



Re-Accredited 'B++' 2.86 CGPA by NAAC

VEER NARMAD SOUTH GUJARAT UNIVERSITY

University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.

વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી

યુનિવર્સિટી કેમ્પસ, ઉદ્ધના-મગદલા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.

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-: પરિપત્ર :-

વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન આંકડાશાસ્ત્ર (Statistics) કોર્સ ચલાવતી તમામ કોલેજોનાં આચાર્યશ્રીઓ તથા વિભાગીય વડાશ્રીને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૪-૨૫ થી અમલમાં આવનાર M.Sc. Statistics (Sem-3 and 4) નો & M.Sc. Applied Statistics (Sem-3 and 4) નો અભ્યાસક્રમ આંકડાશાસ્ત્ર વિષયની અભ્યાસસમિતિનાં ચેરમેનશ્રીએ અભ્યાસ સમિતિ વતી મંજૂર કરી વિજ્ઞાન વિદ્યાશાખાને કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાનાં અધ્યક્ષશ્રીએ વિજ્ઞાન વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ વિજ્ઞાન વિદ્યાશાખા વતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણને એકેડેમિક કાઉન્સિલની તા.૦૧/૦૩/૨૦૨૪ ની સભાનાં ઠરાવ ક્રમાંક:૧૦૪ અન્વયે માન.કુલપતિશ્રીને આપેલ સત્તા અંતર્ગત માનનીય ઈ.ચા.કુલપતિશ્રી ધ્વારા મંજૂર કરેલ છે. જેની આથી જાણ કરવામાં આવે છે.

(બિડાણ:ઉપર મુજબ)

ક્રમાંક : એસ./આંકડાશાસ્ત્ર/પરિપત્ર/૧૦૦૭૦/૨૦૨૪
તા.૧૪-૦૫-૨૦૨૪

Wife
કુલસચિવ

પ્રતિ,

- ૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન આંકડાશાસ્ત્ર કોર્સ ચલાવતી તમામ કોલેજોનાં આચાર્યશ્રીઓ. તથા વિભાગીય વડાશ્રી.આપશ્રીની કોલેજ/વિભાગના સંબંધિત શિક્ષકોને જાણ કરી અમલ કરવા સારું.
- ૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા.
- ૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.
.....તરફ જાણ તેમજ અમલ સારું.

Syllabi
of
M. Sc. (Applied Statistics)
Semester-III
AS PER NEP 2020

To be implemented from the Academic Year 2024-2025.

UNDER THE FACULTY OF SCIENCE
OF VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

COURSES	NO.	TILTE	HRS/WEEK	EXAM SCHEDULE			TOTAL MARKS	CREDIT
				DURATION (HRS)	INTERNAL MARKS	EXTERNAL MARKS		
CORE-I	301	STATISTICAL INFERENCE-III	4	3	30	70	100	4
CORE-II	302	APPLIED REGRESSION ANALYSIS	4	3	30	70	100	4
CORE-III	303	SAMPLING THEORY -II	4	3	30	70	100	4
ELECTIVE-I	3041	STATISTICAL SIMULATION	4	3	30	70	100	4
ELECTIVE-II	3042	DATA MINING						
ELECTIVE-III	3043	STOCHASTIC PROCESS						
PRACTICAL BASED ON 301 TO 3044 USING EXCEL, JAMOVI& SPSS	305	PRACTICAL PAPER -III	12	10-15	50	100	150	6
SKILL BASED ELECTIVE COURSE	306	STATISTICAL COMPUTING USING SPSS	2	2	20	30	50	2
TOTAL HRS. FOR STUDENS			30		190	410	600	24
TOTAL HRS. FOR THE DEPTT.			26(Fixed for theory paper)+12/batch of practical =26+(12*No. of batches)					

NOTE: EXAM OF "SKILL BASED ELECTIVE COURSE' BE TAKEN ON COMPUTERS

Core-I

Course: 301: Statistical Inference-III

Unit-I

Introduction:

- (i) Introduction of Non-Parametric Test, Assumptions and its Applications,
- (ii) Difference Between Parametric Tests and Non-Parametric Tests
- (iii) Scale of Measurements and Selection Criteria of different Nonparametric Tests.

Unit-II

Quick overview of the following:

- **One population Test**
 - (i) The Binomial Test
 - (ii) The Chi-square Test
 - (iii) Kolmogorov-Smirnov Test
 - (iv) Run Test
- **Two Population Test**
 - (i) Rank Sum Test/Mann-Whitney U Test
 - (ii) McNemar's Test
 - (iii) Kolmogorov-Smirnov Test
 - (iv) Wilcoxon Signed rank test
 - (v) Spearman rank correlation coefficient
- **K Population case:**
Chi square test for K independent sample

Unit-III

- **Two Population Test (For Independent samples)**
 - (i) The Walsh Test
 - (ii) Fisher exact probability test
 - (iii) Median Test
- **Non-parametric correlation and Kendall-Theil-Sen Regression**

Unit-IV

- K Population Case :**
- **Independent samples:**
 - (i) Kruskal-Wallis Test
 - (ii) Kendall's W Test
 - (iii) Extension of Median Test
 - (iv) Jonkheere-Tespstra Test
 - **Related Samples:**
 - (i) Cochran's Q Test
 - (ii) Friedman Test
 - (iii) Kendall's W Test
 - **Post Hoc Tests:**
 - (i) Dunn Test
 - (ii) Dunn Control Test
 - (iii) Steel Dwass Test
 - (iv) Nemenyi Test

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Core-II

Course: 302: Applied Regression Analysis

UNIT I:

Introduction:

- Nature of Regression Analysis
- Uses and Interpretation of Regression

Simple Linear Regression

- Ordinary Least Squares Method of Estimation
- The Classical Linear Regression Model
- Properties of Least-Squares Estimators: The Gauss–Markov Theorem
- Confidence Intervals and t -Tests: The Intercept, Slope, Prediction, Fitted Values
- The Coefficient of Determination, R^2
- The Residuals
- Estimation by Maximum Likelihood.

Unit II:

Multiple Linear Regression (Three variable Regression model)

- The Multiple Linear Regression Model
- Predictors and Regressors
- Ordinary Least Squares and its properties
- Confidence Intervals and t -Tests: The Intercept, Slope, Prediction, Fitted Values
- The Coefficient of Determination, R^2 and adjusted R^2
- The Residuals and Residual Analysis
- Estimation of the parameters by Method of Maximum Likelihood

The general linear model:

- General form of the model: Gauss Markov linear model (GMLM) and Generalised Gauss Markov Linear Model (GGMLM).
- Normal Equations and least squares estimates
- The coefficient of Determination, Normality assumption about error term, Statistical Inference under normality assumption.
- Estimation of the parameters by Method of Maximum Likelihood

UNIT III:

Model Adequacy Checking:

- Introduction
- Residual Analysis
- Detection and treatment of Outliers
- Lack of fit of the Regression Model

Quadratic forms:

- Introduction and distribution of Quadratic forms
- Estimation of scale parameter in the general linear model by quadratic functions.

UNIT IV:

Testing and Analysis of Variance

- General Form for Hypothesis Testing
- Special Cases of the General Form
- General Likelihood Ratio Tests

UNIT-V:

Binomial and Poisson Regression

- Distributions for Counted Data : Bernoulli Distribution, Binomial Distribution, Negative Binomial distribution and Poisson Distribution.
- Regression Models for Counts:
 - Binomial Regression
 - Poisson Regression
 - Negative Binomial Distribution

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Core-III
Course 303: Sampling Theory -II

UNIT I:

➤ **Methods of estimation in sampling:**

Ratio method of estimation -Ratio estimator, unbiased ratio estimator and almost unbiased ratio estimator, Product method of estimation, Regression method of estimation, Difference estimator

➤ **Systematic Random Sampling: -**

Introduction, Sample Selection Procedures, Advantages and Disadvantages, Estimation of mean, total and proportion. Sampling Variance, Comparison of Systematic with Simple Random Sampling, and Stratified Random Sampling, Interpretation Systematic Sampling, Two-dimensional Systematic Sampling.

UNIT II:

➤ **Single-Stage Cluster Sampling: Clusters of Equal Sizes**

Reasons for Cluster Sampling, A Simple Rule, Comparisons of Precision Made from Survey Data, Variance in Terms of Intracluster Correlation, Variance functions, A Cost Function, Cluster Sampling for Proportions

➤ **Single-Stage Cluster Sampling: Clusters of Unequal Size**

Cluster Units of Unequal Sizes, Sampling with Probability Proportional to Size, Selection with Unequal Probabilities with Replacement, The Optimum Measure of Size, Relative Accuracies of Three Techniques, Sampling with Unequal Probabilities Without Replacement, The Horvitz-Thompson Estimator, Brewer's Method, Murthy's Method, Methods Related to Systematic Sampling, The Rao, Hartley, Cochran Method, Numerical Comparisons, Stratified and Ratio Estimates

UNIT III:

➤ **Sub-sampling With Units of Equal Size**

Two-stage sampling, finding means and variances in two-stage sampling, Variance of the estimated mean in two-stage sampling, sample estimation of the variance, the estimation of proportions, optimum sampling and sub sampling fractions, estimation of m_{opt} from a pilot survey, three-stage sampling.

➤ **Sub-sampling With Units of Unequal sizes**

Introduction, sampling methods when $n = 1$, sampling with probability proportional to estimated size, summary of methods form $n = 1$, sampling methods when $n > 1$, two useful results, units selected with equal probabilities: unbiased estimator, units selected with equal probabilities: ratio to size estimate, units selected with unequal probabilities with replacement: unbiased estimator, units selected without replacement, comparison of the methods

UNIT IV:

➤ **Double Sampling**

Description of the Technique, Double Sampling for Stratification, Optimum Allocation, Estimated Variance in Double Sampling for Stratification, Double Sampling for Analytical Comparisons, Regression Estimators, Optimum Allocation and Comparison with Single Sampling, Estimated Variance in Double Sampling for Regression, Ratio Estimators, Repeated Sampling of the Same Population Sampling on Two Occasions, Sampling on More than Two Occasions, Simplifications and Further Developments.

➤ **Sources of Error in Surveys**

Introduction, Effects of Nonresponse, Types of Nonresponses, Call – Backs, A mathematical model of the effects of call backs, Optimum Sampling Fraction Among the Non-respondents, Adjustment for Bias without call backs, A mathematical model for errors of measurement, Effect of constant bias.

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Elective -I
Course 3041: Statistical Simulation

UNIT I:

- Statistic simulations: generating random variables, simulating normal, gamma and beta random variables. Comparison of algorithms to generate random variables. Generating random variables from failure rates.

UNIT II:

- Simulating multivariate distributions, MCMC methods and Gibbs sampler, simulating random fields, simulating stochastic process. Variance reduction technique: importance sampling for integration, control variates and antithetic variables.

UNIT III:

- Simulating a non-homogeneous Poisson process, Optimization using Monte Carlo methods, simulated annealing for optimization. Solving differential equations by Monte Carlo methods.

UNIT IV:

- Jackknife and Bootstrap: Bootstrap methods, re-sampling paradigms, bias and standard errors, Bootstrapping for estimation of sampling distribution. Confidence intervals, variance stabilizing transformation, bootstrapping in regression and sampling from finite populations.

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Elective –II
Course 3042: Data Mining

UNIT I: Introduction to Data Mining

- Introduction to Data mining
- Types of data mining techniques
- Process of data mining
- Data Pre-processing
- Application of data mining
- Exploratory data analysis (EDA)

UNIT II: Supervised Learning

- Introduction to Classification
- Multiple Linear Regression/Stepwise Regression
- Logistic Regression
- K-nearest neighbours (KNN)
- Bayes classifier
- Nearest neighbour classifier
- Decision tree algorithms (e.g., ID3, C4.5, CART)
- Ensemble Methods: Tree based algorithm (TBA), Random Forest, Bagging and Boosting techniques, Gradient Boosting Machines

UNIT III: Unsupervised Learning

- Introduction to Clustering
- Clustering procedures
- Association Rules
- Self-organizing map

UNIT IV: Optimization

- Neural Network
- Genetic Algorithm

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4. The elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, and Jerome Friedman, 2nd edition, Springer, 2009.
5. Data Mining: Practical Machine Learning Tools and Techniques, 4th Edition, Ian H. Witten, Eibe Frank, Mark A. Hall, Christopher J. Pal, Elsevier (Morgan Kaufmann)
6. Introduction to Data Mining eBook: Global Edition, Pang-Ning Tan, Michael Steinbach, Vipin kumar , Anuj Karpathe, Pearson Education, 2019, M03 4, ISBN: 0273775324, 9780273775324
7. Data Mining: The Text Book, Charu C. Aggarwal, Springer

Elective -III
Course 3043: Stochastic Process

UNIT I:

- Stochastic Process, Markov Process and Markov chain.
- Markov chain with finite and countable state space, limiting behaviour of n-step transition probabilities, stationary process.

UNIT II:

- Markov Processes in continuous time (Poisson Process, Birth and death processes), Classification of states of a Markov chain.
- Random walks, Gambler's ruin.

UNIT III:

- Queuing Theory: Definition, Characteristics of a queuing system, Poisson Process and Exponential distribution, Classification of queues, Birth model, Death model, Birth death model.

UNIT IV:

- Detailed study of M/M/1 and M/M/C queuing models.

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11. Donald Gross, John F. Shortle, James M. Thompson, and Carl M. Harris (2019): "Fundamentals of Queuing Theory" by Donald Gross, John F. Shortle, James M. Thompson, and Carl M. Harris , Wiley, 5th Edition, ISBN: 9781119493604

Course 305 : Practical Paper –III

Based on Theory Paper 301 to 304

SKILL BASED ELECTIVE COURSE
Course 306: Statistical Computing Using SPSS

UNIT I:

SPSS Introduction :

- Starting SPSS
- Types of Data
- Levels of Measurement
- Missing Values
- Important Files // database files

Data Management

- Selecting Cases
- Standardizing Data

Data Transformation

- Transformation of Data
- Split File
- Variable and Value Labels
- Recode Variables/Visual Binning
- Random Sample of the Data
- Creating a Population Variable
- Multi Response

UNIT II:

• **Basic Data Analysis**

- Descriptive Statistics
- Frequency Tables/Cross Tabs
- Parametric test
- Nonparametric test
- Correlation & Regression

REFERENCES

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Syllabi
of
M. Sc. (Applied Statistics)
Semester-IV
AS PER NEP 2020

To be implemented from the Academic Year 2024-2025.

UNDER THE FACULTY OF SCIENCE
OF VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

COURSES	NO.	TILTE	HRS/ WEEK	EXAM SCHEDULE			TOTAL MARKS	CRE DIT
				DURATION (HRS)	INTERNAL MARKS	EXTERNAL MARKS		
CORE-I	401	OPERATIONS RESEARCH II	4	3	30	70	100	4
CORE-II	402	APPLIED DESIGN OF EXPERIMENTS	4	3	30	70	100	4
CORE-III	403	ECONOMETRICS	4	3	30	70	100	4
ELECTIVE-I	4041	BIOSTATISTICS & CLINICAL RESEARCH	4	3	30	70	100	4
ELECTIVE-II	4042	ECONOMICS & BUSINESS STATISTICS						
ELECTIVE-III	4043	PROJECT/ DISSERTATION						
PRACTICAL BASED ON 301 TO 3044 USING EXCEL, JAMOVI, SPSS & R	405	PRACTICAL PAPER -IV	12	10-15	50	100	150	6
SKILL BASED ELECTIVE COURSE	406	PROGRAMMING LANGUAGE 'R'	2	2	20	30	50	2
TOTAL HRS FOR STUDENS			30		190	410	600	24
TOTAL HRS FOR THE DEPTT.			26(Fixed for theory paper)+12/batch of practical+ 4 hrs /project group/dissertation =26+(12*No. of practical batches) +(4*No. of project groups/dissertations)					

➤ **NOTE: EXAM OF "SKILL BASED ELECTIVE COURSE'
BE TAKEN ON COMPUTERS**

Core-I
Course 401: Operations Research II

UNIT I:

- Sensitivity Analysis:
 - Basic concepts
 - Changes in the coefficient of objective function
 - Changes in the components of vector b and of Matrix A
 - Addition / Deletion of variable in the problem
 - Addition / Deletion of constraint in the problem

UNIT II:

- Integer Programming:
 - Introduction
 - All and mixed integer programming (IPP) problems
 - Gomory's all-IPP algorithm
 - The branch and bound technique
 - Zero - one programming

UNIT III:

- PERT / CPM:
 - Basic concepts
 - Construction and Time Calculation of the Network
 - Determination of Float and of the Critical Path
 - Crashing a Project
 - Scheduling a Project
 - Resource Analysis and Allocation
 - Application of PERT/ CPM

UNIT IV:

- Sequencing
 - Definition, Notations and Assumptions
 - Solution of sequencing problem.
 - Problems with n-jobs and 2-machines
 - Problems with n-jobs and 3-machines
 - Problems with 2-jobs and m-machines
- Dynamic Programming
 - Introduction
 - The recursive Equation Approach
 - Characteristics of Dynamic Programming
 - Dynamic Programming Algorithm
 - Solution of Discrete D.P.P.
 - Some APPLICATION
 - Solution of L.P.P. By Dynamic Programming

REFERENCES

1. K. Swarup, Gupta P.K. and Man Mohan(2008): "Operations Research"; S. Chand & Co., New Delhi, ISBN: 8180545350, ISBN-13: 9788180545351
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7. Hira, D. S., Gupta, P.K.(2007): OPERATIONS RESEARCH, S. Chand & Co., New Delh, ISBN: 81-219-0281-9
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9. Rathindra P. Sen (2010): “Operations Research Algorithms and Applications” PHL Learning PVT. LTD., ISBN: 978-81-203-3930-9

Core – II
Course 402: Applied Design of Experiments

UNIT I:

- Concept and history of Design of experiments.
- The need for Designed experiments.
- Elementary ideas of blocking and randomized block design.
- Elementary idea of treatment structure and Basic principles of Design of experiments.
- Concept of complete and incomplete block designs. Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin square Design(LSD), their analysis with applications. Missing plot technique for RBD, LSD with their applications.

UNIT II:

- Concept of BIBD and its properties
- Types of BIBD.
- Intra block analysis of BIBD.
- Missing plot technique for BIBD.

UNIT III:

- Analysis of Covariance: Analysis of covariance for CRD, RBD and LSD.
- Youden square design, Cross over design and split-plot designs.

UNIT IV:

- Factorial Experiments: Characterization of experiments, factorial experiments, factorial experiments with factors at two levels, grouping for interaction contrasts, confounding, confounding in more than two blocks, experiments with factors at three levels each, analysis of factorial experiments.

REFERENCE

1. Montgomery, D. C. (2006): “Design and Analysis of Experiments”; 5thEd, Wiley (India), ISBN: 812651048X, ISBN-13: 9788126510481,978-8126510481.
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11. Panse, V.G. and Sukhatme, P.V. (1978): “Statistical methods for agricultural workers”; ICAR, New Delhi.

Core-III
Course-403: Econometrics

Unit-I

Introduction:

- Review of Single Equation method OLS estimation: Estimation, Prediction, and tests of hypotheses, G.L.M. and generalized least squares estimation. Aitken's generalized least square (G.L.S) estimator
- Introduction to Econometrics and econometric models.
- Types of measurements and Data
- Problems with different types of data
- Problems associated with violation of assumptions of GLM

Unit-II

Multicollinearity:

- Nature and meaning of Multicollinearity.
- Consequences
- Detection
- Remedial Measures

Unit-III

Heteroscedasticity:

- Nature and meaning of Heteroscedasticity.
- Consequences
- Detection
- Remedial Measures

Unit-IV

Autocorrelation:

- Nature and meaning of Autocorrelation.
- Consequences
- Detection
- Remedial Measures

Unit-V

Dummy Variable Models:

- The Nature of Dummy Variables
- ANOVA Models
 - Caution in the Use of Dummy Variables
- ANOVA Models with Two Qualitative Variables
- Regression with a Mixture of Quantitative and Qualitative Regressors: The ANCOVA Models
- The Dummy Variable Alternative to the Chow Test
- Interaction Effects Using Dummy Variables
- The Use of Dummy Variables in Seasonal Analysis

Unit-VI

Stochastic Regressors and Instrumental Variable Estimation:

- Nature and meaning
- Parameter estimation and its properties
- Asymptotic properties

- Instrumental variable methods: Wald, Bartlett, Durbin, MLE.

Unit-VII

Simultaneous equation system:

- Structure and models, typology of economic relations, structural form, reduced form and final form of an economic, model.
- Problem of identification under linear homogeneous and Covariance restrictions. Rank and Order conditions of Identification
- Restrictions on structural parameters.
- **Methods of estimation:** Limited information and full information methods, indirect least squares. Two stage least squares.

REFERENCES

1. Damodar N. Gujarati, Dawn C. Porter: “Basic Econometrics”; McGraw Hill 2008. 5th edition. ISBN: 0071276254, 9780071276252
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8. Cramer, Jan Salomon. Empirical Econometrics. Netherlands: North-Holland Publishing Company, 1971. 1st edition. ISBN: 9780720430509, 072043050X.
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Elective-I
Course-4041:Bio-Statistics&ClinicalResearch

UNITI:

- Introduction to Bio-statistics, Sources of medical uncertainties, managing medical uncertainties. Applications of Bio-statistics as a science.
- Clinical trials: the need and ethics of clinical trials, bias and random error in clinical studies, conduct of clinical trials, overview of Phase I-IV trials, multi-center trials. Data management: data definitions, data collection system for food clinical practice, protocol definition.

UNITII:

- Design of clinical trials: parallel vs. cross-over designs, cross-sectional vs. longitude designs, review of factorial designs, objectives and endpoints of clinical trials, design of Phase I trials, design of single-stage and multi-stage Phase II trials, design, and monitoring of Phase III trials with sequential stopping, design of bioequivalence trials

UNITIII:

- Reporting and analysis: analysis of categorical outcomes from Phase I - III trials, analysis of survival data from clinical trials. Interim analysis method, motivating intent-to-treat analysis.

UNITIV:

- Determining sample size. Surrogate endpoints: selection and design of trials with surrogate endpoints, analysis of surrogate endpoint data.

REFERENCES

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3. Govindarajulu Z. (2000): "Statistical Techniques in Bioassay", 2nd revised edition, Karger, ISBN-10: 9783805571197, ISBN-13: 978-3805571197
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clinical Trials”, 3rded.SpringerPublication, ISBN 978-1-4419-1585-6 e-ISBN 978-1-4419-1586-3

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Elective II
Course 4042: Economic & Business Statistics

UNIT I:

Index Numbers: Price, Quantity and Value indices. Price Index Numbers: Construction, Uses, Limitations, Tests for index numbers, Chain Index Number. Consumer Price Index, Wholesale Price Index and Index of Industrial Production – Construction of index numbers and uses. Cost of Living Index Number and various Official Index Numbers, HDI (Human Development Index).

UNIT II:

Demand Analysis: Concept related to demand and supply, price elasticities of demand and supply, Methods of determining demand and supply curves for cross section data and time series data, Leontief's method, Pigou's Method, Engels Curves, Pareto's Law of Income Distribution.

UNIT III:

Time Series Analysis: Definition and importance of time series analysis. Components of a Time series. Different methods for determination of trend, Methods for elimination of seasonal components. Determination of cyclic components. Variate difference method and their merits and demerits.

UNIT IV:

Stationary Time series, Box-Jenkins Models, Introduction to Autoregressive (AR) Models, Moving Average (MA) Models, Mixed Autoregressive Moving Average (ARMA) Models. Autoregressive Integrated Moving Average (ARIMA) Models. Properties of these models. Forecasting Techniques, Seasonal ARIMA model, Introduction to conditional Heteroscedasticity model; Volatility models, ARCH model, GARCH model, properties, estimation and forecasting of these models.

REFERENCES

1. Allen R. G. D. (1975). Index Numbers in Theory and Practice, Macmillan. ISBN: 9781349023141.
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Course 405 : Practical Paper –IV

Based on Theory Paper 401 to 404

Skill Based Course Course-406: Programming Language ‘R’

UNIT I:

- **Introduction to R**
 - Background and resources
 - Installing R and R Studio
 - R console.
 - R commander
 - Command and syntax
 - Packages and libraries
 - Help in R
 - Workspace in R
- **Data Structures**
 - Introduction to data structure
 - Vectors
 - Matrices
 - Arrays
 - Lists
 - Factors
 - Data frames
 - Importing and Exporting data
 - Data types
- **Data management**
 - Split
 - Find and replacement
 - Manipulations with alphabets
 - Evaluation of strings
 - Data frames.
- **Conditional executions and loops**
 - If loop
 - While loop
 - For loop

UNIT II: Statistical Analysis in R

- **Data Visualization of R**
(Creating, Modifying the points, line, title, subtitle, axes of the plot/graph, Adding additional elements and legends to graph etc.)
 - Pie Chart
 - Bar graph
 - Line Graph
 - Scatter plot
 - Stack Plot
 - Box-Plot
 - Special graph
 - Multiple plots
- **Frequencies & Descriptive Statistics**
 - Frequency
 - Measure of central tendency
 - Measure of Dispersion
 - Measure of skewness
- **Statistical Testing**
 - Cross tabulation
 - One sample t test
 - Independent sample t test
 - Paired sample t test
 - One way ANOVA
- **Statistical Modelling**
 - Correlation
 - Simple linear regression
 - Multiple linear regression

REFERENCES

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2. Dr. Mark Gardener (2015), “Beginning R: The statistical programming language”, Wiley, ISBN-978-81-265-4120-1
3. Jared P. Lander (2014), “R for everyone advance analytics and graphics”, Addison Wesley data & analytics series, Dorling Kindersley (India) Pvt. Ltd., ISBN-978-93-325-3924-2
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5. Nina Zumel and John Mount (2015), “Practical data science with R”, Dreamtech Press, ISBN-978-93-5119-437-8
6. Paul D. Lewis (2010), “R for medicine and biology”, Jones and Bartlett Publishers, ISBN-978-0-7637-5808-0.