Dr. M.G.R.
EDUCATIONAL AND RESEARCH INSTITUTE
DEEMED TO BE UNIVERSITY
University with Graded Autonomy Status
(An ISO 21001 : 2018 Certified Institution)
Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

Department of Mathematics

M.Sc – Statistics

Curriculum and Syllabus

2018 Regulations

(Both Offline and Online)

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M.Sc Statistics

Curriculum (Both Online and Offline)

2018 Regulations

I SEMESTER						
S.No	**Sub. Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	HMMS18001	Real Analysis & Linear Algebra	4	0	0	4
2	HMMS18002	Probability and Distributions	4	0	0	4
3	HMMS18003	Sampling Techniques	4	0	0	4
4	HMMS18004	Statistical Inference I	4	0	0	4
		TOTAL	**16**	**0**	**0**	**16**

II SEMESTER						
S.No	**Sub. Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	HMMS18005	Statistical Quality Control and Reliability	4	0	0	4
2	HMMS18006	Trend Analysis and Index numbers	4	0	0	4
3	HMMS18007	Numerical Methods	4	0	0	4
4	HMMS18008	Statistical Inference II	4	0	0	4
		TOTAL	**16**	**0**	**0**	**16**

III SEMESTER						
S.No	**Sub. Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	HMMS18009	Design of Experiments	4	0	0	4
2	HMMS18010	Advanced Optimization Techniques	4	0	0	4
3	HMMS18EXX	Elective I	4	0	0	4
4	HMMS18EXX	Elective II	4	0	0	4
		TOTAL	**16**	**0**	**0**	**16**

IV SEMESTER						
S.No	**Sub. Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	HMMS18011	Stochastic Processes and Applications	4	0	0	4
2	HMMS18012	Multivariate Analysis and Non parametric methods	4	0	0	4
3	HMMS18EXX	Elective III	4	0	0	4
4	HMMS18L01	Project	0	0	15	15
		TOTAL	**12**	**0**	**15**	**27**

LIST OF ELECTIVES						
S.No	**Sub. Code**	**Title of Subject**	**L**	**T**	**P**	**C**
1	HMMS18E01	Data Mining	4	0	0	4
2	HMMS18E02	Applied Regression Analysis	4	0	0	4
3	HMMS18E03	Survival Analysis	4	0	0	4
4	HMMS18E04	Statistics and Econometrics	4	0	0	4
5	HMMS18E05	Vital Statistics	4	0	0	4

Total No. of credits: 75

HMMS18001 **Real Analysis & Linear Algebra**

UNIT – I **12 Hours**

Continuity and Derivability of a real valued function – Uniform Continuity – Pointwise Convergence of sequence and series of functions – Uniform Convergence and its applications (without proof).

UNIT – II **12 Hours**

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

UNIT – III **12 Hours**

The Riemann Integral – Partitions and Sums – Upper and Lower R – Integrals – Riemann Integrability – Riemann's necessary and sufficient conditions for R – Integrability – Problems – Algebra of Integrable functions. Fundamental theorem of Integral Calculus – First and Second Mean Value Theorems.

UNIT- IV **12 Hours**

Vector Spaces, Subspaces, Linear Independence and Dependence – Basis and Dimension – Sum of subspaces - Coordinates.

UNIT –V **12 Hours**

Linear Transformation, The Algebra of Linear Transformations, Isomorphism, Representation of Transformations by Matrices – Linear Functionals.

References Books:

1. Walter Rudin (1976) *Principles of Mathematical Analysis*, Third Edition, Mcgraw Hill.
2. Apostol, T.M (1985) *Mathematical Analysis*, Narosa.
3. White, A.J (1968) *Real Analysis : An Introduction*, Addison Wesley Publishing Co.
4. Kenneth Hoffman, Ray Kunze (1996) *Linear Algebra*, Prentice Hall India.
5. Finkbeiner, D.T (1978) *Introduction to Matrices and Linear Transformations*, W.H.Freeman & Co.

HMMS18002 **Probability and Distributions**

UNIT - I **12 Hours**

Variables – Uni-variate Data, Frequency Distribution, Measures of Central Tendency, Mean – Median – Mode, Quartiles, Measures of Dispersion – The Range – Quartile Deviation –Standard Deviation, Relative Measures of Dispersion, Coefficient of Variation, Quartile Coefficient of Variation.

UNIT -II **12 Hours**

Axioms of Probability, Conditional probability, Total probability, Baye's Theorem, Random variable Probability mass function, Probability density function, Properties, Moments (Definition and simple problems).

UNIT- III **12 Hours**

Measures of Skewness & Kurtosis, Bi-variate data, Applications of Correlation: Karl Pearson's Coefficient of Correlation, Rank Correlation: Spearman's Rank Correlation, Linear Regression.

UNIT -IV **12 Hours**

Binomial, Poisson , Geometric ,Uniform ,Exponential, Normal distributions. Central Limit Theorem, Lindeberg-Levy Theorem, Cramer's Theorem

Unit – V **12 Hours**

Chebychev's Inequality.,Generalised Form of Bienaymc-Chebychev's Inequality. Weak Law of Large Numbers, Bernoulli's Law of Large Numbers, Khinchin's Theorem, Borel-CantelIi Lemma. *(Zero-One Law).*

Reference Books:

1. Gupta S.C., Kapoor V.K., *Fundamentals of Mathematical Statistics*, S.Chand & Co.,(2007).
2. Veerarajan T., *Probability, Statistics and, Random Processes*, Tata McGraw Hill Publishing Co., (2008).
3. Richard Johnson A., *Miller & Freund's Probability and statistics for Engineers (9th ed),* Prentice Hall of India, (2016).
4. Bhat,B.R. : Modern probability Theory, 3rd Edition, New Age India
5. 5. Rohatgi,V.K. : Introduction to Probability Theory and Mathematical Statistics

HMMS18003 **Sampling Techniques**

UNIT I - INTRODUCTION

Advantages of the sampling method – The Principal steps in a sample survey – the role of sampling theory – probability sampling – alternatives to probability sampling – use of the Normal distribution – Bias and its effects

UNIT II - SIMPLE RANDOM SAMPLING

Selection of Simple Random Sampling – Definition and Notation – properties of the estimates – variance of the estimates – confidence limits – random sampling with replacement – estimation of a ratio

UNIT III - STRATIFIED RANDOM SAMPLING

Notations – properties of estimates – estimated variance and confidence – limits – optimum allocation – estimation of sample size with continuous data – Stratified sampling for proportions – estimation of sample size with proportions

UNIT IV - SYSTEMATIC SAMPLING

Variance of the estimated mean – comparison of Systematic with stratified random sampling – populations in random order – population with linear trend – methods for population with linear trend – populations with periodic variation – Auto correlated populations – Natural Populations

UNIT V - CLUSTER SAMPLING

Reasons for Cluster Sampling – A Simple Rule – Cluster Sampling for proportions – Cluster units of unequal sizes – Sampling probability proportional to size – Selection with unequal probabilities with replacement – the optimum measure of size – sampling with unequal probabilities without replacement

Reference Books:

1. William G.Cochran (1977), Sampling Techniques third edition, John wiley & Sons
2. S.C Gupta and V.K.Kapoor (2001), Fundamentals of Applied Statistics third edition, Sultan Chand & Sons

HMMS18004 **Statistical Inference I**

Unit –I **12 Hours**

Characteristics of Estimators, Invariance Property of Consistent Estimators, Sufficient Conditions for Consistency, Efficient Estimators, Most Efficient Estimator'.

Unit –II **12 Hours**

Minimum Variance Unbiased (M.V.U.) Estimator, Sufficiency, Factorization Theorem (Neyman), Fisher-Neyman Criterion.

Unit –III **12 Hours**

Cramer-Rao Inequality, Minimum Variance Bound (MVB) estimator, Complete Family of Distributions. MVU and Blackwellisation. (Rao-Blackwell Theorem), MVUE

Unit –IV **12 Hours**

Methods or Estimation, Method of Maximum Likelihood Estimation., Method of Minimum Variance, Method of Moments, Invariance Property of MLE.

Unit –V **12 Hours**

Confidence Interval and Confidence Limits, Confidence Intervals for Large Samples.

References Books:

1. Rohatgi, V.K.: *An Introduction to Probability Theory and Mathematical Statistics* (Wiley Eastern).
2. Gupta S.C., Kapoor V.K., *Fundamentals of Mathematical Statistics*, S.Chand & Co.,(2007).
3. Milton and Arnold – *Introduction to probability and Statistics* (4th Edition)-TMH publication.
4. Goon AM, Gupta MK, Das Gupta B : *Outlines of Statistics* , Vol-II, the World Press Pvt. Ltd., Kolkata.

HMMS18005 **Statistical Quality Control and Reliability**

Unit –I **12 Hours**

Introduction, Basics of statistical quality control, Definition, Benefits of statistical quality control, Process control and product control ,Control limits, Specification limits and tolerance,limits . Control charts, control limits, Tools for S.Q.C. control charts for variables, $\bar{X}$ and R charts criterion for detecting lack of control in $\bar{X}$ and R charts, Interpretation of $\bar{X}$ and R charts ,Control chart for standard deviation

Unit –II **12 hours**

Control charts for attributes, control chart for fraction defective (p-chart), control chart for number of defectives (d-chart), control chart for number of defects per unit (c-chart) c-chart for variable sample size or u-chart

Unit – III **12 hours**

Natural tolerance limits and specification limits, acceptance sampling inspection plans, sampling inspection plans for attributes single sampling plan, double sampling plan, single sampling *vs.* double sampling plans, sequential sampling plan

Unit –IV **12 Hours**

Component reliability and hazard models, MTTF, Derivation of reliability function by Markov model, system reliability models in series and parallel

Unit –V **12 Hours**

K out of m systems, non- series parallel systems, maintainability function, Availability function, 2-unit parallel system with repair.

References Books:

1. Douglas C. Montgomery, Introduction to Statistical Quality Control, Wiley Eastern (2020)
2. Gupta S.C., Kapoor V.K., Fundamentals of Applied Statistics, S.Chand & Co.,(2007).
3. Arun kumar,Alka Chaudhary, Applied Statistics,Krishna Prakasan,(2009)
4. John T. Burr Elementary Statistical Quality Control, 2nd Edition, CRC Press (2004).
5. Balagurusamy.E, Reliability Engineering, Tata McGraw Hill Education Pvt Ltd., Thirteenth reprint,(2012)
6. Grant, E.L. and R.S. Leaven worth (2004)- Statistical Quality Control, 2nd edition, Mc-Graw Hill Book Co.

HMMS18006 **Trend Analysis and Index numbers**

Unit - I **12 Hours**

Components of Time series, trend, periodic changes, irregular (or random) component, Analysis of time series, Mathematical models for time series, uses of time series.

Unit - II **12 Hours**

Measurement of Trend, graphic method, method of semi-averages, method of curve fitting by principle of least squares, growth curves and their fitting, moving average method, approximation to moving averages

Unit – III **12 Hours**

Measurement of seasonal variations, method of simple averages, ratio to trend method, ratio to moving average method, link relative method, de-seasonalisation of data, measurement of cyclic variations

Unit – IV **12 Hours**

Auto-regression series first order auto-regression series (Markoff's series), second order auto-regression series (Yule's series), general auto-regression, Variate difference method

Unit – V **12 Hours**

Index numbers, construction of index numbers, Laspeyre's method, Paasche's method, Fisher method, Price index.

References Books:

1. Douglas. C. Montgomery, Cheryl Jennings, Murat Kuhalci. *Introduction to Time Series and Forecasting,* Second Edition, Wiley Eastern Pub.
2. A.K. Sharma, *Text Book of Index Number and Time Series*, Discovery publishing house,(2005)
3. Gupta S.C., Kapoor, V.K., *Fundamentals of Applied Statistics*, S. Chand & Co.,(2007).
4. Shumway & Stoffer (2011) *Time Series Analysis and its applications, with examples in R,* 3rd edition, Springer.
5. Brockwell & Davis (2016*) Introduction to Time Series and Forecasting*, 3rd edition, Springer.

HMMS18007 **Numerical Methods**

UNIT I **12 Hrs**

Curve fitting-Method of group averages-Principle of least square-Method of moments-Finite differences-Operators (Forward, Backward & Shifting) -Relationship between the operators

UNIT II **12 Hrs**

Gauss Elimination method – Gauss-Jordan method – Iterative methods – Gauss-Jacobi method – Gauss-Seidel method – Matrix Inversion by Gauss-Jordan method

UNIT III **12 Hrs**

Solution of Algebraic and Transcendental equations – Method of false position -Fixed point iteration method (single and multi variables)- Newton-Raphson method (single and multi variables)

UNIT IV **12 Hrs**

Newton forward and backward differences – Central differences – Stirling's and Bessel's formulae –Interpolation with Newton's divided differences – Lagrange's method

UNIT V **12 Hrs**

Numerical differentiation with interpolation polynomials – Numerical integration by Trapezoidal and Simpson's (both 1/3 rd & 3/8 th) rules – Two and three point Gaussian Quadrature formulae – Double integrals using Trapezoidal and Simpson's rules

Reference Books:

1. Veerarajan T., Numerical Methods, Tata McGraw Hill Publishing Co., (2007)
2. Sastry S.S., Introductory Methods of Numerical Analysis, Prentice Hall of India, (2012)

HMMS18008 **Statistical Inference II**

Unit –I **12 Hours**

Introduction, Statistical Hypothesis (Simple and-Composite),Test of a Statistical Hypothesis, Null Hypothesis ,Alternative Hypothesis ,Critical Region, Types of Errors ,level of Significance Power of the Test Steps in Solving Testing of Hypothesis Problem Optimum Tests Under Different Situations, Most Powerful Test (MP Test.) .Uniformly Most Powerful Test

Unit –II **12 Hours**

Neyman-Pearson lemma, Unbiased Test and Unbiased Critical Region, Optimum Regions and Sufficient Statistics, likelihood Ratio Test ,Properties of Likelihood Ratio Test.

Unit –III **12 Hours**

Test for the Mean of a Normal Population, Test for the Equality of Means of Two Normal Populations, Test for the Equality of -Means of Several Normal Populations, Test for the Variance of a Normal Population, Test for Equality of Variances of two Normal populations, Test for the Equality of Variances of several Normal Populations

Unit –IV **12 Hours**

Non-parametric Methods, Advantages and Disadvantages of N'P' Methods over Parametric Methods Basic Distribution , Wald-Wolfowitz Run Test ,Test for Randomness ,Median Test Sign Test Mann-Whitney-Wilcoxon U-test

Unit –V **12 Hours**

Sequential Analysis, Sequential Probability Ratio Test (SPRT), Operating Characteristic (O.C.) Function of S.P.R.T, Average Sample Number (A.S.N.).

References Books:

1. Rohatgi, V.K.: An Introduction to Probability Theory and Mathematical Statistics (Wiley Eastern).
2. Gupta S.C., Kapoor V.K., Fundamentals of Mathematical Statistics, S.Chand & Co.,(2007).
3. Milton and Arnold – Introduction to probability and Statistics (4th Edition)-TMH publication.
4. Goon AM, Gupta MK, Das Gupta B : Outlines of Statistics , Vol-II, the World Press Pvt. Ltd., Kolkata.

HMMS18009 **Design of Experiments**

Unit I **12 Hours**

Anova, Cochran's theorem (Statement only) one way classification table, one way classification table with data random effect.

Unit II **12 Hours**

2- way classification (one observation per cell), 2- way classification (one observation per cell random effect model), anova for 2 way classified data with m observations per cell, anova for 3 way classification.

Unit III **12 Hours**

Design of experiments, Introduction, terminology, three principles of experimental design, local control, plot size, CRD, RBD, Efficiency of RBD relative to CRD, Estimation of missing values in RBD, LSD, Advantages and disadvantages.

Unit IV **12 Hours**

Statistical analysis of m X m LSD for one observation per experimental unit, examples, Estimation of missing values in LSD, ANACOVA-Formation of table and examples only

Unit V **12 Hours**

Factorial experiments, advantages, 2^n factorial design, Yate's method for 2^2 experiments, Yate's method for 2^3 experiments, BIBD Analysis.

References Books:

1. Douglas C. Montgomery, Design and analysis of experiments, 7th ed., John Wiley & sons, (2020)
2. Gupta S.C., Kapoor V.K., Fundamentals of Applied Statistics, S. Chand & Co.,(2007).
3. Veerarajan T., Probability, Statistics and Random processes, Tata McGraw Hill Pvt. Ltd.,
4. John T. Burr Elementary Statistical Quality Control, 2nd Edition, CRC Press (2004).
5. Das, M.N. and Giri, N. (1979) : Design and analysis of experiments, Wiley Eastern.

HMMS18010 Advanced Optimization Techniques

UNIT I **12 Hours**

Introduction to Optimization – Classical Optimization Theory – Unconstrained Problems – Necessary and Sufficient Conditions – The Newton-Raphson Method – Constrained Problems Equality Constraints – Inequality Constraints.

UNIT II **12 Hours**

Introduction to Linear Programming – Two-Variable LP Model – Graphical Solution – Solutions of Maximization and Minimization Models – Simplex Method – Computational Details of the Simplex Algorithm - M-Method –Two-phase MethodDegeneracy.

UNIT III **12 Hours**

Transportation Model – Definition – Determination Of The Starting Solution – Iterative Computations of the Transportation Algorithm- Simplex Method Explanation of the Method of Multipliers – The Assignment Model – The Hungarian Method – Simplex Explanation of the Hungarian Method – The Transshipment Model .

UNIT IV **12 Hours**

Integer Linear Programming – Illustrative Applications – Branch-and-Bound Algorithm – Cutting Plane Algorithm – Traveling Salesperson Problem – B&B Solution Algorithm.

UNIT V **12 Hours**

Deterministic Dynamic Programming – Recursive Nature of Computations in DP – Forward and Backward Recursion – Cargo Loading Model – Workforce Size Model – Equipment Replacement Model – Investment and Inventory Models .

References Books:

1. Taha, H.A (2002),Operations Research- An Introduction, Prentice Hall India.
2. Hillier, Lieberman (2001)An Introduction to Operations Research, McGrawHill,
3. Wagner, H.M (2000)Principles of Operations Research, Prentice-Hall India,.
4. Nocedal, Wright, (2003)Numerical Optimization, Springer.
5. Gupta, P.K Man Mohan (2001)Problems in Operations Research, Sultan Chand.

HMMS18011 Stochastic Processes and Applications

UNIT I **12 Hrs**

Generating Function: Mean and Variance, Generating Function of Bivariate Distribution, Laplace Transform, Some Important Properties of Laplace Transforms, Inverse Laplace Transform ,Laplace (Stieltjes) Transform of a Probability Distribution or Random Variable ,The Laplace Transform of the Distribution Function in Terms of the Density Function

UNIT II **12 Hrs**

Markov chains Transition Matrix ,Order of a Markov Chain, Markov Chains as Graphs, Higher Transition Probabilities, Markov-Bernoulli Chain Classification of States: Determination of Higher Transition Probabilities Aperiodic Chain: Limiting Behaviour, Stability of A Markov System ,Computation of the Equilibrium Probabilities ,Reducible Chains ,Finite Reducible Chains with a Single Closed Class ,Chain with One Single Class of Persistent Non-null, Aperiodic States ,Absorbing Markov Chains

UNIT III **12 Hrs**

Markov Processes with Continuous State Space Introduction: Brownian Motion Wiener Process, Differential Equations for A Wiener Process, Kolmogorov Equations ,First Passage Time Distribution for Wiener Process, Distribution of the First Passage Time to a Fixed Point ,Ornstein-Uhlenbeck Process

UNIT IV **12 Hrs**

Renewal Processes and Theory, Renewal Process, Renewal Process in Discrete Time
Renewal Theory in Discrete Time, Renewal Processes in Continuous Time ,Renewal Function and Renewal Density Renewal Equation , Stopping Time, Wald's Equation, Renewal Theorem, Elementary Renewal Theorem, Applications ,Renewal Theorems (Blackwell's and Smith's)

UNIT V **12 Hrs**

Applications in Stochastic Models, Queueing Systems and Models, Queueing Processes ,Steady State Distribution ,Little's Formula , Birth and Death Processes in Queueing Theory. The Model M/M/S ,Model M/M/S/S : Erlang Loss Model, Non-Markovian Queueing Models ,Queues with Poisson Input: Model M/G/1 ,Pollaczek-Khinchine Formula ,Busy Period , Markov Chain Monte Carlo (MCMC) simulation.

Reference Books:

1. Medhi, J ,Stochastic Processes, New Academic Science, 2009.
2. Sheldon Ross, Simulation, Academic Press fifth edition, 2013.
3. Sheldon M. Ross · Stochastic Processes, Wiley Eastern,1995

HMMS18012 Multivariate Analysis and Non parametric methods

UNIT I **12 Hrs**

Bivariate Normal Distribution (BVN): p.d.f. of BVN, properties of BVN, marginal and conditional p.d.f. of BVN. Multivariate Data: Random Vector: Probability mass/density functions, Distribution function, Mean vector & Dispersion matrix, Marginal & Conditional distributions.

UNIT II **12 Hrs**

Multivariate Normal distribution and its properties. Sampling distribution for mean vector and variance- covariance matrix. Multiple and partial correlation coefficient and their properties.

UNIT III **12 Hrs**

Nonparametric Tests: Introduction and Concept, Parametric versus non-parametric tests, advantages and disadvantages of non-parametric tests. Test for randomness based on total number of runs, Empirical distribution function,

UNIT IV **12 Hrs**

Kolmogrov Smirnov test for one sample, Sign tests- one sample. Kolmogrov Smirnov two samples test.

UNIT V **12 Hrs**

Wilcoxon signed rank tests, Wilcoxon-Mann- Whitney U test, Kruskal-Wallis test.

Reference Books:

1. Bhuyan, KC., Multivariate Analysis and its Applications, New Central Book Agency (P) Limited
2. Gun, A.M., Gupta, M.K. and Das gupta, B.: An Outline of Statistical Theory, Vol.II, (4thed.), World Press.
1. Johnson, R.A. and Wichern, D.W. (2007): Applied Multivariate Analysis, 6thEdn., Pearson & Prentice Hall.
4. Anderson, T.W. (2003): An Introduction to Multivariate Statistical Analysis, 3rdEdn., John Wiley

HMMS18E01 **Data Mining**

UNIT I **12 Hrs**

Data Mining, Introduction, Types of Data and patterns that can Be Mined, Classification and Regression for Predictive Analysis, Cluster Analysis, Outlier Analysis, Technologies Used-Statistics, Machine, Database Systems and Data Warehouses, Information Retrieval

UNIT II **12 Hrs**

Data Preprocessing, Data Quality: Why Preprocess the Data, Major Tasks in Data Preprocessing Data Cleaning ,Missing Values, Noisy Data ,Data Cleaning as a Process, Data Integration ,Data Reduction ,Data Reduction Strategies ,Principal Components ,Attribute Subset Selection ,Regression and Log-Linear Models: Parametric. Model evaluation and selection.

UNIT III **12 Hrs**

Classification, Decision Tree Induction, Bayes Classification Methods, Rule-Based Classification Using IF-THEN Rules for Classification, Rule Extraction from a Decision Tree .Rule Induction Using a Sequential Covering Algorithm

UNIT IV **12 Hrs**

Classification: Advanced Methods Bayesian Belief Networks, Classification by Back propagation Support Vector Machines, Classification Using Frequent Patterns, *k*-Nearest-Neighbor Classifiers, Case-Based reasoning.

UNIT V **12 Hrs**

Outlier Analysis, Types of Outliers Challenges of Outlier Detection, Outlier Detection Methods, Supervised, Semi-Supervised, and Unsupervised Methods .Statistical Methods, Proximity-Based Methods, and Clustering-Based Methods, Statistical Approaches, Parametric Methods Nonparametric Methods, Grid-Based Method, Density-Based Outlier Detection, Clustering-Based Approach, Classification-Based Approaches.

Reference Books:

1. Micheline Kamber, Jian Pei, Jiawei Han, Data Mining Concepts and Techniques, Third Edition,Morgan Kaufmann Publishers, 2012.
2. Florin Gorunescu, Data mining concepts models and techniques, Springer Verlag ,2011.
3. Xindong Wu, Vipin Kumar, The Top Ten Algorithms in Data Mining, CRC press, 2009.

HMMS18E02 Applied Regression Analysis

Unit-I SIMPLE REGRESSION

The Linear Model and Assumptions -Least Squares Estimation -Predicted Values and Residuals -Analysis of Variation in the Dependent - Precision of Estimates - Tests of Significance and Confidence Intervals - Regression Through the - Models with Several Independent Variables - Violation of Assumptions.

Unit-II MATRICES

Basic Definitions - Special Types of Matrices - Matrix Operations - Geometric Interpretations of Vectors. - Linear Equations and Solutions - Orthogonal Transformations and Projections – Eigen values and Eigenvectors -Singular Value Decomposition

Unit-III MULTIPLE REGRESSION IN MATRIX NOTATION

The Model -The Normal Equations and Their Solution - The Y and Residuals Vectors - Properties of Linear Functions of Random Vectors - Properties of Regression Estimates Matrix Formulae .

Unit-IV ANALYSIS OF VARIANCE AND QUADRATIC FORMS

Introduction to Quadratic Forms - Analysis of Variance - Expectations of Quadratic - Distribution of Quadratic - General Form for Hypothesis Testing - The General Linear Hypothesis -Special Cases of the General Form - A Numerical Example - Computing Q from Differences in Sums of Squares - The R-Notation to Label Sums of Squares - Example: Sequential and Partial Sums of Squares

Unit-V FIVE INDEPENDENT VARIABLES

Spartina Biomass Production in the Cape Fear Estuary- Regression Analysis for the Full Model-The Correlation Matrix-Multiple Regression Results: Full Model-Simplifying the Model-Results of the Final Model.

Text Book

1. John O. Rawlings,Sastry G. Pantula, David A. Dickey - Applied Regression Analysis – Springer second edition
2. Sanford Weisberg - Applied Linear Regression - Wiley Fourth Edition

HMMS18E03 Survival Analysis

Unit-I Survival Analysis

Introduction - Survival analysis -Censored Data-Terminology - Goals of survival analysis - Descriptive measures of survival

Unit-II Kaplan-Meier Survival Curves

Introduction -Kaplan-Meier Survival Curves -The Log-Rank Test - General features of KM curves-The log-rank test for two groups -The log-rank test for several groups- Alternatives to the log rank test-Confidence intervals for KM curves

Unit-III The Cox Proportional Hazards Model

Cox PH - The formula for the Cox PH model- Why the Cox PH model is - ML estimation of the Cox PH model - Computing the hazard - Interval estimation: interaction- Adjusted survival curves using the Cox PH model - The meaning of the PH assumption - The Cox likelihood - Using age as the time scale

Unit-IV Evaluating the Proportional Hazards Assumption

Backround- Checking the proportional hazards assumption-Graphical approach- log–log plots - observed versus expected plots-The goodness-of-fit (GOF) -Testing approach-Assessing the PH assumption using time dependent covariates

Unit-V The Stratified Cox

Stratified Cox - General Stratified Cox (SC) Model -The No-Interaction Assumption - How to Test It -Second Example Involving -Several Stratification Variables-A Graphical View of the Stratified Cox Approach-The Stratified Cox Likelihood

Text Book

1. David G. Kleinbaum,Mitchel Klein-Survival Analysis – Springer Third Edition
2. ELISA T. LEE , JOHN WENYU WANG -Statistical Methods for Survival Data Analysis- A JOHN WILEY & SONS, INC., PUBLICATION
3. JERALD F. LAWLESS -Statistical Models and Methods for Lifetime Data - A JOHN WILEY & SONS, INC., PUBLICATION

HMMS18E04 **Statistics and Econometrics**

UNIT-I

Statistics. Descriptive Statistics. Inferential Statistics: Population and Sample. Variable, Observation. and Data Set. Quantitative Variable: Discrete and Continuous Variable. Qualitative Variable. Nominal, Ordinal, Interval, and Ratio Levels of Measurement. Summation Notation. Computers and Statistics.

UNIT-II

Raw Data. Frequency Distribution for Qualitative Data. Relative Frequency of a Category. Percentage. Bar Graph. Pie Chart. Frequency Distribution for Quantitative Data. Class Limits, Class Boundaries, Class Marks, and Class Width. Single-Valued Classes. Histograms. Cumulative Frequency Distributions. Cumulative Relative Frequency Distributions. Ogives. Stem-and-Leaf Displays.

UNIT-III

Measures of Central Tendency. Mean, Median, and Mode for Ungrouped Data. Measures of Dispersion. Range, Variance, and Standard Deviation for Ungrouped Data. Measures of Central Tendency and Dispersion for Grouped Data. Chebyshev's Theorem. Empirical Rule. Coefficient of Variation. Z Scores. Measures of Position: Percentiles, Deciles, and Quartiles. Interquartile Range. Box-and-Whisker Plot.

UNIT-IV

Experiment, Outcomes, and Sample Space. Tree Diagrams and the Counting Rule. Events, Simple Events, and Compound Events. Probability. Classical, Relative Frequency and Subjective Probability Definitions. Marginal and Conditional Probabilities. Mutually Exclusive Events. Dependent and Independent Events. Complementary Events. Multiplication Rule for the Intersection of Events. Addition Rule for the Union of Events. Bayes' Theorem. Permutations and Combinations. Using Permutations and Combinations to Solve Probability Problems.

UNIT-V

Random Variable. Discrete Random Variable. Continuous Random Variable. Probability Distribution. Mean of a Discrete Random Variable. Standard Deviation of a Discrete Random Variable.

Text Book

1. LARRY J. STEPHENS-THEORY AND PROBLEMS OF BEGINNING STATISTICS- SCHAUM'S OUTLINE SERIES McGRAW-HILL
2. Dominick Salvatore, Derrick Reagle-Statistics and Econometrics- SCHAUM'S OUTLINE SERIES McGRAW-HILL.

HMMS18E05 **Vital Statistics**

UNIT I **12 Hrs**

Introduction, uses of vital statistics, Methods of obtaining vital statistics measurement of population rates and ratios of vital events measurement of mortality, Crude death rate (C.D.R.) Specific death rates (S.D.R.) Infant mortality rate (I.M.R.) , Standardized death rates

UNIT II **12 Hrs**

Mortality table (or life table), stationary population stable population, central mortality ,force of mortality, Assumptions, Descriptions and construction of life table, Uses of life tables, Abridged life table.

UNIT III **12 Hrs**

Reed Merrell method, Greville's method, King's method, Fertility, Crude birth rate (C.B.R.), General fertility rate (G.F.R.) Specific fertility rate (S.F.R.) Total fertility rate (T.F.R.).

UNIT IV **12 Hrs**

Measurement of population growth, Pearl's vital index, Gross reproduction rate (G.R.R.),Net reproduction rate (N.R.R.)

UNIT V **12 Hrs**

Graduation of mortality rates, Makeham's graduation formula, Gompertz Makeham formula for mortality, Makeham's second law of mortality.

Reference Books:

1. Gupta S.C., Kapoor V.K., Fundamentals of Applied Statistics, S. Chand & Co.,(2007).
2. A.K.Sharma, Textbook of Business Statistics (Unit IV),DPH New Delhi, 2005.