Faculty of Life Sciences

# Syllabus

## M.Sc. MEDICAL STATISTICS

As per UGC's Learning Outcome Based Curriculum Framework (LOCF) under the CBCS pattern Implementation Year 2021-22 onwards

*MSc*

# Syllabus

# M.Sc. Medical Statistics
## As per UGC's Learning Outcome Based Curriculum Framework (LOCF) under the CBCS pattern Implementation Year 2021-22 onwards



## JSS Academy of Higher Education & Research
**Deemed to be University**
**Re-Accredited "A+" Grade by NAAC**
**Sri Shivarathreeshwara Nagara, Mysuru - 570015, Karnataka**

# M.Sc. Medical Statistics

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# M.Sc. Medical Statistics

**Foreword**

MSc Medical Statistics is an Innovative Career Oriented Program which allows for greater flexibility for the students to enhance their learning experience, The MSc in Medical Statistics is a flexible degree programme blending theoretical and applied statistical disciplines ideal for training in medical statistics, This course aims to train students from a variety of academic backgrounds to work as statisticians in various sectors. Medical Statistics is a fundamental scientific component of health research, deals with applications of statistics to medicine and the health sciences, including epidemiology, public health, demography and clinical research. Medical Statistics is a sub discipline of statistics. "It is the science of summarizing, collecting, presenting and interpreting data in medical practice and using them to estimate the magnitude of associations and test hypotheses". It has a central role in medical investigations. The course is designed to cover modern statistical theory and methods providing a good foundation for research in Medical Statistics. The emphasis throughout is on applying and adapting it to real-life circumstances. The course provides opportunity to develop skills for data analysis and the individual project work provides field experience and hands-on training. The course also aim at providing students scope for professional development in understanding and use of statistical software packages including SPSS, R, MATLAB, JMP and Python.

<u>**Course Overview**</u>

**PROGRAM OBJECTIVES**

The main objectives of the program are:

- To cover modern statistical theory and methods in order to provide a good foundation for research in Medical Statistics.
- To provide opportunity to develop skills for data analysis and the individual project work provides field experience and hands-on training.
- It provides training in the theory and practice of statistics with special reference to clinical trials, epidemiology and Geo Spatial statistics.

**PROGRAM OUTCOMES**

At the end of the program, the student will be able to:

- It helps in preparing the next generation statistician ready for scientific decision-making, aided with advanced statistical software translating into sharp and extensive analytics, pertinent to various domains.
- Understand the application of statistical knowledge to find solution to real-world problems.
- Gain knowledge of critical thinking for data driven solution with advanced methodologies, applicable statistical software packages like R, SPSS, MATLAB etc translating into sharp and extensive analytics, pertinent to various domains, aiding students and organization for scientific decision-making.
- Career Opportunities in varied domains such as Government, Pharma, Insurance, Banking, Finance, Information Technology and many other sectors that will entail market research, forecasting and predictive analysis.

.**Program Specific Outcome: At the end of the program, students will be able:**

- To develop an ability to understand the basic and advanced levels of Statistics.
- To develop the ability to think critically for solving various problems in statistics.
- To develop an ability to select an appropriate statistical method that is relevant or suitable for the given data in any situation.
- It provides opportunity to develop skills for data analysis and the individual project work provides field experience and hands-on training.
- It provides students scope for professional development in understanding and use of statistical software packages including SPSS, R, MATLAB and Excel.
- It provides a platform for pursuing higher studies leading to doctorate degrees.
- It encourage for collaboration with multidisciplinary researchers.

**Duration:** M.Sc. Medical Statistics is a postgraduate level program offered by the JSSAHER, school of Life sciences. This is a 2-years program, consisting of four semesters with two semesters per year.

**Program Code:** MS (Medical statistics)

**Eligibility:** Any Undergraduate Science degree with at least 50% marks in aggregate recognized by UGC with Mathematics as one of the subject in second PUC or 10+2 or its equivalence.

| SEMESTER – I | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SL. NO. | Study components and Code | Title of the paper | Hrs/ Week | Duration in Hours | CIA | Theory/ Practical Exam | Max. Marks | Total Credit |
| 1 | DSC – 01 | Mathematical Statistics | 4 | 3 | 30 | 70 | 100 | 4 |
| 2 | DSC – 02 | Basic Medical Statistics | 4 | 3 | 30 | 70 | 100 | 4 |
| 3 | DSC – 03 | Population and Health Data Management | 4 | 3 | 30 | 70 | 100 | 4 |
| 4 | DSE 01a (Or) DSE 01b | Statistical Model Using 'R' (Or) Computer Programming | 4 | 3 | 30 | 70 | 100 | 4 |
| 5 | SEC – 01 | Statistical Computing using Excel and SPSS | 2 | 2 | __ | 50 | 50 | 2 |
| 6 | Practical – 01 | Data Analysis using SPSS | 4 | 3 | 15 | 35 | 50 | 2 |
| 7 | practical – 02 | Data Analysis using R Studio | 4 | 3 | 15 | 35 | 50 | 2 |
| Total Marks and credits | | | | | | | 550 | 22 |

| SEMESTER – II | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | DSC – 04 | Statistical Epidemiology | 4 | 3 | 30 | 70 | 100 | 4 |
| 2 | DSC – 05 | Time Series Analysis | 4 | 3 | 30 | 70 | 100 | 4 |
| 3 | DSC – 06 | Python Programming | 4 | 3 | 30 | 70 | 100 | 4 |
| 4 | DSE 02a (Or) DSE 02b | Big Data Analytics (Or) Spatial Statistics | 4 | 3 | 30 | 70 | 100 | 4 |
| 5 | SEC-02 | Clinical Trials | 2 | 2 | __ | 50 | 50 | 2 |
| 6 | Practical - 03 | Statistical Modeling using Python | 4 | 3 | 15 | 35 | 50 | 2 |
| 7 | Practical –0 4 | Statistical Modeling using JMP | 4 | 3 | 15 | 35 | 50 | 2 |
| | | | | | | | | |
| Total Marks and credits | | | | | | | 550 | 22 |

| | | SEMESTER – III | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | **DSC – 07** | Regression and Generalized Linear Models | 4 | 3 | 30 | 70 | 100 | 4 |
| 2 | **DSC – 08** | Multivariate Analysis | 4 | 3 | 30 | 70 | 100 | 4 |
| 3 | **DSC – 09** | Design and Analysis of Experiments | 4 | 3 | 30 | 70 | 100 | 4 |
| | **DSE 03a (Or) DSE 03b** | Survival Data Analysis (Or) Operational Research and Quality Control. | 4 | 3 | 30 | 70 | 100 | 4 |
| 4 | **SEC – 03** | Data Analysis Using MATLAB | 2 | 2 | __ | 50 | 50 | 2 |
| 5 | **AECC** | Documentation & Research Methodology | 2 | 2 | - | 50 | 50 | 2 |
| 6 | **Practical – 05** | Statistical Analysis using MATLAB | 4 | 3 | 15 | 35 | 50 | 2 |
| 7 | **Practical – 06** | Statistical Analysis using DOE Software | 4 | 3 | 15 | 35 | 50 | 2 |
| | | **Internship** | | | | | 50 | 2 |
| **Total Marks and credits** | | | | | | | 650 | 26 |

| SEMESTER – IV | | |
|---|---|---|
| **Dissertation** | 300 | 12 |
| **Total (Semester I to IV)** | 2050 | 82 |

## Note:

**DSC-06 :Python Programming (Common papers for Medical Statistics and Geoinformatics)**

**DSE-02b: Spatial Statistics (Common papers for Medical Statistics and Geoinformatics)**

# Semester One

| No. of hours/week | Credits |
|---|---|
| 4 | 4 |

## DSC 01: Mathematical Statistics

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**Course Objectives**

- To increase the student's ability in deductive reasoning and critical thinking to solve problems.
- To efficiently solve Mathematical properties and theorems.

**Course Outcomes**

After successful completion of the course, students will be able to:
- To introduce the students to basics in mathematics as relevant to medical statistics program.
- The students learn elementary mathematics, matrices, and numerical methods and properties.
- At the end of the course; the student is well versed with the necessary mathematical theorems components to understand the field statistics.

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### Unit-I
### Mathematical Preliminaries
Elements of Set Theory, Elements of Theory of Matrix and Determinants: Matrix Algebra, Determinants, Matrix Inverse, Partitioned Matrices, Rank, Eigenvalues and Eigenvectors, Trace of a Matrix, Direct Product, Quadratic Forms and Definiteness, Idempotent Matrices, Differentiation, System of Equations, Orthogonal Projection of a Vector

### Unit-II
### Mathematical Expectation
Mathematical Expectation of a Random Variable, Expected value of Function of a Random Variable, Properties of Expectation: Addition Theorem of expectation, Multiple Theorem of Expectation. Properties of Variance, Covariance: variance of a Linear Combination of Random Variables. Inequalities Involving Expectation, Moments of Bivariate Probability Distributions, Conditional Expectation and Conditional Variance.

### Unit-III
### Generating Functions
Introduction, Probability Generating Function: Convolutions, Moment Generating Function: Limitation, Properties, Uniqueness Theorem. Factorial Moment Generating Function, Cumulant Generating Function, Characteristic Function: Properties, Necessary and sufficient Condition for a

Function to be Characteristic Function, Multivariate Characteristic Function, Multivariate Moment Generating Function.

**Unit-IV**

**Sampling Distribution**

Definition, Student t-Distribution, Chi-square Distribution, Fisher's z-Distribution, F-Distribution, Properties and Features of t, chi-square, F Probability Curve, Inter-relation between t, chi-square and F Distribution, Analytical Method, Tests of Significance Based on t, F and Z Distributions.

**Recommended Textbooks and References:**

1   Kapur JN, Saxena HC. Mathematical Statistics. 12th ed. New Delhi: S. Chand and company Ltd;1984.
2   Gupta SC, Kapoor VK. Fundamentals of Mathematical Statistics. 11th ed. New Delhi: Sultan Chand and Sons; 2002.
3   Parimal Mukhopadhyay. Mathematical Statistics. 3rd ed. Kolkata: Books and Allied (p) Ltd; 2006.
4   Agarwal BL. Basic Statistics. 6th ed. New Delhi: New Age International (p) Ltd; 2013.

| No. of hours/week | Credits |
|---|---|
| 4 | 4 |

## DSC 02: Basic Medical Statistics

**Course Objectives:**

- To enhance students in order to bring in contact with the different ways in which Statistics is used in medical discipline.
- The importance of statistics in research and prepare them for a career in health care.

**Course Outcomes:**

- Classify the data by means of diagrams and graph
- Calculate and interpret the various measures of central tendency, dispersion, skewness, Kurtosis
- Assembling a discrete and continuous probability distribution
- Constructing a sampling distribution of the sample mean
- Developing null and alternate hypotheses to test problems

**Unit I:**
**The Scope of Medical Statistics**
Definition and Scope of Medical Statistics, Scales of Measurement: Nominal , Metric and Ordinal Scales ,Discrete and Continuous Variables, Construction of Statistical Table and Frequency Distribution, Diagrammatical and Graphical Representation of Data, Measures of Central Tendency : Mean, Median, Mode, Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance, Coefficient of Variation, Skewness and Kurtosis.

**Unit II:**
**Quantitative Aspects of Medical Decisions: Probability**
Random Experiment, Sample Space, Event, Trial, Outcomes, Mutually Exclusive and Exhaustive, Events, Independent Events, Types of Probability, Axiomatic Approach to Probability, Additional Rule of Probability, Conditional Probability, Generalization of Multiplicative Law of Probability, Bayes Theorem, Probability Distribution: Binomial, Poisson and Normal Distribution-Properties and simple problems.

<u>**Unit III:**</u>

**Architecture of Medical Statistics: Sample Survey Methods**

Population and Sample Need for Sampling, Census and Sample Surveys, Sampling and Non-Sampling Errors, Advantages and Disadvantages of Sampling Method, Types of Sampling Method Random Sampling: SRSWR, SRSWOR, Systematic Sampling, Stratified Sampling, Cluster Sampling, Non Probability Sampling.

<u>**Unit IV:**</u>

**Test of Significance**

Hypothesis, Errors, Level of Signification, P Value, Critical Region, Degrees of Freedom, Student t Test, Chi-Square Test, F Test, Non-Parametric Test: Kolmogorov - Smirnov One Sample and Two Sample Test, Runs Test, Wilcoxon Signed Rank Test, Mann-Whitney U Test, Median Test for Three or More Samples, Kruskal-Wallis Test, One Way and Two-Way ANOVA.

**Recommended Textbooks and References:**

1. Martin Bland: An Introduction to Medical Statistics, Oxford Medical Publications, 3rd Edition.
2. Abhaya Indrayan Sanjeev B.Sarmukaddam: Medical Biostatistics, CRC Press Inc.Volume7.
3. P. Armitage and G. Berry: Statistical Methods in Medical Research, Third Edition.
4. Gurumani N: An Introduction to Biostatistics, MJP Publisher; 2 Edition.
5. Cochran W.G : Sampling Technigues, Wiley; Third edition (2007).
6. Murthy M.N: Sampling Thorey and Methods, Alpha Science International Ltd; 2nd Edition.
7. S C Gupta and V K Kapoor: Fundamental of Mathematical Statistics, Sultan Chand & Sons (2014)

| No. of hours/week | Credits |
|---|---|
| 4 | 4 |

SEMESTER ONE

## DSC 03- Population and Health Data Management

**Course Objectives:**
•To introduce students to Learn basic measures of Mortality, Fertility and Population Growth.
•To enable students to construct Life tables and estimate the National Income using different approaches.

**Course Outcome**
•Students will be able to understand distinction between Vital Statistics and Demography.
•Gain of theoretical and analytical Concept of Life Tables, their construction and uses.
• Understand the different population growth models.

## Unit I:
**Demography and Measures of population**
Introduction to demographic data: Census, vital events, registration, survey, Application of Demography, Static Demography, Dynamic Demography, Collection of Demographic Data, Measures of population, Growth of population ,Population Density, population distribution by age and Sex in India . Models for population growth: exponential, logistic, Gompertz models, Deterministic models, birth and death processes, logistic growth, Competition between populations, growth rate, stable population analysis, population projection by component method and using Leslie matrix.

## Unit II
**Vital Statistics**
Basic concept of Vital Statistics, Uses and Advantages of Vital Statistics, Application, Measures of Vital Statistics, Measures of fertility, Fertility rates, Reproduction rate, Measures of Martial Status, Measures Of Morbidity, Measures of Mortality, Crude Death rate ,Standardized death  rates, Specific Death rates, Monitoring of Family Planning Programme .

## Unit III
**Life Table**
Basic Concept and Definition of a life table, construction of a life table, types of life table ,Basic Assumptions for preparing a life table, Uses and Application of Life Table, Force of Mortality and Expectation of life, Population projection using logistic curve.

**National income and Development statistics**
Estimation of National Income - product approach, income approach and expenditure approach. Population growth in developing and developed countries, basic concept of National income – GNP,GDP, Uses of National income, problems in estimating National income ,Methods of estimating National income, CSO,NSSO and Its activities, National accounts statistics of CSO, Measuring inequality of incomes, Gini coefficient.


**Recommended Textbooks and References:**

1. Mahajan B.K.: Methods in Biostatistics,7th edition.
2. Spiegelman H : Introduction to demography, Harvard University press.
3. UNESCO: Principles of Vital Statistics Systems, Series M-12.
4. Keyfitz, N. Mathematical Demography
5. Pollard, J.H.: Mathematical Models for the growth or human population, Cambridge University press.

| No. of hours/week | Credits |
|---|---|
| 4 | 4 |

## DSE 01a: Statistical Model Using 'R'

**Course Objectives:**

•To make students exercise the fundamentals of statistical analysis in R environment
•Preparation, analysis, modeling and visualization of data, covering both conceptual and practical issues

**Course Outcomes:**
•Install,Code and Use R Programming Language in to perform basic tasks on Vectors, Matrices and Data frames
•Visualize data attributes
•Understand the fundamental syntax of R through readings, practice exercises, demonstrations, and writing R code.
•Analyze and Interpret probability, Correlation and Regression

## Unit I
### Introduction to Statistical Software R
Downloading and Installing R, Essentials, Advantages and Objects, Functions and Arguments, Manipulating Vectors, Factors, Matrix Operations: Addition, Subtraction, Multiplication, Lists, Importing of Files, Inbuilt Data Frame, Getting Help: The Functions Help (), Help.Search() and Example().

## Unit II
### Descriptive Statistics and Graphics in R
Measure of Central Tendency and Measure of Dispersion (Mean, Median, Standard Deviation, Variance, Quartiles, Fivenum Summary), Measure of Skewness and Kurtosis, R-Graphics- Bar Graph, Pie Chart, Line Graph, Box-Plot, Stem and Leaf Plot and Histogram.

## Unit III
### Probability and Probability Distribution Using R Functions
Sample Spaces, Events, Set Union, Intersection, Difference, Basic Probability Problems In R, Conditional Probability, Fitting of Distributions to Given Data with R –Binomial Distribution, Poisson Distribution and Normal Distribution, Simulation from Discrete and Continuous Distribution.

<u>**Unit IV**</u>
**Using R Functions for Standard Statistical Tests and Programming in R**
One and Two Sample t-Tests, Chi-Square Test, Analysis of Variance (ANOVA), Correlation Analysis, Creating an XY Plot of Data, using the Regression Function to Fit a Straight-Line, Multiple linear regressions, Logistic regression, Programming in R: For/While/Loops.

**Recommended Textbooks and References:**
1) Purohit S.G., Gore,S.D. and Deshmukh,S.R.(2008) Statistics Using R, Alpha Science
2) Peter Dalgaard: Introductory statistics for R, Springer
3) Verzani, J. (2005). Using R for Introductory Statistics, Chapman and Hall, London
4) Introduction to Probability,and Statistics Using R,G. Jay Kerns,First Edition
5) Gasteiger Johann (2003) Chemoinformatics: A Textbook, Wiley, John & Son
6) Schaum's Outline of Computer Graphics by Zhigang Xiang and Roy A. Plastock Second Edition, Mc Graw Hill, USA

| No. of hours/week | Credits |
|---|---|
| 4 | 4 |

## DSE 01b: Computer Programming

**Course Objectives:**

•Express algorithms and draw flowcharts in a language independent manner.
•Each how to write modular, efficient and readable C programs.
•Describe the techniques for creating program modules in C using functions & recursive functions.
•Familiarize pointers and dynamic memory allocation functions to efficiently solve problems

**Course Outcomes:**
•Write, compile and debug programs in C language.
•Use different data types in a computer program.
•Design programs involving decision structures, loops, arrays and functions.
• Use pointers to understand the dynamics of memory; create & perform different file operations

**Unit I**
 **Introduction to Computers:** Computer Systems, Computing Environments, Computer Languages, Creating and Running Programs, Software Development, Flow charts.
**Number Systems**: Binary, Octal, Decimal, Hexadecimal.
**Introduction to C Language:** Background, C Programs, Identifiers, Data Types, Variables, Constants, Input / Output Statements Arithmetic Operators and Expressions: Evaluating Expressions, Precedence and Associativity of Operators, Type Conversions.

**Unit II**
**Condition Statements And Functions:** Conditional Control Statements: Bitwise Operators, Relational and Logical Operators, If, If-Else, Switch-Statement and Examples. Loop Control Statements: For, While, DoWhile and Examples. Continue, Break and Goto statements
**Functions:** Function Basics, User-defined Functions, Inter Function Communication, Standard Functions, Methods of Parameter Passing, Recursive Functions.
 **Storage Classes:** Auto, Register, Static, Extern, Scope Rules, and Type Qualifiers.

**Unit III**
**Arrays and Pointers:**
**Arrays:** Concepts, Using Arrays in C, Inter-Function Communication, Array
Applications, Two- Dimensional Arrays, Multidimensional Arrays, Linear and Binary
Search, Selection and Bubble Sort.

**Pointers:** Introduction (Basic Concepts), pointers to pointers, compatibility, Pointer Applications, Arrays and Pointers, Pointer Arithmetic, memory allocation functions, array of pointers, pointers to void, pointers to functions, command –line arguments, Introduction to structures and unions.

**Unit IV**
**Strings and Strings:**
**Strings:** Concepts, C Strings, String Input/Output Functions, Arrays of Strings, String Manipulation Functions.
**Input and Output:** Introduction to Files, Modes of Files, Streams, Standard Library Input/ Output Functions, Character Input/Output Functions.

**Recommended Textbooks and References:**

1. B.A. Forouzan and R.F. Gilberg, "A Structured Programming Approach in C", Cengage Learning, 2007
2. Kernighan BW and Ritchie DM, "The C Programming Language", 2nd Edition, Prentice Hall of India, 2006.
3. Rajaraman V, "The Fundamentals of Computer", 4th Edition, Prentice-Hall of India, 2006

| No. of hours/week | Credits |
|---|---|
| 2 | 2 |

<u>SEMESTER ONE</u>

## SEC 01: Statistical Computing using Excel and SPSS

**Course Objectives:**
•To enhance students' ability to use software, computer simulations and statistical techniques
•To find solutions to problems arising in planning and decision-making.


**Course Outcomes:**
•Identify the different components of the Excel worksheet
•Charts and diagrams to represent statistical data
•Students in this course study a wide variety of statistical and graphical techniques, including classical statistical tests, linear and nonlinear modeling.
•Impart training to students who seek to acquire and refine their skills relating to data analysis and manipulation**.**

## Unit1
### Introduction to Excel
Workbooks and Worksheets, Cell Addresses, Entering and Editing Data, Savings Files, Importing/Accessing Data, Mathematical Operators and Functions, Creating Formulas, Data Analysis Toolpak. Creating and Formatting Tables.


## Unit2
### Statistical Functions in Excel Analysis Toolpak
Frequency Distribution Tables, Histograms and Bar Charts, Pie Chart, Scatter Diagram, Descriptive Statistics, Creating an XY Plot of Data, Simple linear Regression Function, Correlation, Analysis of Variance, Paired and Unpaired t-Test, F test.


## Unit3
### SPSS for Windows: An Introduction
Overview and Scope of SPSS, Loading Data, Starting SPSS for Windows, Entering Data, importing a File, Defining the Variables, Missing Values, Help, Exiting and Saving SPSS.

## Unit4
**Writing / Performing Programs using SPSS on Problems from the Following Topics:**
Frequencies, Bar Chart, Pie chart, Box plot, Descriptive Statistics, One and Two Sample Parametric Tests, Chi-Square Tests, Regression and Correlation Analysis, ANOVA and Kruskal-Wallis Test.

**Recommended Textbooks and References:**

1. Essentials Of Biostatistics Workbook Statistical Computing Using Excel: By Lisa M.Sullivan(Second Edition)
2. An Introduction to Statistics Using Microsoft Excel: By Dan Remenyi George Onofrei Joe English
3. Practical Statistics Using SPSS Authors Nicola Spiers, Brad Manktelow, Michael J. Hewitt
4. A Handbook of Statistical Analyses Using SPSS By Sabine Landau and Brian S. Everitt

| No. of hours/week | Credits |
|---|---|
| 4 | 2 |

### Practical 01: Data Analysis using SPSS

1. Diagrammatical and Graphical methods.
2. Frequency Distribution.
3. Descriptive Statistics
4. Correlation and Regression.
5. Student's t Test .
6. One Way ANOVA.

### Practical 02: Data Analysis using R Studio

1. Vector, Matrices and Function.
2. List, inbuilt data frame and Importing files.
3. Frequency Distribution table and Descriptive Statistics
4. Graphical representation
5. Correlation and Regression.
6. Parametric and non-parametric test.

# Semester Two

| No. of hours/week | Credits |
|---|---|
| 4 | 4 |

SEMESTER TWO

## DSC 04-Statistical Epidemiology

**Course Objectives:**
•To introduce students to Learn basics of Epidemiology and its importance.
•To understand different measures of diseases and regression models relating to the exposure of diseases**.**

**Course Outcome**
•Students will be able to understand different tools of Epidemiology and their role in observational studies.
  Gain Knowledge on different public health programmes and health services.
•Understand the different regression models pertaining to exposure of diseases.

## Unit I
### Introduction and Tools of Epidemiology, Probability in Observational Studies
Historical aspects of Epidemiology and evolution, Definition and understanding - Natural history of disease, Tools of Epidemiology: measuring disease Frequency (Prevalence, incidence, morbidity rates and attack rates). Probability and the incidence proportion, Inference based on an estimated probability, - Conditional probabilities, Independence of two events, Example of conditional probabilities—Berkson's bias

## Unit II
### Measures of Disease-Exposure Association, Principles of Measurements
- Relative risk - Odds ratio , The odds ratio as an approximation to the relative risk , Symmetry of roles of disease and exposure in the odds ratio, Relative hazard , Excess risk , Attributable risk, Types of measures, Reliability, Validity, Accuracy , Questionnaire construction , Diagnostic tests, Measurement issues, Assessing Significance in a 2x2 Table and Estimation and Inference for Measures of Association, Population-based designs, Role of hypothesis tests and interpretation of p-values

## Unit III
### Regression Models Relating Exposure to Disease
Infectious disease Epidemiology, Chronic disease Epidemiology, Epidemiology of policy, public health programme, Health services etc. Roles of Genetic and Environmental Factors in Disease Causation, Some introductory regression models , the linear model , Pros and cons of the linear model , the log linear model ,the probit model , the simple logistic regression model. Cox models.

## Unit IV

**Goodness of Fit, Estimation of Logistic Regression Model Parameters**

Overall test of association, Properties of the log likelihood function and the maximum likelihood estimate, Null hypotheses that specify more than one regression coefficient , Logistic regression with case-control data, Confounding and Interaction within Logistic Regression Models , Assessment of confounding using logistic regression models , Introducing interaction into the multiple logistic regression model , Collinearity and centering variables, Goodness of Fit Tests for Logistic Regression: Model Building, goodness of fit, The Hosmer-Lemeshow test. Matched Studies, Alternatives and Extensions to the Logistic Regression Model -Mantel-Haenszel techniques applied to pair-matched data Small sample adjustment for odds ratio estimator, Confounding and interaction effects.

**Recommended Textbooks and References:**

1. Gordis L, Epidemiology, 2004, Elsevier Saunders.
2. Nicholas P.Jewell, Statistics for Epidemiology, CHAPMAN & HALL/CRC A CRC Press Company.
3. Kuh D, Shlomo YB, editors. A life course approach to chronic disease epidemiology. Oxford University Press; 2004.
4. Bonita R, Beaglehole R, Kjellström T. Basic epidemiology. World Health Organization; 2006.

| No. of hours/week | Credits |
|---|---|
| 4 | 4 |

## DSC 05- Time Series Analysis

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**Course Objectives:**
•To introduce students to Learn basics Concept of time series analysis.
•To provide knowledge on stationary and non-stationary processes on time series analysis.

**Course Outcome**
•Understand the concept of time series with its components and able to compute ACF and PACF.
•Remove trend and seasonality using different methods to convert the time series into stationary.
•Apply auto regressive, moving average, ARMA, ARIMA models, Box Jenkins approach to forecast time-series data empirically.
Check and validate models with its residual analysis and diagnostic checking.

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**Unit I**
**Introduction to time series**
Components of time series, additive and multiplicative models, measurement of trend by moving averages and by least squares, test for trend and seasonality .Time series as discrete parameter stochastic process, auto-covariance and auto-correlation functions and Partial autocorrelation functions and its Properties.

**Unit II**
**Exploratory time series analysis**
 Exponential smoothing for seasonal data, Holt-winter smoothing, forecasting based on smoothing. Modeling time series data based on First and second order exponential smoothing. Linear models for stationary time series.

**Unit III**
**Detailed study of the stationary processes and Non-stationary time series models** Autoregressive (AR), Moving Average (MA), Autoregressive Moving Average, ACF and PACF plots of these processes. ARIMA and Seasonal ARIMA Models. Estimation of mean, auto covariance and autocorrelation functions under large sample theory (statement only). Choice of AR and MA periods, Estimation for ARIMA model parameters, FPE,AIC, BIC, residual analysis and diagnostic checking. Unit-root non stationarity, unit-root tests (Dickey-Fuller).

**Unit IV**
**Spectral analysis**
 Weakly stationary process, Periodogram and correlogram Analyses, Spectral decomposition of weakly AR process and representation as a one sided MA process – necessary and sufficient conditions, Implication of spectral decomposition in prediction problems.

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**Recommended Textbooks and References:**

1. Statistical Methods for Forecasting, Abraham,B and Ledolter,J.C (1983). Wiley
2. Time Series Analysis, Forecasting and Control Box, G. E. P. and Jenkins,Wiley, Fifth Edition.
3. Time Series-Theory and Methods, Brockwell,P. J and Davis, R.A(1987). Springler-Verlag, Second Edition
4. Interactive spatial data analysis, Bailey .T.C and Gatrell ,A.C.(1995)  Longman, Harlo
5. Statistical Analysis of Time Series, Anderson, T. W(1971),  Wiley
6. Introduction to Statistical Time Series, Fuller, W. A(1978), John Wiley, Second Edition.
7. Time Series, Kendall, M. G(1978). by Maurice G. Kendall, Oxford Univ Press, Third Edition.
8. Time Series Analysis, Tanaka, K(1996).  Wiley Series, Sixth Edition.

| No. of hours/week | Credits |
|---|---|
| 4 | 4 |

SEMESTER TWO

## DSC 06- Python Programming

**Course Objectives:**
- Master the fundamentals of writing Python scripts
- Inspire students with the broad and real-world applications of Web GIS.
- Recognize situations where spatial programming is needed
- Integrate programming with GIS analysis

**Course Outcomes**
- Learn basics of Python
- Develop console application in python
- Develop database application in python
- Apply Python in geospatial analysis

### Unit-I
**Introduction, Data Types and Operators**
Installation and working with Python, Variables and data types in python, Perform computations and create logical statements using Python's operators: Arithmetic, Assignment, Comparison, Logical, Membership, Identity, Bitwise operators, list, tuple and string operations

### Unit-II
**Python Decision Making and Loops**
Write conditional statements using If statement, if ...else statement, elif statement and Boolean expressions, While loop, For loop, Nested Loop, Infinite loop, Break statement, Continue statement, Pass statement, Use for and while loops along with useful built-in functions to iterate over and manipulate lists, sets, and dictionaries. Plotting data, Programs using decision making and loops.

### Unit-III
**Python File Operations & Modules**
An Introduction To File I/O, Use Text Files, Use CSV Files, use binary files, Handle a single exception, handle multiple exceptions, Illustrative programs, Exercises. Importing own module as well as external modules, Programming using functions, modules and external packages Understanding Libraries, Data Frames and Basic operations with data frames.

## Unit-IV
### Python For GIS

Geoprocessing with Python, Importing ArcPy, use of built-in tools, setting environments, too messages, working with vectors and its geometries, raster data handling, batch processing, Map automations, working with toolbox. Introduction to GDAL, Geopandas, NumPy.

**Recommended Textbooks and References:**

1. McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. O'Reilly Media, Inc.
2. Erik Westra (2016). Python Geospatial Development. Packt Publishing Limited; 3rd edition.
3. Eric Matthes (2019). Python Crash Course: A Hands-On, Project-Based Introduction to Programming, No Starch Press; 2nd edition.
4. Paul A. Zandbergen (2020) Python Scripting for ArcGIS Pro, ESRI Press.
5. Paul A. Zandbergen (2020) Advanced Python Scripting for ArcGIS Pro, ESRI Press.
6. Eric Pimpler (2015). Programming ArcGIS with Python Cookbook, Packt Publishing Limited; 2nd edition.
7. Laura Tateosian (2018). Python For ArcGIS. Springer, 1st edition.
8. Silas Toms, and Dara O'Beirne (2017). ArcPy and ArcGIS -: Automating ArcGIS for Desktop and ArcGIS Online with Python, Packt Publishing Limited; 2nd edition.

**REFERENCE WEBSITES:**

9. http://www.w3schools.com
10. http://docs.python.org
11. http://www.tutorialspoint.com
12. http://www.learnpython.org
13. https://automating-gis-processes.github.io/CSC18/
14. https://www.e-education.psu.edu/geog489/syllabus

| No. of hours/week | Credits |
|---|---|
| 4 | 4 |

SEMESTER TWO

## DSE 02a- Big Data Analytics

**Course Objectives:**
•This paper elaborates the basic techniques of data science that included eminent algorithms used to mining data and basic statistical modelling.
•The course is targeted towards individuals who want to learn about the data processed and the potential applications of large-scale data analytics

**Course Outcome**
•Understand different data structures and to know different multivariate models.
•Describe model building machine learning techniques and to identify the components of big data.
•To know more on big data analytics, analysis and related challenges.

### Unit I
### Introduction to Big data
Data Storage and Analysis - Characteristics of Big Data – Big Data Analytics - Analytical Architecture – Challenges in Big Data Analytics –the storage dilemma, structured and unstructured data, Analysis of scalability of algorithms to big data, Data warehouses and online analytical processing, Efficient storage of big data including data streams.

### Unit II
### Data warehouse and Hadoop environment
Types of Databases – Advantages – NewSQL – SQL vs. NOSQL vs NewSQL. Introduction to Hadoop: Features – Advantages – Versions – Overview of Hadoop Eco systems – Hadoop distributions – Hadoop vs. SQL – RDBMS vs. Hadoop – Hadoop Components – Architecture – HDFS.

### Unit III
### Introduction to Machine learning and Algorithms
Linear Regression – Clustering – Collaborative filtering – Association rule mining – Decision tree.

**Map Reduce**

Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

**Recommended Textbooks and References:**

1. Applied multivariate statistical analysis by R A Johnson and D W Wichern,Sixth Edition,PHI, 2012.
2. Multivariate data analysis by Joseph F. Hair Jr,Rolph E.Anderson, Ronald LTatham, and William C.Black, Fifth Edition,Pearson Education, 1998.
3. Rob Kitchin. (2014). The Data Revolution: Big Data, Open Data, Data Infrastructures and Their Consequences. SAGE Publications.
4. Lazer, David, Ryan Kennedy, Gary King, and Alessandro Vespignani. (2014). The Parable of Google Flu: Traps in Big Data Analysis. Science 343(6176): 1203-1205.
5. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, Professional Hadoop Solutions,Wiley, 2015.
6. Tom White, Hadoop: The Definitive Guide, O'Reilly Media Inc., 015.
7. Pethuru Raj, Anupama Raman, DhivyaNagaraj and Siddhartha Duggirala, HighPerformance Big-Data Analytics: Computing Systems and Approaches, Springer, 2015.

| No. of hours/week | Credits |
|---|---|
| 4 | 4 |

SEMESTER TWO

## DSE 02b- Spatial Statistics

**Course Objectives:**
•To study and understand the concept of Spatial-statistics and its applications in spatial sciences.
•To study the methodology and designs, Spatial statistics relations and spatial process     and modeling

**Course Outcome**
•On completion of this course the students will be able to solve various problems in the field of spatial statistics employing project management, statistical relation with geospatial technology.
•Knows the concepts of geospatial relations and models.

### Unit I
**Methodology and Designs**
Problem identification-Objectives-variables and attributes-management of univariate and multivariate data-concepts and application of Normal-Gamma and Gaussian distributions-population-sample-sampling-spatial sampling practice-Statistical testing t, f, chisquare and Z applications.

### Unit II
**Basic of data exploration**
Raw data relative data tables - dot plots in univariate – bivariate explorations - Diagram as tools of exploration: histogram – bar chart – paretochart – line graphs-box plots – stem or leaf plots - q-q plots, p-p plots – ogives – class interval selection in thematic mapping.

### Unit III
**Geospatial Relations**
Concepts of interdependence – dependences – independence, correlations: simple – multiple correlation – autocorrelation – cross correlation – variograms – kriging –partial correlations – univariate – multivariate.

.

<u>**Unit IV**</u>
**Spatial processes and Modeling**

Pattern recognition in point – line – area distribution – network analysis – space partitioning – multivariate classification methods: factor analysis methods – classification methods – overlay analysis.

**Recommended Textbooks and References:**

1. Aslam Mahmood, and Moonis Raza, (1986). Statistical Methods in Geographical Studies, Rajesh Publications, New Delhi.
2. Davis, (1986). Statistics and Data Analysis in Geology, John Willy & Sons Inc., New York.
3. ArcGIS Geostatistical Analyst: ArcGIS 9 by ESRI Press Publisher, Red Lands, California.
4. FitzGerald B. F., (1974). Development in Geographical Method, Science in Geography – 1, Oxford University Press, Oxford.
5. Doaugherty Richard, (1974). Data Collection, Science in Geography – 2, Oxford University Press, Oxford.
6. Davis Peter, (1974). Data Description and Presentation, Science in Geography - 3, Oxford University Press, Oxford.
7. McCullagh Patrick, (1974). Data Use and Interpretation, Science in Geography – 4, Oxford University Press, Oxford.

| No. of hours/week | Credits |
|---|---|
| 2 | 2 |

SEMESTER TWO

## SEC 02- Clinical Trials

**Course Objectives:**
•To learn scientific view to study the statistical challenges of clinical
Comparison of two or more treatments in human subjects.
• To know the various approaches to drug discovery and phases of
Clinical trials.

**Course Outcome**
•Understand the process of drug development and clinical practices.
•Gained the knowledge of different types and design of clinical trials.
•Know the importance of Informed consent and safety monitoring in
clinical trials.

## Unit I
### Drug development process
Introduction Various Approaches to drug discovery --Pharmacological, Toxicological, IND Application, Drug characterization, Dosage form.

## Unit II
### Clinical development of drug
Introduction to Clinical trials, Various phases of clinical trial, Good Clinical Practice – ICH, GCP, Central drug standard control organization (CDSCO) guidelines, Ethical guidelines in Clinical Research (IRB/ IEC), Role and responsibilities of clinical trial personnel as per ICHGC (a. Sponsor b. Investigators c. Clinical research associate d. Auditors e. Contract research coordinators f. Regulatory authority).

## Unit III
### Types and Design of clinical trials
Randomization techniques (Simple randomization, restricted randomization, blocking method and stratification), Types of research designs based on Controlling Method (Experimental, Quasi

experimental, and Observational methods), Time Sequences (Prospective and Retrospective), Sampling methods (Cohort study, case Control study and cross sectional study), Health outcome measures (Clinical & Physiological, Humanistic and economic), Blinding (single, double and triple) in clinical trials.

## Unit IV

**Informed consent Process and Safety monitoring in clinical trials**

Ethical principles governing informed consent process, Structure and content of a Patient Information Sheet and documentation. Studies of test reproducibility ,Studies of the accuracy of tests ,Studies of the effect of test results on clinical decisions ,Studies of feasibility, costs and risks of tests, Studies of the effect of testing on outcomes ,Pitfalls in the design or analysis of diagnostic test studies.

**Recommended Textbooks and References:**

1. Chow S.C. and Liu J.P (2009). Design and Analysis of Bioavailability and bioequivalence. 3<sup>rd</sup> Edn. CRC Press.
2. Chow S.C. and Liu J.P. (2004). Design and Analysis of Clinical Trials. 2nd Edn. Marcel Dekkar
3. Fleiss J. L.(1989). The Design and Analysis of Clinical Experiments. Wiley.
4. Friedman L. M.Furburg C. Demets D. L.(1998). Fundamentals of Clinical Trials, Springer.
5. Jennison .C. and Turnbull B. W. (1999). Group Sequential Methods with Applications to Clinical Trails, CRC Press.
6. Marubeni .E. and Valsecchi M. G. (1994). Analyzing Survival Data from Clinical Trials and Observational Studies, Wiley.
7. Designing Clinical Research – Third Edition – Stephen B.Hulley , Pub: Lippincott Williams and Wilkings, a Wolters Kluwer business, 530, Walnut Street, Philadelphia, PA 19106 USA, LWW.com

| No. of hours/week | Credits |
|---|---|
| 4 | 2 |

SEMESTER TWO

### Practical 03: Statistical Modeling using Python

1. Statistical data Representation.
2. Mathematical functions and Operators.
3. Visualization techniques.
4. Decision Making and Loops
5. Hypothesis testing.
6. Hazard Ratios

### Practical 04: Statistical Modeling using JMP

1. Data Analysis with Descriptive Statistics.
2. Creating Plots and charts.
3. Correlation and Regression analysis.
4. Parametric and Non-Parametric tests.
5. Time Series Analysis and Forecasting.
6. Univariate – bivariate explorations using GIS Package.

# Semester Three

| No. of hours/week | Credits |
|---|---|
| 4 | 4 |

## DSC 07- Regression and Generalized Linear Models

**Course Objectives:**

•This course helps to know theory and practice of generalized linear models (GLM), testing, estimation, and confidence intervals of parameters, regression and analysis of variance.
•It also teaches the modeling of nonlinear regression, diagnostics and their plots, variable selection and model selection.

**Course Outcome**

•Perform statistical analysis, such as estimation, hypothesis testing, and analysis of variance, under generalized linear models, nonlinear regression models and regression models.
•Understand to apply logistic regression for categorical variables.
•To be familiar with the exponential family of distributions and know that the normal, the binomial, the Poisson, and the gamma distributions belong to this family.
•know the class of generalized linear models (GLM) as regression models with responses from the exponential family of distributions.

### Unit I
**Simple and Multiple regressions**
Assumptions, inference related to regression parameters, standard error of prediction, tests on intercepts and slopes, confidence interval, extrapolation, diagnostic checks and correction: graphical techniques, tests for normality, uncorrelatedness, homoscedasticity, lack-of-fit testing, polynomial regression, transformations on Y or X (Box-Cox, square root, log etc.), method of weighted least squares, dummy variables, inverse regression.

### Unit II
**Logistic and Non-Linear Regression**
Explanation, types of Logistic Regression, Logit transformation, ML estimation, Tests of hypotheses, Wald test, LR test, multiple logistic regression, forward, backward method. Non Linear equation, comparison of linear and Non Linear Regression. Linearization transforms, uses & limitations, examination of non-linearity, iterative procedures for NLS, Newton-Raphson, Marquardt's methods, Additive regression models.

**Unit III**
**Generalized linear models**

Assumptions, Estimability and linear estimation: Gauss-Markov model, Least squares estimation, Distributional properties, BLUE, Variances and covariances of BLUEs, Error space, Estimation space.

**Unit IV**
**Family of Generalized Linear Models**

Exponential family of distributions, Formal structure for the class of GLMs, Likelihood equations, quasi likelihood, Link functions, Power class link function. **:** The Generalized Linear Mixed Model, including both fixed and random effects,

**Recommended Textbooks and References:**

1. Linear Models, Searle, S.R.(1971), John Wiley.
2. Linear Models in Statistics, Alvin C. Rencher (2000): John Wiley & Sons, New York
3. Linear Models - An Introduction , Guttman, I (1982): John Wiley
4. An Introduction to Generalized Linear Models, Dobson A J and Barnett A G Chapman and Hall(2008), 3rd Edition.
5. Applying Generalized Linear models, Lindsey J K, Springer, 1997.
6. Generalized Linear Models, McCullagh P and Nelder J A, Chapman and Hall(1989) 2$^{nd}$ Edition.

| No. of hours/week | Credits |
| --- | --- |
| 4 | 4 |

## DSC 08- Multivariate Analysis

**Course Objectives:**
•Provide students to identify and apply the multivariate statistical techniques in health research.
•Understand the principles and characteristics of the multivariate data analysis techniques

**Course Outcomes:**

•Students in this course learn principal component analysis, clustering, applications in test on mean vectors and MANOVA
•To understand the assumptions underlying their use, and appreciate the strengths and limitations of these methods.
•To use multivariate techniques appropriately, undertake multivariate hypothesis tests, and draw appropriate conclusions.
•Knowledge of multivariate methods is particularly helpful for gaining employment in statistical consulting.

**Unit I**

Multivariate Data in Biological Sciences, Examples, Multivariate Normal Distribution, Maximum Likelihood Estimators Of Parameters, Multivariate Linear Regression Model, Estimation Of Parameters, Testing Linear Hypothesis About Regression Co-efficients.

**Unit II**

Principal Component Analysis, Factor Analysis –Orthogonal Factor Model, Factor Loadings, Estimation Factor Loadings, Factor Scores, Applications, Canonical Correlations and Canonical Variable - Definition, Use, Estimation and Computation.

**Unit III**

Application in Test on Mean Vectors for Single and Several Multivariate Normal Populations, Hotelling's $T^2$ -Statistic and its Distribution, Relationship with Mahalanobis $D^2$ Statistic, Applications of Hotelling's $T^2$-Statistic.

<u>**Unit IV**</u>

Classification and Clustering, Linear Discrimination, Classification Trees, Hierarchical Clustering, K-Means Clustering, Multidimensional Scaling. Methods and Applications of MANOVA. Structural Equation Modelling and Path Analysis.

**Recommended Textbooks and References:**

1. Anderson, T. W. (1984) Introduction to Multivariate Analysis (John Wiley)
2. Kshirsagar, A. M. (1983) Multivariate Analysis (Marcel Dekker)
3. Morrison, D.F. (1990) Multivariate Statistical Methods (McGraw Hill Co.)(3rd ed.)
4. Rao, C. R. (1995) Linear Statistical Inference and its Applications. (Wiley Eastern Ltd.)
5. Johnson R.A. & Wichern, D.W. (1988) Applied Multivariate Statistical Analysis
6. Ḧardle, W. and Simar, L. (2003). Applied Multivariate Statistical Analysis. Springer.
7. Mardia, K.V., Kent, J.T. and Bibby, J.M. (1979). Multivariate Analysis. Academic Press.

| No. of hours/week | Credits |
|---|---|
| 4 | 4 |

## DSC 09- Design and Analysis of Experiments

**Course Objectives:**
•To learn the basic principles in the design of simple experiments and different tests for comparing pairs of treatment means, factorial experiments, confounding with solving real life examples.
•To learn the applications of different designs in agriculture.

**Course Outcome**
• Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA.
•Analyze the data using split plot and general factorial experiments.
•Construct fractional factorial experiments and apply confounding in real life problems.

## UNIT - I
**Introduction to design of Experiment**
Need for Research, Research , Response, Factor, Treatment Level, Replication, Need for Design of Experiments,  Experimental Design Technique,  Completely Randomized Design ( ANOVA), Randomized Complete Block Design, Latin Square Design.

## UNIT-II
**Factorial Experiments**
Two stage Nested Design, three stage nested design, $2^n$ – Factorial Experiment, Concept of $2^2$ – Factorial Experiment, Residual and Model Accuracy, Concept of $2^3$ – Factorial Experiment. Block and Confounded design of $2^2$ – Experiment, Block and Confounded design of $2^3$ – Experiment.

## UNIT – III
**Fractional Factorial Design**
Two level Fractional Factorial design : introduction, Half Fraction of $2^3$ -  Factorial Experiment, Half Fraction of $2^2$ -  Factorial Experiment, Half Fraction of $2^4$ -  Factorial Experiment, Half Fraction of $2^5$ -  Factorial Experiment, One -  Quarter Fraction of $2^n$ Factorial Experiment. Plackett-Burman Design

**Unit IV**

**Regression and Response Surface Design**

$3^k$-Factorial Design, Regression Approach, Linear regression, Simple Regression, Hypothesis Testing in Multiple Regression Testing for Lack of Fit, Introduction to Response Surface Methodology, The Method of Steepest Ascent, Central Composite Design, Response Surface design with Blocks, Box – Behnken design. Mixture Experiment – Simplex Lattice, Simplex Centroid design, Historical Model, Design of Orthogonal Arrays, ANOVA for orthogonal Array, L4 Orthogonal Array, L8 – Orthogonal Array, L9-Orthogonal Array, Multivariate Analysis of Variance (MANOVA).

**Recommended Textbooks and References:**

1. DOE Simplified: Practical Tools for Effective Experimentation, Third Edition Paperback – 1 July 2015, by Mark J. Anderson (Author), Patrick J. Whitcomb (Author)
2. DOE Simplified: Practical Tools for Effective Experimentation, 3rd Edition, *By Mark J. Anderson, Patrick J. Whitcomb,* Copyright Year 2015 , ISBN 9781482218947, Published July 1, 2015 by Productivity Press, 268 Pages 85 /W Illustrations.
3. Design and Analysis of EXPERIMENTS: 7th Edition, Doulas C. Montgomery, Copy @ 2009 by John Wiley & Sons, Inc, Authorized reprint by Wiley India (P) Ltd, 4435-36/7, Ansari Road, Daryaganj, New Delhi – 110002
4. Design and Analysis of EXPERIMENTS: R. Panneerselvam, PHL Learning Private Limited, New Delhi - 110001

| No. of hours/week | Credits |
|---|---|
| 4 | 4 |

SEMESTER THREE

## DSE 03a: Survival Data Analysis

**Course Objectives:**
•To understand different models from Survival Analysis and different types of censoring, learn to estimate and interpret survival characteristics.
•To provide the construction of parametric and non-parametric estimators of survival distributions, and probability density functions based on incomplete data.

**Course Outcome**
•Understand the concept of censoring, life distributions and ageing classes.
•Gained the ability to recognize the difference between parametric and non-parametric survival models.
•To estimate survival function, cumulative hazard rate function using Kaplan-Meier estimator and cox proportional models.

## Unit I
**Introduction to Survival Analysis**
Basic functions and Models. Censoring and Truncation , Parametric univariate estimation: Exponential, extreme value, gamma, Pareto, logistic, normal and log – normal, Survival function, hazard rate, cumulative hazard function, and mean residual life. Censoring mechanisms: type I, type II and random censoring. Equilibrium distribution function, Exponential distribution & it's ageing properties: Lack of memory property.

## Unit II
**Nonparametric univariate estimation**
Actuarial, Kaplan-Meier and Nelson-Aalen Estimators, Tests of equality of survival functions: Gehan's and Mantel-Haenszel tests. Treatment of ties (Peto's method).

## Unit III
**Semi parametric regression models**
Cox proportional hazard model – estimation, tests, Diagnostics. Graphical methods: Hazard plots and Survival plots, Regression for grouped data: Life table, logistic and proportional hazards approaches.

<u>Unit IV</u>
**Multivariate Models**

Additive Models. Accelerated Models, Competing Risk and Multivariate Survival models, Frailty Models. Ageing classes - IFR, IFRA, NBU, NBUE, HNBUE.

**Recommended Textbooks and References:**

1. Deshpande, J.V, Purohit, S.G.,(2005),Life Time Data :Statistical Models and Methods.
2. Klein J. P. and Moesch berger M.L. (1997) Survival Analysis: Techniques for censored and truncated data. Springer, New York.
3. Collett D (2003) Modelling Survival Data in Medical research 2 nd edition ,Chapman and Hall/CRC
4. Cox, D.R. and Oakes, D. (1984) Analysis of Survival Data, Chapman and Hall, New York.
5. Elandt-Johnson, R.E., Johnson N.L. (1980) Survival models and Data Analysis, John Wiley and Sons.
6. Gross A.J. and Clark, V. A. (1975) Survival Distributions: Reliability Applications in the Biomedical Sciences, John Wiley and Sons.
7. Miller, R.G. (1981) Survival Analysis, John Wiley and Sons.
8. Therneau T M and Grambsch P M (2000) Modeling Survival data extending the Cox model. Springer,  New York.
9. Duchateau L JohnsonP (2008) The Frailty model. Springer, New York
10. Hanagal D D (2011) Modeling Survival Data using frailty models CRC press

| No. of hours/week | Credits |
|---|---|
| 4 | 4 |

## DSE 03b- Operational Research and Quality Control

**Course Objectives:**

•To provide the knowledge and skills needed to apply in modeling problematic real-life situations.
•To concentrate on mathematical programming, stochastic models, statistical quality management and various other analytical aspects.

**Course Outcomes:**
•Build their expertise in mathematical modeling and gain flexible problem-solving skills based on a deep knowledge of optimization.
•Identify the goals and objectives of inventory and warehouse management and be capable of developing deterministic and stochastic inventory models.
•To know the concept of Quality and reliability theory and apply in real-life situations.
•To demonstrate the supplier selection process, understand quality management and supply chain management.

## Unit I
### Introduction to Operational Research
Definition & scope of Operational Research, Formulation of simple Linear Programming Problems, Simplex method and basics of Duality. Characteristics of Inventory System, Economic Lot Size Inventory models, reorder Level, Simple single period Stochastic Inventory Model.

## Unit II
### Queueing Models and Reliability
Definition of Queues and their characteristics, Queueing Models with Markovian Input and Markovian Service, M/M/1 & M/M/C .Queueing Models. Definitions of Reliability, Availability, Reliability of multicomponent systems, failure time distributions: exponential and Weibull.

## Unit III
### Concept of Quality and Control Charts
Quality characteristics. Control charts for variables and attributes. OC and ARL of control charts. Moving average (MA) and EWMA and CUSUM charts. Process control with auto correlated observations. Multivariate control charts.

**Acceptance Sampling Plans and TQM**

Acceptance sampling plans for attribute inspection Single, Double. Multiple and Sequential sampling plans and their properties; Plants for inspection by variable for one-sided and two-sided specifications; continuous sampling plans - chain sampling plans TQM, TQM the seven QC tools, Six-sigma programme.

**Recommended Textbooks and References:**

1. Churchman, C.W., Ackoff, R.L. and Amoff, E.L. (1957). Introduction to Operations Research.
2.  Hillier, F.R and Leibennan, G (1962). Introduction to Operations Research
3. Kanti Swarup and Gupta, M.M. (1985); Operations Research.
4. Philips, D.T., Ravindran, A. and Solberg, J. Operations Research, Principles and Practice.
5.  Taha, HA. (1982). Operational Research.
6. Johnson, N.L. and Kotz,S. (1993): Process capability indices, Chapman and Hall.
7. Montgomery; D. C. (1985): Statistical PrOi:eSS Control,Wiley.
8. Shridhara Bhat K. (2002): Total Quality Management Himalaya Publishing House.

| No. of hours/week | Credits |
|---|---|
| 2 | 2 |

SEMESTER THREE

## SEC 03-Data Analysis Using MATLAB

**Course Objectives:**
•To introduce students to the basic concepts of Matlab and its applications in real world.
•To bring about a problem- solving approach to the students by using matrix operators, solving linear equations and graphics.

**Course Outcomes:**
•Know the basic aspects of MATLAB software.
•Solve different types of mathematical problems and draw various types of graphs
Using MATLAB.
•Use of multivariate techniques to model the data.

## Unit I

### Introduction to MATLAB
What Is MATLAB, Advantages And Disadvantages, MATLAB   Key Features, Getting Help In MATLAB, Importing And Exporting Data, Desktop Basics, Arithmetic Operations: Addition, Multiplication, Division, Powers, Log, Trigonometry, Exponential and Functions, Variables In MATLAB.

## Unit II

### Descriptive Statistics and Distribution
Functions For Calculating And Plotting Descriptive Statistics: Maximum, Minimum, Mean, Median, Mode, Standard Deviation, Variance And Statistics On Plots, Basic Visualization: Bar Diagram And Histogram, MATLAB Commands For Discrete Distribution And Continuous Distribution, Introduction to Simulation Using MATLAB.

## Unit III

### Linear Algebra and Matlab Graphics
Basics Matrix Operation: Matrix Addition and Scalar Multiplication, Matrix Multiplication, Matrix Algebra ,Matrix Inverses ,Powers Of A Matrix, the Transpose And Symmetric Matrices, Cross Product, Dot Product,  System Of Linear Equations, Inverse And Determinants, Eigen Values. Matlab Graphics-2-D Plots And 3-D Plots, Formatting And Annotation, Images ,Printing And Savings ,Line Plots :Syntax, Plotting Multiple Lines.

## Unit IV
### Modeling Data

Linear Correlation, Correlation Co-Efficient, Linear Regression: Simple Linear Regression, Fitting Data with Cure Fitting Toolbox, Multivariate Data, M-Files, Parametric and Non Parametric Test. Introduction and basic concept to Image Analysis.

**Recommended Textbooks and References:**

1. Understanding MATLAB by S.N. Alam (Author), S.S. Alam
2. Statistics in MATLAB: A Primer by MoonJung Cho, Wendy L. Martinez
3. Computational Statistics Handbook with MATLAB, Wendy L. Martinez, Angel R. Martinez, Second Edition,

| No. of hours/week | Credits |
|---|---|
| 2 | 2 |

## AECC- Documentation & Research Methodology

**Course Objectives:**

•Explain what research is and the different definitions of research.
•Understand some basic concepts of research and its methodologies.
•Identify appropriate research topics and define appropriate research problem and parameters.
•Prepare a project proposal, Organize and conduct research (advanced project) in a more appropriate manner.

**Course Outcome**
• To develop the basic framework of research process.
• Know the various research designs and techniques.
• To identify various sources of information for data collection.
•Gain a practical understanding of the various methodological tools used for social scientific research and to prepare good research report.

### Unit I
**Introduction to Research**
Need for Research, Designing the methodology, Protocol Writing, Report Writing and Presentation of data, Sample size determination and Power of study

### Unit II
**The Anatomy and Physiology of Research**
What it is made of, How it works, Designing the study, Conceiving the Research Question: Origins of a research question, Characteristics of a good research questions, Developing the research question and study plan, Choosing Study Subjects: Basic terms and concepts, Selection criteria, Sampling, Recruitment of study subjects. Measurement scales- Precision, Accuracy and other features of measurement approaches. Type of case studies.

**Designing a Cohort Studies**

Prospective cohort studies, Retrospective cohort studies, Nested Case-Control and Case-Cohort studies, planning a cohort study, designing an Observational Study: Cross sectional studies, Case control studies, choosing among observational designs, Enhancing Causal Inference in Observational Studies: Spurious associations.

<u>**Unit IV**</u>

 **Implementing the Study and Quality Control**

Assembling Resources - Space, Research team, Leadership and Team- Building, Institutional Review Board Approval, Operational Manual and Forms Development, Database Design,

Finalizing The Protocol: Pre-test and Pilot Studies, Quality Control During The study : Good Clinical Practice, Quality Control for Clinical Procedures, Quality Control for Laboratory Procedures, Quality Control for Data Management.


**Recommended Textbooks and References:**

1. Designing Clinical Research, Stephen B.Hulley, Pub: Lippincott Williams and Wilkings, a Wolters   Kluwer  business, 530 W Walnut street,  Philadelphia,  PA 19106   USA, LWW.com, Third Edition

2. Introductory Biostatistics, CHAP T.LE  - PUBLISHED BY John  wiley and Sons,,Inc., Hoboken,  New Jersey, Second Edition.

3. Research Methodology (2018), C.R Kothari and Gaurav Garg, NEW AGE INTERNATIONAL PUBLISHERS, Fourth Edition.
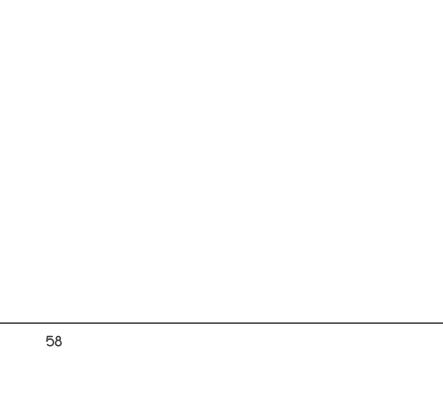
| No. of hours/week | Credits |
| --- | --- |
| 2 | 2 |

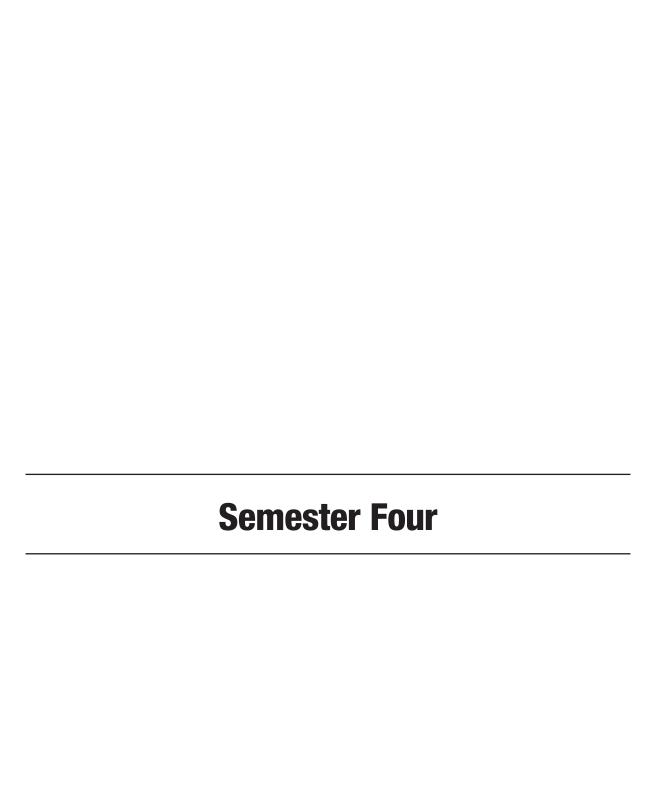<u>SEMESTER THREE</u>

**Practical 05- Statistical Analysis using MATLAB**

1. Arithmetic Operations and Functions.
2. Descriptive Statistics
3. 2-D Plot and 3-D Plot.
4. MATLAB Graphics
5. Basic Visualization.
6. Matrix Operation.
7. Discrete and Continuous distribution..
8. Correlation and Regression Analysis.

**Practical 06- Statistical Analysis using DOE Software**

1. Factorial Design-$2^2$ and $2^2$.
2. Block and Confounded design of $2^2$.
3. Plackett –Burman Design.
4. Design Lackett –Burman Design.
5. Simplex Lattice and Historical Model.
6. Simplex Centroid design.
7. L4 Orthogonal Array, L8-Orthogonal Array.

# Internship -2 Credits

# Semester Four

Accepts of method validation: observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with static package (Sigma STAT, SPSS for student t-test, ANOVA, etc.), hypothesis testing.

## DISSERTATION

| Course Type | Marks | Credits | L | T | P | C |
|---|---|---|---|---|---|---|
| Project | 300 | | | | | 12 |

The student shall carryout, a semester long project work under the supervision/mentorship of identified guide (internal or external or both). The project work shall be compiled and submitted in the form of dissertation as per the format. The project work shall be original research work related to the programme or case studies that provide an analysis of specific research questions/socio-economic issues, etc. leading to a dissertation as partial fulfilment of the degree.

# Question Paper Pattern

**JSS Academy of Higher Education & Research, Mysuru**
(Deemed to be University)
**First Semester M.Sc., (Program) (RS-1) Examination - Year**
**Subject:**
*Note:* Draw neat, labeled diagrams wherever necessary.
*Your answers should be specific to the questions asked.*

**Time: 03 Hours** **Max Marks: 70**

I. **LONG ESSAYS (Answer any TWO of the following)** **2x15=30 Marks**

1.

2.

3.

II. **SHORT ESSAYS (Answer any FIVE of the following)** **5x6=30 Marks**

4.

5.

6.

7.

8.

9.

10.

III. **SHORT ANSWERS (Answer all the following)** **5x2=10 Marks**

11.

12.

13.

14.

15.

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**JSS Academy of Higher Education & Research, Mysuru**
(Deemed to be University)
**First Semester M.Sc., (Program) (RS-1) Examination - Year**
**Subject:**
*Note:* *Draw neat, labeled diagrams wherever necessary.*

*Your answers should be specific to the questions asked.*

**Time: 02 Hours**                                                        **Max Marks: 50**

**I**      **LONG ESSAYS (Answer any TWO of the following)**          **2x10=20 Marks**

   1.

   2.

   3.

**II**     **SHORT ESSAYS (Answer any FIVE of the following)**          **5x4=20 Marks**

   4.

   5.

   6.

   7.

   8.

   9.

   10.

**III**    **SHORT ANSWERS (Answer all the following)**               **5x2=10 Marks**

   11.

   12.

   13.

   14.

   15.

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