Limited, New Delhi, 3rd Edition, 2001.
2. Hogg R.V. and Craig A.T., An introduction to Mathematical Statistics, Third Edition, Amerind, New York, London.

Reference Books:

1. Rohatgi V.K., Introduction to Probability theory and Mathematical Statistics, Wiley Eastern Limited, New Delhi
2. Johnson & Kotz., Distribution in Statistics, Vol I, II & III, Wiley, U.P, India.

Semester – I

Core IV: COMPUTER PROGRAMMING WITH (C++)

Hours : 6
Code : Credits : 2

Objective: To impart the knowledge of programming skills in C++

UNIT – I
Object Oriented Programming (OOPs) Paradigm – Basic Concepts of OOPs – Object Oriented Languages. A Simple C++ Program – More C++ Statements – Structure of C++ Program. Tokens, Keywords – Identifiers and Constants – Basic Data Types – User-defined Data Types – Operator in C++ – Scope Resolution Operator – Expressions and their Types – Control Structures.

UNIT – II
Functions in C++: Introduction – The main function – Function Prototyping – Inline Functions – Default Arguments – Function Overloading – Math Library Functions. Classes and Objects: Specifying a Class – A C++ Program with Class – Defining Member Functions – Nesting Member Functions – Private Member Functions – Arrays within a class – Friendly functions – Memory Allocation of Objects – Array of Objects – Local Classes.

UNIT – III
Constructors – Copy Constructor – Dynamic Constructors – Constructing Two-dimensional Arrays. Destructors. Operator Overloading – Introduction – Defining Operator Overloading – Overloading Unary Operators – Overloading Binary Operators – Rules for Overloading Operators. Function Overloading – Function Overloading with Arguments – Special Features of Function Overloading.

UNIT – IV
Inheritance: Introduction – Types of Base Classes – Types of Derivation – Public – Private – Protected – Defining Derived Classes –Single Inheritance – Making a Private Member Inheritable – Multilevel Inheritance – Multiple Inheritance – Hierarchical Inheritance – Hybrid Inheritance – Polymorphism – Introduction – Virtual Functions.

UNIT – V
Managing Console I/O Operations: C++ Streams – C++ Stream Classes – istream, ostream, iostream, fstream, ifstream, ofstream, filebuff. Unformatted I/O Operations – Formatted I/O Operations –Managing output with Manipulators. Classes for File Stream Operations – Opening and Closing a file – Detecting end-of-file.

Text Book:
1. E. Balagurusamy: Object Oriented Programming with C++, Tata McGraw-Hill Publishing Company Limited, New Delhi, 4th Edition, 2008.

Reference Book:
1. Venugopal, Rajkumar, Ravishankar: Mastering C++, Tata McGraw-Hill Publishing Company

Limited, New Delhi.

Semester - II

Core V: SAMPLING THEORY

Hours : 6
Code : Credits: 5

Objective : To help the students in recognizing the possible pitfalls in published data and understand the need for randomness and desirability of stratification in sampling

UNIT – I

Census and Sampling surveys - Principal steps in a sample survey – Pilot survey –NSSO, CSO and their functions. Concept of sampling and non-sampling errors- Sources of non-sampling errors- Finite population-sampling techniques – SRSWR/SRSWOR, Stratified random sampling, Systematic sampling- Comparison of SRS, Stratified RS and Systematic RS (without derivation).

UNIT – II

Varying Probability Sampling- Introduction, Procedures of selecting a sample, Estimation in Probability proportional to size (pps) sampling with replacement: population total and its variance, Gain due to pps sampling with replacement-pps sampling without replacement, Procedures of selection of a pps sampling without replacement, Estimation in pps sampling without replacement : Population total and its sampling variance – pps systematic sampling.

UNIT – III

Ratio estimators: Introduction, Definition and notations, Bias of ratio estimators, approximate variance of ratio estimator-Ratio estimators in stratified sampling, comparison of separate and combined ratio estimator. Regression estimators: Introduction, Difference estimator, regression estimator, Regression estimator in stratified sampling.

UNIT – IV

Cluster sampling-Introduction-Notations-Equal cluster sampling –Estimation of mean and variance – Relative efficiency of cluster sampling – optimum cluster size –Cluster sampling for proportions. Unequal Cluster sampling – Estimation of mean and variance – Relative efficiency of unequal cluster sampling.

UNIT – V

Two stage sampling with equal first stage units – Estimation of mean and variance- Two stage sampling with unequal first stage units – Estimation of mean and variance- Two stage pps sampling- Three stage with equal probability- Three-stage pps sampling.

Text Books :

1. Daroga Singh and F.S.Chowdhary, Theory and analysis of Sampling Survey Design, John Wiley & Sons, New Age International (P) Ltd., Publishers,New Delhi, 2002.
2. R.S.N.Pillai and V.Bagavathi, Statistics, S. Chand & Company Ltd., New Delhi, Reprint 2009.

Reference Books:

1. Cochran W.G., Sampling Techniques, John Wiley & Sons, Canada, Third Edition, Reprint 2008.
2. Murthy M.N., Sampling Theory and Methods, Statistical Publishing Society, Calcutta.

Semester –II

Core VI : STATISTICAL INFERENCE – I

Hours : 6

Code : Credits : 5

Objective: To understand the theoretical knowledge in estimation and acquire practical experience in the estimation of parameters.

UNIT – I

Parametric Point Estimation – Properties of Estimators – Consistency – Sufficient condition for consistency – Sufficient statistics – Factorization theorem – Distributions admitting sufficient statistic – Fisher's information – Minimal sufficient statistics.

UNIT – II

Concept of Unbiasedness – Cramer – Rao inequality – Minimum variance bound estimator – Bhattacharya bounds – Concept of Efficiency – UMVUE – Completeness and Boundedly completeness – Rao-Blackwell theorem – Lehmann – Scheffe theorem.

UNIT – III

Methods of Point Estimation – Method of MLE – Method of Moments, Method of Minimum Chi-square – Method of Modified minimum Chi-square.

UNIT – IV

Exponential family – location and scale family – Location invariant estimator – Scale invariant Estimator – Pitman estimator for location and scale – Simple Problems- Principles of decision theory-Loss and Risk functions-Concept of Bayesian Inference - Baye's Estimator – Posterior Baye's Estimator (Concept Only)

UNIT –V

Interval Estimation – Confidence level and confidence co-efficient – Shortest length confidence intervals – Construction of Confidence intervals for Population Proportion-– Confidence intervals for mean, variance of a normal population – Confidence intervals for Difference between means- Confidence intervals for ratio of variances.

Text Books:

1. M. Mood, A. Greybill, C. Boes, Introduction to the Theory of Statistics, Tata McGrraw – Hill Education Pvt Limited, New Delhi.
2. A.M. Goon , M.K. Gupta and B. Das Gupta – An Outline of Statistical Theory, Volume 2, World Press Pvt Ltd., Calcutta – 700 073.
3. M. Rajagopal and P. Dhanavandan : "Statistical Inference ", PHI Learning Private Linited, New Delhi , 2012.

Reference Books :

1. R.V. Hogg . and A.T. Craig , An Introduction to Mathematical Statistics, Third Edition, Amerind, New York, London.
2. V.K. Rohatgi., A.K. Md. Ehsanes Saleh " An Introduction to Probability and Statistics", Wiley Series in Probability and Statistics, Texts and references section, Second Edition, 2013

3. S.C.Gupta and V.K.Kapoor "Fundamentals of Mathematical Statistics", Eleventh Edition, Sultan Chand & Sons, New Delhi 2013.

Semester - II

Core VII: STATISTICAL QUALITY CONTROL & RELIABILITY

Code:

Hours : 6
Credits : 5

Objective: To develop the skills in applying SQC tools and techniques in Industries.

UNIT I

Basis of Control Charts - Shewhart Control Charts for $\bar{x}$, R, p, np, c and their uses – OC and ARL of Control Charts – Control Charts based on CV – Modified Control Charts – CUSUM procedures – Concept and use of V- mask – Derivation of ARL - Decision Procedure –Tabular CUSUM Procedure.

UNIT II

Charts for individual observations - Moving Range and Moving Average Charts – Exponentially Weighted Moving Average Charts - Process Capability Index – Process Capability Ratio - Process Capability Analysis.

UNIT III

Attribute Sampling Plans – Single Sampling Plan- Conditions of Applications – Operating Procedure – Measures of Performance - OC, ASN, AOQ, ATI functions of SSP – Double Sampling Plan – Measures of Performance - OC, ASN, AOQ, ATI functions – MIL STD 105-D (Concept only).

UNIT IV

Variable Sampling Plan – Single Sampling Plan– Operating Procedure – Known & Unknown Sigma plans for one sided specifications - OC function - Determination of the sample size – MIL STD 414 (Concept only) – Continuous Sampling Plans – CSP-I, CSP-II and CSP-III Plans – Derivation of OC function (for CSP-I only) – Sequential Sampling Plans by attributes based on Binomial and Poisson Distributions.

UNIT V

Need for Reliability - Definitions of Reliability – Basic elements of Reliability – Hazard Rate – Measurement of Reliability – Exponential model Hazard rate – Mean Time between failures (MTBF) – Mean Time to Repair (MTTR) - IFR and DFR distributions – Censored Samples – MLE of reliability under Type – I Censoring – Reliability for Series and Parallel Systems - k out of m System – Maintainability (Concept only).

Text Books:

1. Douglas C.Montgomary : Introduction to Statistical Quality Control, Wiley India(P) Ltd, Fourth Edition, Second Reprint 2008, New Delhi.
2. Sheldon M.Ross : Intoduction to Probability Models, Elsevier Academic Press, Tenth Edition, 2010, USA.
3. EdwardG. Schilling : Acceptance Sampling in Quality Control, Marcel Dekker, Inc, ASQC Quality Press, 1982, USA.

Reference Books:

1. A.J.Duncan, : Quality Control and Industrial Statistics, Irwin Homewood.
2. M. Mahajan, : Statistical Quality Control, Dhanpat Rai & Co(P) Ltd, 2009, Delhi.

3. S.C.Gupta and V.K.Kapoor, : Fundamentals of Applied Statistics, Fourth thoroughly revised edition, Sultan Chand & Sons Publishers, Reprint 2009, New Delhi.

Semester – II

Elective I: STOCHASTIC PROCESSES

Code:

Hours : 6
Credits : 2

Objective: To impart the notations of Stochastic processes and their applications.

UNIT – I
Introduction to Stochastic Processes – Definition – Classification of Stochastic processes – Markov process – Markov chain – Countable State Markov Chain –Transition Probability Matrix – Chapman-Kolmogrov Equations – Calculation of 'n' step transition probability matrix.

UNIT – II
Classification of states of a Markov Chain – Recurrent and Transient states – Criteria for classification of the states – Random walk with absorbing and reflecting barriers – Probability of absorption – Duration of Random Walk – Gambler's ruin problem.

UNIT – III
Continuous time Markov Chain-Kolmogrov backward and forward differential equations – Pure Birth and Pure Death Processes – Yule Process - Birth and Death Process – Poisson Process – Applications in queuing theory.

UNIT – IV
Branching Process (one dimension only) – Generating Functions - Relationship – Properties of Generating Functions – Extinction probabilities – Concept of Weiner Process.

UNIT –V
Renewal process – Integral equation satisfied by a renewal function – Elementary renewal theorem – Strict and wide sense stationary processes with Examples – Basic ideas of auto-regressive and moving average models.

Text Books:

1. J. Medhi : "Stochastic Processes", Wiley eastern limited, New Delhi.
2. Karlin & Taylor: A first course in Stochastic processes, Vol.No.1, second edition, Academic process, New York.

Reference Book:

1. Sheldon M. Ross : "Introduction to Probability models", University of Southern California, Los Angels, California,10th Edition , 2013.

Semester – I & II

Core Practical – I : STATISTICS PRACTICAL – I

Hours : 6
Code : Credits: 5

DISTRIBUTION THEORY

1. Fitting Poisson distribution.
2. Fitting Binomial distribution.
3. Fitting Normal distribution.
4. Fitting lognormal distribution.
5. Fitting logistic distribution (Yules method).
6. Fitting logistic distribution (Rhodes method).

SAMPLING THEORY

7. Probability proportionate sampling.
8. Cluster sampling.
9. Ratio Estimation.
10. Regression Estimation.

STATISTICAL INFERENCE –I (Estimation)

11. Minimum Chi-Square method of estimation.
12. MLE and Standard error of MLE of Poisson.
13. MLE and Standard error of MLE of Binomial.
14. MLE and Standard error of MLE of Normal.

STATISTICAL QUALITY CONTROL & RELIABILITY

15. Single sampling plans.
16. Double sampling plans.
17. Sequential Sampling plans.
18. CUSUM control chart.
19. Reliability of Type – I censoring.
20. Reliability of Type – II censoring.

Semester – II

Core Practical – II : STATISTICS PRACTICAL – II

Hours : 6
Code : Credits: 5

1. Write and execute a C++ program to compute Mean, SD and Correlation coefficient for the given data.
2. Write and execute a C++ program to fit a linear equation using least square method for the known data.
3. Write and execute a C++ program to fit a Binomial distribution for the given observed data.
4. Write and execute a C++ program to fit a Poisson distribution for the given observed data.
5. Write and execute a C++ program for testing single mean using Z-test
6. Write and execute a C++ program for testing two means using Z-test
7. Write and execute a C++ program for testing single mean using t-test
8. Write and execute a C++ program for testing two-means using t-test
9. Write and execute a C++ program for testing two-variances using F-test
10. Write and execute a C++ program to find Probability of Acceptance of Single Sampling Plan for attributes using Poisson distribution.
11. Write and execute a C++ program to find Probability of Acceptance of Single Sampling Plan for Variables using Normal distribution.
12. Write and execute a C++ program for solving a system of equations using Gauss Elimination method.

Semester – III

Core VIII : STATISTICAL INFERENCE - II

Hours : 6
Code : Credits : 5

Objective: To understand the strong theoretical knowledge of parametric and non-parametric test and acquire practical knowledge in analyzing the data- Monotone Likely Ratio Property.

UNIT – I

Test of hypothesis: Simple and Composite hypothesis – Two types of Errors – Critical Regions – Randomized and Non-Randomized tests – Power function – Most powerful test – Neyman – Pearson lemma based on Randomized test – MLR property.

UNIT – II

Unbiased test - Uniformly Most Powerful Unbiased Test – Similar test – Relation between UMP unbiased test and UMP similar test – Unbiased test for one parameter exponential family – Test with Neyman Structure – Invariant test – Most powerful invariant tests – Confidence bounds and their connections with test of hypothesis.

UNIT –III

Likelihood Ratio test – Construction- LR test for Standard Distributions (Binomial, Poisson, Normal and Exponential distributions) – Large sample properties – Asymptotic distribution of LRT –Consistency of LRT- Bortlett test for homogeneity of variances.

UNIT – IV

Non-parametric tests: U-test and it's properties – One sample tests – Kolmogorov – Smirnov test – test for randomness – Sign test- Wilcoxon's signed rank test – Two sample tests – Run test, Median test, K-S test and Mann-Whitney U tests- Kruskall-Wallis H test.

UNIT –V

Basic structure of SPRT – Derivation of boundary constants A and B – Derivation of OC function – Power function – ASN function – Simple problems based on Binomial, Poisson, Normal and Exponential distributions.

Text Books:

1. Alan Stuart,J. Keith Ord, Steven Arnold, Kendal Advanced Theory of Statistics, Classical Inference and the Linear Model, Volume 2.
2. Goon A.M, Gupta M.K and Das Gupta B., An Outline of Statistical Theory, Volume 2, World Press Pvt Ltd., Calcutta – 700 073.

Reference Books:

1. Hogg R.V. and Craig A.T., An introduction to Mathematical Statistics, Third Edition, Amerind, New York, London.
2. Rohatgi V.K., Introduction to Probability theory and Mathematical Statistics, Wiley Eastern Limited, New Delhi

3. M. Rajagobal & R. Dhanavandan , Statistical Inference, 2012 by PHI, Prentice Hall.
4. Lehmann E.L., Testing Statistical Hypothesis, 2nd Edition, Springer.

Semester – III

Core IX: DESIGN OF EXPERIMENTS

Code:

Hours : 6
Credits : 5

Objective: To impart the knowledge and applications of various advanced Design of Experiments in the field of Agriculture and Industries.

UNIT –I

Basic Principles and Techniques of Design of Experiment - concepts of LSD – Applications – Layout of LSD – Advantages and Disadvantages of LSD – Statistical Analysis of LSD – Least Square Estimates of parameters - Factorial experiments – Introduction – 2^2 factorial Design – Statistical Analysis of 2^2 factorial Design – Yates method of computing 2^2 factorial totals.

UNIT –II

2^3 Factorial Experiment – Model Description - Statistical Analysis of 2^3 factorial Design- Yates method of computing 2^3 factorial totals - Confounding – Confounding highest order interaction effect – Confounding first order interaction effect – Confounding using contrasts – Partial confounding (concepts only) .

UNIT – III

Split Plot Design – Introduction – model description – Statistical Analysis – Advantages and Disadvantages. - Analysis of Covariance with one Concomitant variable – Definition – Introduction – Linear covariate model – Least Square Estimates for parameters – Estimation of variance – Statistical analysis.

UNIT –IV

Incomplete Block Design – Introduction – Balanced Incomplete Block Designs – Introduction - Model– Incidence Matrix – Symmetric BIBD – Statistical Analysis of Balanced Incomplete Block Designs (Intra Block only) - Partial BIBD (Concept only).

UNIT –V

Response surface methodology – Introduction – First Order Design – Model – Statistical Analysis of Response surface first order design – Design for Bio-assays – Direct, Indirect and Parallel line assays.

Text Books:

1. S.C. Gupta and V.K. Kapoor : Fundamental of Applied Statistics – Sultan Chand & Sons.
2. Montgomery : Design and Analysis of Experiments – John Wiley.
3. M.N. Das and N.P. Giri : Design and Analysis of Experiments, New Age International, 2nd Edtion, 2008.

Reference Books:

1. W.G. Cochran and G.M. Cox : Experimental Designs – John Wiley.
2. R. Panneer Selvam : Design And Analysis of Experiments, Prentice Hall.
3. Angela Dean and Daniel Voss : Design and Analysis of Experiments, Springer..

Semester – III

Core X: MULTIVARIATE ANALYSIS

Code:

Hours : 6
Credits : 5

Objective: To impart the knowledge and applications of multivariate normal distribution.

UNIT I

Multivariate Analysis- Introduction- Application of Multivariate techniques-Notions of Multivariate normal distribution: Joint distributions, Marginal distributions, Statistical Independence, Conditional distribution and Transformation of variables.

UNIT II

The Multivariate normal distribution and its properties –Estimation of Mean vector and Covariance Matrix, Maximum Likelihood estimators (MLE) - distribution of sample mean vector; Inference concerning the mean when the covariance matrix is known - Characteristic functions - properties.

UNIT III

Sampling distribution of Covariance matrix - Wishart distribution, Properties of Wishart distribution- Inferences about a mean vector, Hotelling's T^2 and likelihood ratio Tests – Distribution of partial and multiple correlation coefficients under null case.

UNIT IV

Problem of classification- Criteria for good classification- procedures of classification into one of two populations with known probability distributions- classification into one of two known multivariate normal populations- probabilities of misclassification-classification into one of several multivariate normal populations – discriminat function.

UNIT V

Principal component Analysis- Introduction, Definition of principal components in the population, Extraction of principal components. Canonical correlations - Introduction, Canonical correlations and variates in the populations. Factor Analysis – Introduction - model, MLE's for random orthogonal factors and estimation of fixed factors.

Text Books :

1. Richard A. Johnson & Dean W. Wichern, Applied Multivariate Statistical Analysis, PHI Learning Private Limited, New Delhi (Sixth Edition) , 2012.
2. Anderson T.W, An Introduction to Multivariate Statistical Analysis, Wiley India Pvt.Ltd, New Delhi (Third Edition), 2011.

Reference Book:

1. Hair, Black, Babin & Anderson & Tatham, Multivariate Data Analysis, Pearson Education, (Fifth Edition) Reprint 2005.

Semester - III

Elective II : NUMERICAL ANALYSIS

Hours : 6
Code : Credits : 2

Objective : To improve the mathematical skills among the PG students

UNIT – I
Errors in Numerical Calculations – Introduction – Error and their Computations – Relative Error – A general error formula – Error in series approximation.

UNIT – II
Solution of Algebraic and Trancedental equations – Bisection Method – Method of False position – Iteration method – Newton-Raphson method – Horner's method.

UNIT – III
Solution of Linear system of equations – Gauss - elimination method – Gauss-Jordon method – LU decomposition – Iterative methods – Gauss - Jacobi and Gauss – Seidal methods – Inverse of a matrix by Gauss –Jordan method

UNIT – IV
Initial value problems for Ordinary Differential Equations – Introduction – Taylor series method – Euler's method – Modified Euler's method – Runge-Kutta methods – Predictor – Corrector methods – Adam's and Milne's method.

UNIT – V
Numerical solution for Partial Differential Equations – Introduction – Finite Difference approximations to derivatives – Laplace's equation – Parabolic equations – hyperbolic equations.

Text Books:
1. Dr. B.S. Grewal : " Numerical Methods in Engineering & Science", Khanna Publishers, New Delhi.
2. Dr.M.K. Venkataraman : "Numerical Methods in Science and Engineering", the National Publishing Company, Chennai.

Reference Books:
1. S.S. Sastry : "Introductory methods of Numerical Analysis", , PHI Learning Pvt Ltd, New Delhi.
2. P.Kandasamy, V.Thilagavathy, K.Gunavathi : "Numerical Methods",S.Chand& Company Ltd, New Delhi.

Semester IV

Core XI: ADVANCED OPERATIONS RESEARCH

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

Objective : To impact the knowledge and applications of Operations Research techniques.

UNIT I

Linear Programming Problem: Artificial variable Techniques – Two Phase method – Concept of Duality – Duality and Dual solution – Dual Simplex algorithm – Concepts and Simple problems

UNIT II

Non-linear programming: Introduction – General NLPP – Constrained optimization with equality and inequality constraints - Kuhn-Tucker conditions for General NLPP with m (< n) constraints – Graphical solution

UNIT III

Queuing Theory: Introduction –Problems from Single Server: Infinite Population Model (M/M/1): (FCFS/∞/∞) and Finite Population Model (M/M/1): (FCFS/N/∞) - Problems from Multi Server: Infinite Population Model (M/M/C): (FCFS/∞/∞) and Finite Population Model (M/M/C): (FCFS/N/∞)

UNIT IV

Simulation: Introduction - Advantages and Disadvantages – Monte-Carlo method – Algorithm – Application of Simulation in Inventory and Queuing problems. SNetwork analysis: Basic concepts – CPM and PERT calculations – Cost and Time Analysis (Crashing).

UNIT V

Decision Analysis: Decision making environment – Decisions under uncertainty – Decisions under Risk - EMV and EOL approach – Decision tree analysis.

Text Book

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

Books for Reference:

1. V. Sundaresan, K.S. Ganapathy Subramanian, K.Ganesan - Resource Management Techniques, A.R. Publications, Tamil Nadu, New Revised Edition, June 2000.

2. J.K. Sharma - Operations Research - Theory & Applications – Macmillan India Ltd, Third Edition, 2007.

Semester IV

Core XII: APPLIED REGRESSION ANALYSIS

Hours : 6
Code : Credits : 5

Objective : To impact the knowledge and applications of the various regression models.

UNIT I
Simple regression models with one independent variable, assumptions, estimation of parameters, standard error of estimator, testing the significance of regression coefficients, standard error of prediction.

UNIT II
Diagnostic checks and correction: graphical techniques, tests for normality, uncorrelatedness and homo-scedasticity.

UNIT III
Multiple regression: Standard Gauss Markov Setup. Least square (LS) estimation, Error and estimation spaces. Variance - Covariance of LS estimators. Estimation of error variance, case with correlated observations.

UNIT IV
Non-linear regression: Linearization transforms, their use & limitations, examination of nonlinearity initial estimates, iterative procedures for NLS grid search, Newton-Raphson, steepest descent.

UNIT V
Multiple logistic regressions, forward, backward method. Interpretation of parameters relation with categorical data analysis. Generalized Linear model: link functions such as Poisson and Binomial.

Text Book:

1. Montgomary, D. C., Peck, E. A., and Vining, G. G. (2012). Introduction to Linear Regression Analysis, Fifth Edition, John Wiley and Sons.

Reference Books:
1. Neter, J., Wasserman, W., and Kutner,M.H. (1989). Applied Linear Statistical Models, Second Edition, Irwin.
2. Draper, N. R. and Smith, H. (1998). Applied Regression Analysis, Third Edition, John Wiley and Sons.
3. Seber, G.E.F. and Wild, C.J. (2003). Nonlinear Regression, John Wiley and Sons.

Semester - IV

Elective III: ECONOMETRICS

Code: **Hours : 6**
Credits : 2

Objective: To develop the skills in applying Statistical tools in Econometrics.

Unit – I

Definition and Scope of Econometrics – Goals and Division of Econometrics – Specification and Estimation of the model – Evaluation of the parameter estimates – Forecasting power of the model – Desirable properties of an econometric model

Unit – II

Simple Linear Regression Model: OLS method of estimating the parameters - properties of OLS estimators
Multiple Regression: Model with two explanatory variables

UNIT – III

Auto correlation: Assumptions of serial independence – Sources and Consequences of Auto correlation – Tests for Auto correlation
Multi-collinearity: Meaning - Consequences of Multi-collinearity - Solutions for Multi-collinearity

UNIT – IV

Identification: The problem of identification – Formal rules for identification - Identifying restrictions - Simultaneous - Equation methods: Estimation of parameters – ILS, 2SLS, LIML and FIML methods of estimation

UNIT – V

Harrod – Domar Model: Planning strategies in India – Planning models – Mahalanobis model of Indian planning – One sector, Two sector and Four sector models – Similarities between Mahalanobis and Harrod – Domar Models

Text Books:

1. A. Koutsoyiannis, Theory of Econometrics, PALGRAVE, Replica Press Pvt. Ltd, India
2. Damodar N.Gujarati and Sangeetha, Basic Econometrics, Fourth Edition, Tata McGraw Hill Private Limited, New Delhi

Reference Books:

1. S.P.Singh, Anil K. Parashar & H.P.Singh, Econometrics and Mathematical Economics, S. Chand & Company Ltd, Ramnagar, New Delhi - 110 055.
2. J. Johnston, Econometric Methods (II Edition), International Student Edition, McGraw-

Hill Koga Kusha Ltd, Tokyo.

Semester – III

Core Practical – III : STATISTICS PRACTICAL – III

Code :

Hours : 6
Credits: 5

DESIGN OF EXPERIMENTS

1. Latin Square Design.
2. 2^3 factorial experiments.
3. 2^3 confounding factorial experiment.
4. Balanced Incomplete Block Design.

NUMERICAL ANALYSIS

5. Transcendental Method.
6. Newton Raphson Method.
7. Gauss elimination Method.
8. Gauss Jacobi Method.
9. Taylor Series.
10. Runge-Kutta Method.

MULTIVARIATE ANALYSIS

11. Hotelling's T^2 statistics – Testing for equality of means
12. Mahalanobis D^2 statistic - Testing for equality of means
13. Classification problem – Two multivariate normal populations with known & unknown Parameters
14. Principal component Analysis.

STATISTICAL INFERENCE –II (Testing of Hypothesis)

15. Critical regions and power curves concerning testing of hypothesis on the parameter of the Normal distribution.
16. Critical regions and power curves concerning testing of hypothesis on the parameter of Exponential distribution
17. SPRT of Binomial
18. SPRT of Normal
19. Non-parametric test: Kolmogorov-Smirnov test
20. Mann-Whitney U test

ADVANCED OPERATIONS RESEARCH

21. Simulation
22. Critical Path Method
23. Program Evaluation Review Technique
24. Queuing model M/M/1 (FCFS/N/∞)
25. Decision tree Analysis

Semester - IV

Core Practical – IV : STATISTICS PRACTICAL – IV
(Using R-Software)

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

1. Functions of Statistics : Diagrams (Multiple Bar, Pie-chart).
2. Descriptive Measures: Mean, Median, Mode, SD.
3. Relationship Measures: Correlation & Regression.
4. Calculation of Probabilities under Binomial Distribution.
5. Calculation of Probabilities under Poison Distribution.
6. Calculation of Probabilities under Normal Distribution.
7. Sample Selection under Simple Random Sampling.
8. Partial and Multiple Correlation.
9. Multiple Regression.
10. Fitting Linear Trend by Least Square method.
11. Confidence Interval for mean.
12. t-test for two means.
13. F-test for two variances.
14. Chi-square test for independence of attributes.
15. One-way ANOVA .
16. Two-way ANOVA.
17. 2^3-Factorial Design.
18. Estimation of mean vector and covariance matrices.
19. Factor Analysis.
20. Construction of control charts of Mean and Range.