## Department Of Statistics (UG)

<table>
<thead>
<tr>
<th>Semester</th>
<th>Category</th>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>MC</td>
<td>ST 1502</td>
<td>STATISTICAL METHODS</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>I</td>
<td>MC</td>
<td>ST 1503</td>
<td>PROBABILITY AND RANDOM VARIABLES</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>II</td>
<td>AR</td>
<td>ST 2103</td>
<td>STATISTICAL METHODS FOR ECONOMICS</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>II</td>
<td>AR</td>
<td>ST 2104</td>
<td>BUSINESS STATISTICS</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>II</td>
<td>AR</td>
<td>ST 2105</td>
<td>FUNDAMENTALS OF STATISTICS</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>II</td>
<td>MC</td>
<td>ST 2503</td>
<td>CONTINUOUS DISTRIBUTIONS</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>II</td>
<td>MC</td>
<td>ST 2504</td>
<td>DISCRETE DISTRIBUTIONS</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>III</td>
<td>EG</td>
<td>ST 3301</td>
<td>BASIC STATISTICAL TECHNIQUES</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>III</td>
<td>AO</td>
<td>ST 3204</td>
<td>BIOSTATISTICS</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>III</td>
<td>AO</td>
<td>ST 3205</td>
<td>ADVANCED STATISTICAL METHODS</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>III</td>
<td>MC</td>
<td>ST 3505</td>
<td>SAMPLING THEORY</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>III</td>
<td>MC</td>
<td>ST 3506</td>
<td>MATRIX AND LINEAR ALGEBRA</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>IV</td>
<td>AO</td>
<td>ST 4208</td>
<td>STATISTICS FOR MANAGEMENT</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>IV</td>
<td>AO</td>
<td>ST 4209</td>
<td>MATHEMATICAL STATISTICS</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>IV</td>
<td>AO</td>
<td>ST 4210</td>
<td>ECONOMETRICS</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>IV</td>
<td>EG</td>
<td>ST 4301</td>
<td>PROGRAMMING IN C</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>IV</td>
<td>MC</td>
<td>ST 4503</td>
<td>ESTIMATION THEORY</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>IV</td>
<td>MC</td>
<td>ST 4504</td>
<td>SPREADSHEET APPLICATIONS</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>V</td>
<td>ES</td>
<td>ST 5407</td>
<td>SQL and PL SQL</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>V</td>
<td>ES</td>
<td>ST 5409</td>
<td>RELIABILITY THEORY</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>V</td>
<td>ES</td>
<td>ST 5406</td>
<td>ACTUARIAL STATISTICS</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>V</td>
<td>ES</td>
<td>ST 5408</td>
<td>APPLIED STOCHASTIC PROCESSES</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>V</td>
<td>MC</td>
<td>ST 5508</td>
<td>APPLIED STATISTICS</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>V</td>
<td>MC</td>
<td>ST 5509</td>
<td>REGRESSION ANALYSIS</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>V</td>
<td>MC</td>
<td>ST 5510</td>
<td>TESTING OF HYPOTHESES</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>V</td>
<td>MC</td>
<td>ST 5511</td>
<td>STATISTICAL DATA ANALYSIS USING SPSS</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Week</td>
<td>MS</td>
<td>ST</td>
<td>Course Title</td>
<td>CR</td>
<td>EC</td>
</tr>
<tr>
<td>------</td>
<td>-----</td>
<td>-----</td>
<td>------------------------------------------</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>VI</td>
<td>MS</td>
<td>ST 6606</td>
<td>DESIGN AND ANALYSIS OF EXPERIMENTS</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>VI</td>
<td>MS</td>
<td>ST 6607</td>
<td>OPERATIONS RESEARCH</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>VI</td>
<td>MS</td>
<td>ST 6608</td>
<td>STATISTICAL QUALITY CONTROL</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>VI</td>
<td>SK</td>
<td>ST 6652</td>
<td>R LANGUAGE</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>VI</td>
<td>SK</td>
<td>ST 6652</td>
<td>SURVEY PRACTICE &amp; REPORTING</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>
Objectives: 1) To introduce the basic concepts in Statistics
       2) To develop data reduction techniques

Unit - 1 Definition - Scope and limitations of Statistics - Collection of data - Census. Sampling surveys - Classification and tabulation - diagrammatic and graphical representation of data - Nominal, ordinal and interval scaling.


Unit - 3 Curve fitting - Principle of least squares - linear, nonlinear, exponential and growth curves.

Unit - 4 Correlation - Rank Correlation - Regression analysis - Problems based on raw data and grouped data.

Unit - 5 Association of attributes - Notations - Classes and class frequencies - Consistency of data - Independence of attributes - Yule's coefficient of association - coefficient of colligation.

Books for Study:


Books for Reference:
ST 1503 - PROBABILITY AND RANDOM VARIABLES

Semester I
Category: MC
Hours/Week : 3
Credits : 3

Objectives: 1) To introduce probability theory as a foundation for Statistics.

2) To help students understand the basic notions about random variables.


Unit 5 Introductory notions on Random Variables - Random Variables – Discrete and Continuous Random Variables – p.g.f, p.m.f. and p.d.f. – c.d.f. Mathematical Expectation and Variance of a random variables. Chebyshev’s Inequality.

Books for Study:


Books for Reference:

ST 2103 - STATISTICAL METHODS FOR ECONOMICS
(for Economics Students)

Semester II
Category: AR
Hours/Week: 6
Credits: 4

Objectives: 1) To introduce the basic concepts in Statistics and their applicability in Economics.

2) To develop problem solving skills using statistical tools and techniques.


Unit 2: Data Collection & Sampling Methods: Primary & Secondary data, Sources of data, Methods of collecting data. Sampling – Census & Sample methods – Methods of sampling, Probability Sampling and Non-Probability Sampling.


Unit 5: Time Series & Index numbers: Index numbers – Price & Quantity index numbers of Fisher, Laspeyre, Paasche, Kelly & Marshal-Edgeworth. Cost of living Index. Uses & Limitations of index numbers. Analysis of Time series – (Linear Relationship only)

Books for study:

Books for Reference:

ST 2104 - BUSINESS STATISTICS
(for Commerce Students)

Semester II
Hours/Week : 6
Category: AR
Credits : 4

Objectives:
1) To introduce basic concepts of Statistics
2) To provide statistical techniques for business data analysis.
Unit 1 Measures of Central tendency: Simple averages – mean, median and mode – Geometric mean and Harmonic mean – weighted arithmetic mean.


Skewness: Karl Pearson and Bowley’s Coefficient of skewness – Moments – Kurtosis.

Unit 2 Curve fitting: Fitting a straight line and second degree parabola.


Books for study:


Books for reference:

ST 2105 – FUNDAMENTALS OF STATISTICS

Semester III

Objective:
1) To introduce basic concepts of Statistics
2) To provide statistical techniques for business data analysis


Unit 2: Presentation of Data: Diagrammatic representation of data – Bar diagram – pie diagram – Histogram – Frequency polygon and frequency curve – Pictogram- and cartogram – Measures of central tendency: Simple average, Mean, Median and Mode – Geo-metric mean and Harmonic Mean – Weighted arithmetic mean

Unit 3: Measures of Dispersion: Range – Quartile deviation – Mean deviation – Standard deviation – Coefficient of variation - combined mean and standard deviation - Skewness : Karl Pearson and Bowley’s coefficient of Skewness


Books for study:

Books for reference:

ST 2503 - CONTINUOUS DISTRIBUTIONS

Semester II

Category: MC

Hours/Week : 6

Credits : 6

Objective: 1) To impart essential knowledge in continuous distributions

2) To expose the real-life applications of continuous distribution


Unit 2: Normal Distribution – Properties – M.G.F – Linear Combinations of Normal Variate – Reproductive Property, Bivariate Normal – Mean – Variance
Unit 3: Beta, Gamma, Cauchy, Exponential – Properties – M.G.F – Distribution Function – Properties

Unit 4: Functions of Random Variable – Transformation of Variables – Chi-square, t and F distribution – Properties

Unit 5: Order Statistics and their distributions. Limiting Distribution – Stochastic Convergence – Lindberg – Levy Central Limit Theorem

Books for Study

Books for Reference
ST 2504 - DISCRETE DISTRIBUTIONS

Semester II
Category: MC
Hours/Week : 3
Credits : 3

Objective: 1) To impart essential knowledge in Discrete distributions

2) To expose the real-life applications of Discrete distribution


Unit 5: Hyper geometric distribution – Properties – M.G.F – Characteristic function, Multinomial Distribution – Mean – Variance – Marginal and Conditional distribution – Additive Property
Books for Study:


Books for Reference:


ST 3204 - BIOSTATISTICS
(for Adv. Zoology and Plant Biology & Biotechnology Students)

Semester III
Category: AO
Hours/Week : 6
Credits : 4

Objectives : 1) To imbibe statistical techniques applicable in biological sciences.

2) To demonstrate the applications of statistical methods in real-life situations.

Unit 1 Organizing and summarizing Biological Data – Measures of Central tendency – Measures of Dispersion – Correlation and Regression.
**Unit 2** Probability – Addition, Multiplication and Baye’s theorems, Distributions – Binomial, Poisson and Normal distributions – Sampling distributions $\chi^2$, t and F

**Unit 3** Tests of Significance-Single population mean and the difference between two population means – Paired comparisons-Single proportion and the difference between two population proportions – Confidence Interval – mean, difference of means, proportion, difference of proportions.

**Unit 4** Chi-square distribution and the analysis of frequencies – Test of Goodness of fit – Test of Independence of attributes – Analysis of Variance-Completely Randomized Design-Randomized Block Design – Factorial experiments – $2^2$, $2^3$ experiments.

**Unit 5** Non parametric tests – Sign test, Median test, Mann-Whitney test.

**Books for study:**


**Books for reference:**

Objective: 1) To impart knowledge and methodology behind the various statistical techniques
2) To equip students with statistical techniques useful in business and economic analysis

Unit 1 Association of attributes: Consistency of data - Methods of studying association: Proportion method, Yule's coefficient of association, Coefficient of colligation, Coefficient of contingency. Partial association.


Unit 3 Tests of significance: Procedure of testing a hypothesis - Standard error and sampling distributions. Tests for assigned mean, assigned proportion, equality of means and equality of proportions (small and large sample tests) - Chi-square test for independence.

Unit 4 Analysis of variance: Assumptions in Analysis of variance - Techniques of Analysis of variance - One-way and Two-way classification models.

Unit 5 Statistical Quality Control: Control charts - Control limits - Types of control charts - X bar chart, R chart, p chart and c chart, Advantages and disadvantages of SQC.

Books for study:


Books for reference:
ST 3301: BASIC STATISTICAL TECHNIQUES

Semester: II                                      Category: EG
Hours/Week : 3                                     Credits : 1

Objective: 1) To introduce the basic concepts of statistical methods

               2) To demonstrate the applications via MS-Excel

Unit 1 Definition and scope of statistics - Construction of frequency table - Diagrammatic representation - Illustrations.

Unit 2 Measures of central tendency - Mean, Median, Mode and Quartiles. Illustrations.

Unit 3 Measures of Dispersion - Mean deviation, Standard deviation, Quartile deviation and Co-efficient of variation. Illustrations.
Unit 4 Correlation and regression - Karl Pearson's correlation co-efficient - Spearman's rank correlation - Regression lines. Applications.

Unit 5 Simple ideas in probability theory - Sample space - Events - Probability of an event. Simple problems.

Books for study:


Books for Reference:

1. R.S.N and Bagavathi,(1984), Practical statistics, Sultan Chand and sons.
ST 3505 - SAMPLING THEORY

Semester III Category: MC
Hours/Week : 6 Credits : 6

Objectives: 1) To equip students with Sampling Techniques used in conducting sample surveys.
2) To compare the efficiency of various estimation strategies resulting from different sampling techniques.

Unit 1 Preliminaries: Sampling Vs Census - Basic concepts of sampling - Population - Parameter - Statistic - Unbiasedness - Mean square error - simple problems.

Unit 2 Simple Random Sampling: Simple random sampling with and without replacement - Estimation of population mean - Variance of estimators - Simple problems.

Unit 3 Stratified Sampling: Estimation of total ,mean - Its variance - Allocation problems - Simple problems.

Unit 4 Systematic Sampling: Linear, Circular. Comparisons for populations with one-dimensional linear trend.

Unit 5 Use of Auxiliary Information.Ratio Estimation.Regression Estimation.

Book for study:

Books for Reference:
ST 3506 - MATRIX AND LINEAR ALGEBRA

Semester III

Category: MC

Hours/Week: 3

Credits: 3

Objective: 1) To expose students acquaintance with some fundamental notions and techniques of
matrices and vectors

2) To impart mathematical techniques which are required for pursuing core areas of statistics.


**Unit 3 (Vectors):** Vector space. Linear dependence & Independence. Basis & Dimension. Linear equations – Cramer’s rule.

**Unit 4 (Linear Transformations):** Linear Transformations & Properties. Matrix of a LT. Orthogonal Transformations.


**Book for Study:**

1. Datta, K. B. (2004): Matrix and Linear Algebra. Prentice Hall of India. [Chapters & Sections to be covered]

   For Unit 1: Chapter 1 (Sections 1.1 to 1.4 – Relevant Portions)

   Chapter 2 (Sections 2.2 to 2.4 – Relevant Portions)

   For Unit 2: Chapter 3 (Sections 3.1 to 3.3 – Relevant Portions);

   Chapter 4 (Sections 4.1, 4.2, 4.4, 4.5, 4.7 – Relevant Portions)

   For Unit 3: Chapter 5 (Sections 5.1, 5.2, 5.6 – Relevant Portions)
For Unit 4: Chapter 6 (Sections 6.1 – 6.3, 6.5 – Relevant Portions)

For Unit 5: Chapter 7 (Sections 7.1, 7.2, 7.4 – Relevant Portions)

Books for Reference:


ST 4208 - STATISTICS FOR MANAGEMENT

Semester: IV Category: AO
Hour/Week: 6 Credits: 4

Objectives: 1) To expose students to concepts in Business Statistics

2) To teach the applications of Statistics in Management

UNIT - 2: Tests of Significance: Procedure for testing hypothesis - standard error - tests for assigned mean, assigned proportion, equality of means and equality of proportions - small and large sample tests - Chi-square test for independence - Analysis of Variance - one and two way ANOVA only.

UNIT - 3: Index Numbers: Construction of Index numbers - unweighted index numbers - weighted index numbers - Laspeyre's method, Paasche's method, Dorbish&Bowley method, Marshal Edgeworth method, Fisher's method, Kelly's method - quantity index numbers - chain index numbers - base shifting - Splicing and deflating the index numbers - consumer price index numbers - aggregate expenditure method and family budget method.

UNIT - 4: Statistical Quality Control: Control charts - control limits - types of control charts - \( \overline{X} \) Chart, R chart, p Chart and c chart - merits and demerits of SQC.


Books for study:


Books for reference:


New York.
ST 4209 - MATHEMATICAL STATISTICS

<table>
<thead>
<tr>
<th>Semester IV</th>
<th>Category: AO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours/Week : 6</td>
<td>Credits : 4</td>
</tr>
</tbody>
</table>

**Objective:**
1) To impart statistical concepts and results with rigorous mathematical treatment.
2) To enable the real-life applications of Statistics

**Unit 1** Probability: Definition of probability, finite sample space, conditional probability and independence of events. Basic problems.

**Unit 2** Random variables: Definition of random variable, distribution function, and expectation. Discrete, continuous and concept of mixture of distributions. Expectation and moments: Moment generating function, Chebyshev's inequality.

**Unit 3** Special univariate distributions: Discrete distributions - uniform, binomial and Poisson distributions. Their properties. Continuous distributions - uniform, normal, exponential, beta and gamma distributions.

**Unit 4** Joint, marginal and conditional distributions: Trinomial and bivariate normal distribution. Their properties. Correlation and regression. Transformation of random variables. Chi-square, t, and F distributions.


**Books for study:**


**Books for reference:**

ST4210 - ECONOMETRICS

Semester IV Category: AO
Hours/Week : 6 Credits : 4

Objective: 1) To equip the students with concepts and techniques of analysing economic
phenomena using statistical tools.

2) To expose the students to econometrical modelling.

Unit 1 Statistical inference (basic concepts only), random variables, probability distribution, expectation and variance, random sample, sampling distributions, point and interval estimation, hypothesis testing, illustrations.

Unit 2 Role of econometrics, General linear model - matrix representation,
Least - squares estimation, properties of OLSE , two and three variable regression models, illustrations.

Unit 3 Linear hypothesis - hypothesis testing, coefficient of determination. Tests of structural change. Dummy variables. Prediction. Illustrations.

Unit 4 Problems in regression analysis - Multicollinearity, heteroscedasticity,
Unit 5 Generalized least squares, GLS estimator and its properties, Auto - regressive models, lagged variables.

Books for study


Book for reference:


ST 4301: PROGRAMMING IN “C”

Semester III

Hours/week: 3

Credit: 1

Objective:

1) To equip the students with basic principles of “C” language.
2) To expose the students to their real-life applications.
Unit 1  “C” – Character set, constants, variables and arithmetic expressions. Basic structure of a C program. Operators: Arithmetic operators, assignment operator, relational operators, conditional operators, logical operators and special operators.

Unit 2  Pre-processor directives: #define and #include directives. Library functions: mathematical library functions, string-handling functions. Input and output functions: scanf, printf, gets, puts, getchar and putchar functions.

Unit 3  Control statements: decision making statements – if, if ... elseif, goto, switch case, break and continue statements.

Unit 4  Loop statement: while, do and for statements.

Unit 5  Arrays: one-dimensional and two–dimensional arrays. User defined functions – examples.

Books for study :


Books for Reference:

ST 4503 - ESTIMATION THEORY

Objective: 1) To equip the students with the theory essential for estimation of unknown parameters.

2) To expose the students to its real-life applications.


Unit 4  Elements of Baye's estimation - Prior and Posterior distributions - Examples.

Unit 5  Confidence intervals for mean when S.D is known and S.D is unknown when the sample is drawn from Normal Population , Confidence interval for Proportion, Confidence interval for difference in means, difference in proportions, Confidence interval of variance and ratio of variances.

Books for study:


Books for Reference:

**ST 4504 – SPREADSHEET APPLICATIONS**

**Semester IV**

**Category: MC**

**Hours/Week : 3**

**Credits : 3**

**Objective:**

1) To impart knowledge in Excel Functions and Data Handling

2) To train students in Applied Statistics through MS Excel

**Unit 1:** Overview of MS Excel – Numeric, String and Date Formats – Entering formula in cell, Inbuilt mathematical and Statistical functions and its use

**Unit 2:** Construction of Bar, Pie, Histogram, Line Chart, Scatter Plot, Usage of Secondary axis in charts, Chi-square test of independence
**Unit 3:** Sorting - Filtering – Removing duplicates – Conditional formatting – Relative and Absolute Cell reference – Vlookup – Hlookup – Pivot tables – Integration with Data base MS access and Oracle.

**Unit 4:** Simple Correlation, Simple Regression - Constructing Model - Predicting New Observation - Curve Fitting – Fitting of Binomial, Poisson, Normal

**Unit 5:** Matrix Operations – Inverse – Solutions of linear of equations – Eigen roots and Vectors

**Book for Reference:**

ST 5407 - SQL and PL SQL

Semester: V
Category: ES
Hours/Week: 3
Credits: 2

Objectives:
1) To create an awareness to database concepts
2) To manage database effectively through SQL and PL/SQL

Unit - 1 Introduction to Database Systems – Basic concepts of relational database systems – Database administrator- Data models - Storage management - Entity Relationship model

Unit – 2 Delimiters- Identifiers-Reserved Words-Predefined Identifiers-Quoted Identifiers-Literals- Numeric Literals-Character Literals-String Literals-BOOLEAN Literals-Comments-Restrictions on Comments-Declarations-Constants - Restrictions on Declarations and properties.

Unit - 3 Data Definition Language (DDL) - Data Manipulation Language (DML) - Data Control Language (DCL).

Unit - 4 Programming Languages through SQL. PL / SQL - PL / SQL syntax and constructs - SQL within PL / SQL - DML in PL / SQL - Cursors – Procedures.

Unit- 5: Functions - Packages and Triggers – Merges – Inner joint - Outer joint.
Books for study:


Book for Reference:

ST 5409: RELIABILITY THEORY

Semester: V
Category: ES
Hours/week: 3
Credits : 2

Objective:
1) To Impart the Statistical concepts underlying Reliability theory
2) To discuss several performance measures of systems in industries and related inference problems.

Unit 1 Basic concepts in reliability theory – failure time distribution, reliability, MTBF, hazard rate function, examples, IFR and DFR distributions. Reliability importance of exponential distribution.

Unit 2 types of systems – series, parallel and standby systems of order 2. (k, n) systems. Measures of system performance.

Unit 3 Systems with repair, parallel and standby systems of order 2 with a repair facility. Transient solution and measures of performance. Availability and Steady state availability.

Unit 4 Coherent systems – structure function, examples of coherent systems, properties – representation of coherent systems in terms of paths and cuts – reliability of systems of independent components.

Unit 5 Life testing – exponential distribution in life testing. Inference based on Type II censored sample.

Books for Study:


Books for reference:

ST 5406 - ACTUARIAL STATISTICS

Semester V  
Category: ES  
Hours/Week : 3  
Credits : 2

Objectives: 1) To impart basic concepts in actuarial studies

2) To prepare students to take up a career in Actuarial Practice

Unit – 1  Effective Rate of Interest \( i \) - Nominal Rate of Interest \( i^{(m)} \) - Force of Interest \( \delta \) - Relationships between different rates of interest - Expression for \( \delta \) by use of calculus - Present values - Effective rate of discount \( d \) - Nominal rate of discount \( d^{(m)} \).
Unit - 2  Annuities - Immediate Annuity - Annuity-due - Perpetuity - Accumulation and Present values of Annuities - Increasing and Decreasing annuities - Annuities and interest rates with different frequencies - Continuous Annuities.

Unit - 3  Analysis of Annuity payments - Capital and Interest elements included in the Annuity payments - Loan outstanding after t payments - Purchase price of Annuities - Annuities involving income tax - Purchase price of an annuity net of tax.

Unit - 4  Stochastic Interest rates - Independent annual interest rates - The definition of $S_n$ - Mean and variance of $S_n$ - Definition of $A_n$ - Mean and variance of $A_n$ - Simple problems.

Unit - 5  Probabilities of living and dying - The force of mortality $\mu_x$ - Estimation of $\mu_x$ - Uniform Distribution of deaths - Select and Ultimate rates.

Books for study:


Books for reference:

**ST 5408: APPLIED STOCHASTIC PROCESSES**

<table>
<thead>
<tr>
<th>Semester V</th>
<th>Category: ES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours/Week : 3</td>
<td>Credits : 2</td>
</tr>
</tbody>
</table>

**Objective:**
1) To imbibe Statistical knowledge in Stochastic Process

2) To equip students with elements of stochastic processes with applications in other disciplines.

**Unit – 1** Elements of stochastic processes - definition and examples. Classification of general Stochastic processes.

**Unit – 2** Markov Chains - definition and examples. Recurrent and transient states, periodicity. Examples. One-dimensional random walk.

**Unit – 3** Basic limit theorem and its applications - Irreducible Markov Chain, Basic limit theorem - examples.

**Unit – 4** Stationary distribution of a Markov Chain - existence of a stationary distribution. Illustrations.

**Unit – 5** Continuous time Markov Chains - Poisson process - marginal distribution of a Poisson process - Pure Birth process - marginal distribution of a Pure Birth process.
Books for study:


Books for reference:

ST 5508  APPLIED STATISTICS

Semester V  Category: MC
Hours/Week : 6  Credits : 6

Objective:  1) To expose statistics students to wide genre of study
           2) To bring out its significant role in various areas of study

Unit 1: Index Numbers :- Basic problems in construction of index numbers. Methods – Simple and Weighted Aggregate methods, Average of Price Relatives, Chain Base method

Criteria of goodness – Unit test, Time Reversal, Factor Reversal & Circular tests.

Base shifting, Splicing & Deflating index numbers. Wholesale Price index & Consumer price index numbers. Index of industrial production.

Unit 2: Educational & Psychological Statistics

Scaling procedures – Scaling of individual test items, of scores, of rankings & of ratings.

Reliability of test scores – Index of reliability, Parallel tests, Methods for determining test reliability, Effect of test length & ranges on reliability.

Unit 3: Vital Statistics


Unit 4: Time Series – Trend Component :

Unit 5: Time Series – Other Components:


Book for Study:


Book for Reference:


ST 5509 REGRESSION ANALYSIS

Semester V Category: MC
Hours/Week : 6 Credits : 6

Objective: 1) To introduce the vital area of regression models applicable in a wide variety of situations.

2) To expose the students to the wide areas of its applications.

Unit 2: Model diagnostics - Mean predicted value, Testing normality of error term, QQ-plot, PP-plot, Anderson Darling, Kolmogrov Smirnov

Unit 3: Introduction to Multiple Linear Regression Model, Partial Regression Coefficients, Testing Significance overall significance of Overall fit of the model, Testing for Individual Regression Coefficients, Estimating $R^2$, MAE and MAPE

Unit 4: Dummy Variable trap, Study of Interaction Effects, Varying Intercept and Slope using dummy variable, Detection and Removal of Outliers

Unit 5: Study of Normality of Error Term using graphical and testing procedures, Testing for Multicollinearity using VIF, Testing for assumption of Homoscedasticity

Books for Study:


Books for Reference:

ST 5510 TESTING OF HYPOTHESES

Semester V

Category: MC

Hours/Week : 6

Credits : 6

Objective:
(i) To introduce the concepts of hypothesis testing
(ii) To illustrate the concepts with various numerical examples.

Unit – 1 Statistical hypotheses- simple null hypothesis against simple alternative - Best Critical Region.
Neyman -Pearson Lemma - Most powerful randomized tests - examples.

Unit - 2 One parameter exponential family - Families with monotone likelihood ratio property - UMP
tests for one-sided hypotheses (without proof) - examples.

Unit - 3 Elements of SPRT - Likelihood ratio tests - examples.

Unit - 4 Tests of significance - tests based on normal, t, chi - square and F distributions

Unit - 5 Non-parametric methods - Run test for randomness - sign test for location - Median test - Mann-
Whitney - Wilcoxon test - Kolmogorov-Smirnov test - one and two sample problems.

Books for Study:


Books for Reference:


ST 5511 - STATISTICAL DATA ANALYSIS USING SPSS

Semester V
Hours/Week : 6
Category: MC
Credits : 6

Objective: 1) To train students in SPSS Software
2) To expose the students to the analysis of statistical data

**Unit 1:** Data handling: open SPSS data file – save – import from other data source – data entry – labeling for dummy numbers - recode in to same variable – recode in to different variable – transpose of data – insert variables and cases – merge variables and cases.

**Unit 2:** Data handling: Split – select cases – compute total scores – table looks – Changing column - font style and sizes

**Unit 3:** Diagrammatic representation: Simple Bar diagram – Multiple bar diagram – Sub-divided Bar diagram - Percentage diagram - Pie Diagram – Frequency Table – Histogram – Scatter diagram – Box plot.

**Unit 4:** Descriptive Statistics - Mean, Median, Mode, SD- Skewness- Kurtosis. Correlation – Karl Pearson’s and Spearman’s Rank Correlation

Regression analysis: Simple and Multiple Regression Analysis

[ Enter and stepwise methods]


**Books for Study:**


**Books for reference:**

ST 6606 - DESIGN AND ANALYSIS OF EXPERIMENTS
Semester VI Category: MS
Hours/Week : 5 Credits : 7

Objective: 1) To provide basic principles of experimentation

2) To discuss the analysis of data relating to agriculture, biological sciences and industry.

Unit 1 Contrasts - linear constraints - orthogonal contrasts - linear models - fixed effect model - random effect model - mixed effect model.

Unit 2 Principles of experimentation - analysis of variance - one-way classification - two-way classification - two-way classification with more than one observation per cell efficiency of two way over one way.

Unit 3 Completely Randomised Design (CRD) - Randomised Block Design (RBD) - Latin Square Design (LSD) - missing plot techniques.

Unit 4 Factorial designs: $2^2$, $2^3$ and $3^2$ factorial designs; confounding and partial confounding.
Unit 5 BIBD: Intra block analysis of BIBD. Construction of BIBD (Simple construction).

Books for study:


Books for reference:


ST 6607 - OPERATIONS RESEARCH

Semester VI
Hours/Week : 5
Credits : 7

Objective: 1) To train the students with Optimization techniques towards solving decision
making problems based on deterministic and probabilistic models.

2) To impart an insight of the applications of Operations Research in Management

**Unit 1**  
Introduction to OR - Linear programming problem - Formulation - Graphical method - Basic solution - Optimum solution - Simplex method - Various cases - Unbounded solution - Unrestricted variables, alternative optimum.

**Unit 2**  
Need for artificial variables - Two phase method - Big M method - Primal, Dual relationship - Dual simplex method.

**Unit 3**  

**Unit 4**  
Networks - CPM and PERT - problems.

**Unit 5**  
Decision under uncertainty - Laplace criterion - Minimax criterion - Savage criterion - Hurvitz theorem - Games - Two person zero sum games - Saddle point - Solving by graphical method - solving by LPP.

**Books for study**


**Books for reference:**

ST 6608 - STATISTICAL QUALITY CONTROL

Semester VI

Category: M5

Hours/Week : 5

Credits : 6

Objective: 1) To provide an insight into quality assessment techniques.

2) To provide an insight into the real-life and varied application of the subject.

Unit 1 Quality improvement in the modern business environment: Philosophy and basic concepts of quality improvement - Statistical methods for quality improvement - Total Quality Management (TQM).

Unit 2 Modeling process quality: Describing variation - Histogram, Stem and Leaf plot, Box plot, Frequency distributions, Quantile plot (qq-plot) applications.

Unit 3 Statistical Process Control (SPC): Methods and philosophy of SPC - Control charts for attributes data - p chart, np chart, c and u charts and D chart - Control charts for variables - X and R charts, X and S charts - Applications.

Unit 4 Basic principles of CUSUM and slant control charts - process capability analysis - Applications.
Unit 5  Acceptance sampling: The acceptance sampling problem - Single sampling plan for attributes with applications - Basic concepts of double, multiple and sequential sampling plans - Concept of CSP.

Books for study:


Books for reference:

Objective: 1) To impart efficient Data Handling Techniques

2) To equip students to Statistical Programming Skills based on real life examples and datasets

Unit 1: Overview of R Environment – R editor – Workspace – Data type – Importing and Exporting Data – Basic Computational Ideas – Merges in R

Unit 2: Matrix Determinant – Inverse – Transpose – Trace – Eigen Values and Eigen Vectors – Construction of Bar, Pie, Histogram, Line Chart, Box Plot, Scatter Plot


Unit 5: Control Charts – Variable Control Chart - \( \bar{x} \), R, S. Attribute Control Chart- p, np, c, u. CUSUM Control Chart, EWMA Control Chart, Process Capability Analysis
ST 6652 - SURVEY PRACTICE & REPORTING

COMPONENT 2

Semester VI
Category: SK

Hours/Week : 6
Credits : 6

Objective:
1) To motivate the students to understand the fundamentals to Sampling Survey
2) To enable and motivate the students to perform Statistical Analysis in Sampling Survey

Groups of students are expected to collect Primary Data through Design of Sample Surveys and Secondary Data from various sources, carry out statistical analysis and present a report on their findings. The surveys shall address some of the contemporary issues.

The data analysis needs to be carried out using any statistical package of the students’ choice.

Department of Statistics (PG)
<table>
<thead>
<tr>
<th>Sem</th>
<th>Cate</th>
<th>Code</th>
<th>Title</th>
<th>Hrs</th>
<th>Crs</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>MC</td>
<td>ST 1820</td>
<td>ADVANCED DISTRIBUTION THEORY</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>I</td>
<td>MC</td>
<td>ST 1821</td>
<td>APPLIED REGRESSION ANALYSIS</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>I</td>
<td>MC</td>
<td>ST 1822</td>
<td>STATISTICAL MATHEMATICS</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>I</td>
<td>MC</td>
<td>ST 1823</td>
<td>FUNDAMENTALS OF DATA BASE ADMINISTRATION</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>I</td>
<td>MC</td>
<td>ST 1824</td>
<td>STATISTICS LAB – I</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>II</td>
<td>MC</td>
<td>ST 2814</td>
<td>ESTIMATION THEORY</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>II</td>
<td>MC</td>
<td>ST 2815</td>
<td>TESTING STATISTICAL HYPOTHESES</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>II</td>
<td>MC</td>
<td>ST 2816</td>
<td>SAMPLING THEORY</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>II</td>
<td>MC</td>
<td>ST 2817</td>
<td>CATEGORICAL DATA ANALYSIS</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>II</td>
<td>MC</td>
<td>ST 2818</td>
<td>STATISTICS LAB – II</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>II</td>
<td>ES</td>
<td>ST 2959</td>
<td>MODERN PROBABILITY THEORY</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>II</td>
<td>ES</td>
<td>ST 2960</td>
<td>ACTUARIAL STATISTICS</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>III</td>
<td>MC</td>
<td>ST 3815</td>
<td>MULTIVARIATE ANALYSIS</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>III</td>
<td>MC</td>
<td>ST 3816</td>
<td>STOCHASTIC PROCESSES</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>III</td>
<td>MC</td>
<td>ST 3817</td>
<td>STATISTICAL QUALITY CONTROL</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>III</td>
<td>MC</td>
<td>ST 3818</td>
<td>STATISTICS LAB – III</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>III</td>
<td>ES</td>
<td>ST 3957</td>
<td>DATA WAREHOUSING AND DATA MINING</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>III</td>
<td>ES</td>
<td>ST 3958</td>
<td>NON-PARAMETRIC METHODS</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>III</td>
<td>ID</td>
<td>ST 3875</td>
<td>MATHEMATICAL FINANCE MODELS</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>IV</td>
<td>MC</td>
<td>ST 4813</td>
<td>APPLIED EXPERIMENTAL DESIGNS</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>IV</td>
<td>MC</td>
<td>ST 4814</td>
<td>ADVANCED OPERATIONS RESEARCH</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>IV</td>
<td>MC</td>
<td>ST 4815</td>
<td>BIOSTATISTICS AND SURVIVAL ANALYSIS</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>IV</td>
<td>MC</td>
<td>ST 4816</td>
<td>STATISTICS LAB – IV</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>IV</td>
<td>MC</td>
<td>ST 4817</td>
<td>PROJECTS</td>
<td>8</td>
<td>7</td>
</tr>
</tbody>
</table>
ST 1820 ADVANCED DISTRIBUTION THEORY

Semester I

Category: MC

Hours/Week : 6

Credits : 5

Objectives: 1) To impart knowledge on the construction of statistical models

2) To apply statistical models which are relevant to real life problems


Unit 2: Multivariate discrete distributions : Trinomial and Bivariate Poisson distribution, their properties, Multinomial and Multivariate Poisson distributions.

Unit 3: Multivariate continuous distributions : Bivariate normal and Bivariate exponential (Marshall and Olkin) distributions, properties, Multivariate extensions.
**Unit 4:** Non-central distributions: Non-central Chi-square, Non-central t and Non-central F distributions and their properties. Compound distributions and Mixtures of distributions, order statistics, their distributions and properties.

**Unit 5:** Quadratic forms in Normal variates, properties of idempotent matrices. Quadratic forms, definiteness of a quadratic form. Generalised inverse (elementary ideas only). Necessary and Sufficient condition for a Quadratic form to be distributed as a Chi-square, Cochran’s theorem.

**Books for study**


**Books for reference:**


**ST 1821 APPLIED REGRESSION ANALYSIS**

**Semester:** I  
**Category:** MC  
**Hours/Week:** 6  
**Credits:** 5

**Objectives:** 1) To study linear and non-linear relationships between variables.  
2) To train students in applications of regression models in real life situations.

**Unit 1** Multiple Linear Regression. Estimation of model parameters, Hypothesis testing, Confidence intervals, Prediction, Residual analysis, PRESS statistic, Lack of fit.
Unit 2  Correcting Model Inadequacies. Variance stabilizing transformations, Linearizing a model, Selection of transformation, Generalized and weighted least squares, Indicator variables.


Unit 4  Polynomial and Non Linear Regression. Polynomial regression model in one variable – Piecewise polynomial fitting (Splines), Non-parametric regression, IVM-Linear regression models, Non-linear least squares, Transformation to a linear model, Inference problem in non-linear regression.


Books for Study:


Books for reference:

Objectives: 1) To train students in the mathematical foundation for post-graduate studies in Statistics.

2) To expose students the mathematical pre-requisites of statistics


Infinite series – convergence – tests for convergence

Unit 2: Real functions – Boundedness, monotonicity, continuity. Differentiable functions – Extreme Values.


Unit 5: Eigen values and vectors – Quadratic forms – Diagonal forms – Matrix square root. Gram-Schmidt Orthogonalization (Notion only)

Books for Study:

   Unit – I : Sections 2.1, 2.3 to 2.8, 3.1 to 3.4, 3.6
   Unit – II : Sections 4.2, 4.3, 4.4, 4.5, 7.1, 7.3, 9.2
   Unit – III : Sections 8.1, 8.3, 8.4, 8.5

   Unit IV : Sections 5.9 to 5.13, 5.17, 5.19, 5.22, 6.4, 7.2, 7.3, 7.4
   Unit V : Sections 8.1 to 8.4

   Unit – V : Sections 3.4 to 3.7, 6.5

Books for Reference:

ST 1823 FUNDAMENTALS OF DATA BASE ADMINISTRATION

Semester : I
Category: MC
Hours/Week : 6
Credits : 3

Objectives: 1) To introduce the concepts and practice of data base administration
2) To demonstrate the purpose of analysing large scale statistical data sets

Unit 1: Client Server Architecture – Three Tier Architecture – Application Server Components – SQL Basics that covers creating database objects, storing, retrieving and manipulating data in a relational database – Advanced SQL – SQL* Loader

Unit 2: PLSQL fundamentals, language structures, flow of execution and interface with SQL – Stored Procedures, Functions, Packages and Triggers.


Unit 4: Managing Table Spaces – Maintaining Data files, Control files, Redo Log Files – Storage structure and relationships – Managing rollback segments, Tables and indexes, Data Integrity.

Unit 5: Managing Password Security and resources – Users, Roles and Privileges.

Books for study:

ST 1824 STATISTICS LAB – I

Semester : I  Category: MC (Practical)
Hours/Week : 6  Credits : 3

Objectives: 1) To expose students on the applications of Statistical Model Building using R-Programming

2) To develop statistical model building skills through analysing real life problems

Basics of R Programming

- Importing and Exporting Datasets
- Usage of Inbuilt Mathematical, Statistical and Special Functions in R
• Subset Observations, Variables from Datasets
• Creating new variables from existing variables
• Merging Datasets – Inner Joins, Outer Join, Left Outer Join, Left Inner Join
• Coding user defined functions in R Language

Linear and Matrix Algebra

• Linear Dependency and Linear Indepency
• Determining Matrix Determinant and Matrix Inverse
• Determining Characteristic Roots and Characteristic Vectors
• Determining Rank, Index and Signature of a Quadratic form

Advanced Distribution Theory

• Fitting of Binomial and Poisson Distribution
• Fitting of Truncated Binomial and Truncated Poisson Distribution
• Fitting of Mixture of Geometric and Poisson
• Fitting of Mixture of Two Poisson
• Generating Samples from Discrete and Continuous Distributions

Applied Regression Analysis

• Building Linear Regression Model with Categorical Explanatory Variable
• Testing for Overall Model fit and Individual Regression Coefficients
• Determining R-Square, Adjusted R-Square, MAE and MAPE
• Study of Interaction Effects among Explanatory variable
• Detection of Outliers by Standardised and Studentized Residuals
• Testing for Multicollinearity using VIF and Conditional Index
• Transformation and Combining Variables to deal Multicollinearity
• Residual Analysis – Testing for Normality of Residuals, Transformation
• Residual Analysis – Testing Functional form of explanatory variables
• Testing for Homoscedasticity, Weighted Least Squares Regression
• Model Validation, Bootstrap Regression Methods

ST 2814 ESTIMATION THEORY

Semester II Category: MC
Hours/Week : 5 Credits : 5

Objectives: 1) To provide a strong theoretical foundation to aid in optimal inference strategies.
2) To illustrate the real life applications of estimation procedures.


**Unit 2:** Sufficiency, Fisher-Neyman factorization theorem, examples. Rao-Blackwell theorem.

**Unit 3:** Completeness and bounded completeness. Basu’s theorem. Lehmann-Scheffe theorem, examples.

**Unit 4:** Method of maximum likelihood, consistent asymptotic normal (CAN) estimators, examples. Invariance property of CAN estimators.

**Unit 5:** Baye’s and minimax estimation, examples. M-estimation, Jack knife and Bootstrap methods.

**Books for study:**


**Books for reference:**

ST 2815 TESTING STATISTICAL HYPOTHESES

Semester: II
Hours/Week: 5
Category: MC
Credits: 5

Objectives: 1) To impart knowledge on techniques for testing of hypotheses towards decision support based on sample characteristics.
2) To illustrate the real life applications of testing problems and procedures

Unit 1 Statistical hypotheses, Neyman – Pearson fundamental lemma, distributions with monotone likelihood ratio, Generalization of the fundamental lemma (without proof).

Unit 2 Two-sided hypotheses, Unbiasedness for hypothesis testing.Applications to one-parameter exponential family.Similarity and completeness.

Unit 3 UMP unbiased tests for multiparameter exponential family and applications. Confidence Intervals. Unbiased confidence sets.

Unit 4 Symmetry and invariance, maximal invariants, most powerful invariant tests, unbiasedness and invariance.

Unit 5 Likelihood ratio tests, large sample properties, asymptotic distribution of LRT statistic for simple null hypothesis.

Books for study:

Books for reference


ST 2816  SAMPLING THEORY

Semester: II  Category:MC
Hours/Week: 5  Credits:5

Objectives: 1) To impart knowledge on various sampling techniques useful in survey methodology.
2) To demonstrate sampling inspection procedures using sampling techniques.


Unit 2  Sampling with varying probability – procedures for ppsselection –Desraj ordered and Murthy’s unordered estimators – HT estimator – optimal properties of HT estimators – estimation of variance of HTE

Unit 3  Stratified sampling – estimation of the population mean – allocation problems. Systematic sampling – Methods for populations with linear trend – Comparison with SRSWOR and stratified sampling for standard populations.

Unit 4  Multi stage sampling- Multi phase sampling - Ratio estimation - approximation to bias and MSE – regression estimation - approximation to bias and MSE - Double sampling for ratio and regression .
Cluster sampling and multistage sampling under SRS methods.
Unit 5  Non-response – effects of non-response, Warner’s model, Simmons randomized response technique. Planning and organization of large scale surveys

Books for Study:

Books for Reference:

ST 2817  CATEGORICAL DATA ANALYSIS

Semester II  Category: MC
Hours/Week : 5  Credits : 3

Objectives: 1) To introduce students to the exciting new area of analysis of categorical data

2) To equip students with knowledge and techniques required to handle data-modeling situations involving categorical data.
Unit 1: Categorical Response data – Inference procedures. Contingency tables – Comparison of proportions, partial association in 2 x 2 and 1 x J tables. Testing independence in two-way contingency tables.

Unit 2: Generalized Linear Model – For binary data & count data. Inference for & Fitting of GLMs.


Book for Study:

Book for Reference:
ST 2818  STATISTICS LAB – II

Semester: II  
Category: MC  
Hours/Week : 4  
Credits : 2

Objectives: 1) To Provide hands on experience in implementation of concepts in Estimation theory, Testing of Statistical Hypothesis and Categorical Data Analysis

2) To apply advanced statistical software for relevant applications

Estimation Theory

- Estimation of unknown parameter through MLE Procedure
- Deriving Confidence Intervals for the unknown parameter
- Bayesian Estimation Procedure
- Bootstrap and Jackknife Procedures

Testing of Statistical Hypothesis

- Basic Parametric and Non Parametric Tests
- Determining Test Function, Level and Power of Test Function, Power Curve
- MP Test, Uniformly Most Powerful Test, Uniformly Most Powerful Unbiased test

Sampling Theory

- Simple Random Sampling With and Without Replacement
- Stratified Random Sampling, Midzuno Sampling
ST 2959  MODERN PROBABILITY THEORY

Semester : II  
Category: ES

Hours/Week : 4  
Credits : 3

Objectives:  1) To impart knowledge in the advanced probability theory

2) To illustrate probabilistic pre-requisites which are required for building statistical 
models.

Unit 1: Classes of events: Classes - Fields and σ-Fields; Definition of Probability; Independence of Events, 
Properties, Discrete, General, and Induced Probability Spaces, Counting, Lebesgue- Stieltjes measures. 

Unit 3: Modes of Convergence of Random Variables: Limits of Random Variables, Convergence in Probability, Convergence Almost Surely, Convergence in Distribution, Convergence in $r^{th}$ mean,

Unit 4: Laws of Large Numbers: Weak and Strong law of large Numbers


Book for Study:

Books for Reference:
Objectives: 1) To educate interested students about the applications of statistics in insurance industry.

2) To compute several measures which are relevant to actuarial statistics.

Unit 1: Compound Interest-Accumulated value and present value annuities certain, present values, amounts, annuities, perpetuities, Redemption of loans.

Unit 2: Further compound interest and Annuities certain, Nominal and effective rates of discount – capital redemption of policies.

Unit 3: Mortality tables – construction of mortality tables comparison of different mortality tables.


Unit 5: Office premiums – policy values – Further life contingencies - methods of valuation – Data for valuation – special reserves and adjustments

Books for Study:

Books for reference:


ST 3815 MULTIVARIATE ANALYSIS

Semester : III Category: MC
Hours/Week : 6 Credits : 5

Objectives: 1) To provide students the requisite knowledge and skills to handle multi-dimensional data and extract useful information from the data.

2) To derive statistical inference based on multivariate statistical analysis

Unit 1 (Basic Preparation): Multivariate Normal distribution – Properties, Distributions of linear combinations, independence, marginal distributions, conditional distributions, Partial and Multiple correlation coefficient. Moment generating function.

Unit 3 (Inference for several populations): Paired comparisons & Repeated Measures design, Multivariate ANOVA – One way & Two way. Profile analysis.


Books for study:


Books for Reference:

ST 3816  STOCHASTIC PROCESSES

Semester : III                      Category: MC
Hours/Week: 6                       Credits: 5

Objectives:  1) To introduce the variety of situations that can be handled by the theory of Stochastic Processes
             2) To expose students to several processes in disciplines like Biology, Engineering and Economics that are stochastic in nature.


Unit 5: Branching process – generating function relations, estimation probabilities, two – type branching process – Description of continuous time branching process. Stationary process – mean square distance, prediction and covariance stationary process.

Books for study:

Books for Reference.


ST 3817 STATISTICAL QUALITY CONTROL

Semester: III
Hours/Week : 4
Category: MC
Credits : 3

Objectives: 1) To train students in modern statistical process control techniques.

2) To detect variation in production process and suggests inspection plans

Unit 1: Meaning and Scope of Statistical process control (spc), Shewart Control Charts for X-bar, R, np, p, c charts. and their uses. OC and ARL of control charts. Uses of runs and related patterns of points.

Unit 2: control charts based on C.V. extreme values, moving averages, geometric moving averages, modified control charts

CUSUM procedures, use of V mask, derivation of ARL. Multivariate control charts.
Unit 3: Process capability, tolerance limits, beta content and beta expectation, Normal theory and non-parametric approaches.

Unit 4: Sampling inspection plans. Classification and general properties Sampling plans by variables, estimation of lot defective and plan parameter determination in known and unknown cases. Continuous sampling plans – CSP- 1 and its modifications. Derivation of AOQL for CSP-1, operations of MLP’s and Wald- Wolfowitz plans.

Unit 5: Implementing six sigma. Six sigma overview and implementations- smarter six sigma solutions(S4) measurements : converting defect rates(DPMO or PPM) to six sigma quality levels- six sigma relationships- six sigma assumptions- S4 assessment- basic control charts and S4 assessments- examples.

Books for study :

1. Duncan A.J. – Quality Control and Industrial Statistics (2010), 2nd edition, Homewood,

Books for reference:

Objectives: 1) To enable students to use statistical packages for analyzing Multivariate Data, Stochastic process and Quality Control.

2) To expose students to interpret the output and provide recommendations

Multivariate Analysis

1. Computation of Means, Variances, Covariance and Correlations from a Multivariate dataset.
2. Computation of Partial correlation coefficients from the Var-Cov matrix of a multivariate normal population.
3. Computation of Multiple Correlation coefficients from the Var-Cov matrix of a multivariate normal population.
4. Tests for significance of correlation coefficient using samples from multivariate normal populations—Simple Correlation, Partial correlation and Multiple correlation coefficients.
5. Applications of $T^2$ Statistics to different situations – Test for mean of a single MV normal population, Test for equality of mean vectors of two MV normal populations with equal var-cov matrices & unequal var-cov matrices, Special Applications.
6. MANOVA – One-way & Two-way models.
7. Principal component analysis.
8. Factor Analysis
9. Canonical Correlation Analysis
10. Fishers Discriminant Analysis – Two populations, several populations. Classification with Prior Probabilities.

Statistical Process Control

1. Control Chart for Attributes – $p$-chart, np-chart, c-chart, u-chart.
2. Control charts for variables – $\bar{X}$-chart, R-chart, S-chart.
4. Special charts – Moving range chart, CUSUM charts, Exponentially Weighted Moving Average charts.
5. OC Curves for various charts.
7. Double Sampling Plan – OC curve, ASN curve, AOQ curve, ATI curve

Stochastic Process:
1. Determination of $P^n$ for a transition probability matrix.
2. Determination of stationary distribution.
3. Generating a Poisson process; waiting time distribution.
4. Extinction probability in a branching process.

ST 3957 DATA WAREHOUSING AND DATA MINING

Semester: III  
Category: ES  
Hours/Week: 4  
Credits: 3

Objectives: 1) To recourse knowledge discovery through database which leads to Business Intelligence.
2) To illustrate the applications of data warehousing and data mining in statistical tools


Unit 3: Naive Bayes Classification Method, Bayesian Networks, Path Analysis, Back Popagation Algorithm, Building Predictive Model using Artificial Neural Network, Support Vector Machine, Decision Tree Methods - Classification Tree, Regression Tree, Decision tree based on Statistical Significance - Chi Square Automated Interaction Detector(CHAID). Comparing Classifier Accuracy.
Unit 4: Construction of Gains Chart, ROC Curve, Leave one out validation and N fold validation, Construction of Logit Model Tree, K th Nearest Neighbourhood Classification, Bagging and Boosting Principles, Adaptive Boosting Algorithm, Decision Stumps and Random Forest, Apriori Algorithm and Association Rule Mining

Unit 5: Additive Regression, Logit Boost, Multi Class Classifier, Ordinal Class Classifier, Expectation Maximization Algorithm, Genetic Algorithm, Combining Classifiers, Cost Sensitive Classifier, Text Mining – Methods and Models

Books for Study:
2. Han J and Kamber M (2002), Data Mining concepts and Techniques, Morgan Kaufmann Publishers (Only relevant sections), SRI ESWAR ENTERPRISES

Books for Reference:

ST 3958 NON-PARAMETRIC METHODS

Semester: III
Category: ES
Hours/Week: 4
Credits: 3

Objectives: 1) To explore knowledge in the advanced methods of non-parametric inference.

2) To derive inference for samples drawn from distribution free population

Unit 1: Introduction, Run test for randomness, $\chi^2$ goodness of fit test. Kolmogrov – Smirnov one sample test, Kolmogrov – Smirnov two sample test, Binomial test, Point estimator and confidence interval for probability of success.

Unit 3: Two sample problems – Wilcoxon rank sum test for location parameter (Mann – Whitney).

Test for dispersion parameter – Rank test, Rank like test (Moses), Millers asymptotic test based on Jackknife.

Unit 4: One way layout – Kruskal Wallis test. Test for ordered alternatives, Multiple comparison based on Kruskal Wallis rank sums. Two way layout – Friedman’s rank sums test. Test for ordered alternatives, multiple comparisons.

Unit 5: Kendals test for independence. Theil’s test for regression coefficients. Hollander’s test for parallelism of two regression lines.

Books for Study:

Book for Reference:
ST 3875  MATHEMATICAL FINANCE MODELS

Semester: III  Category: ID
Hours/Week : 6  Credits : 5

Objectives: 1) To expose the students of Statistics to the different aspects of Finance and modeling of Finance phenomena.

2) To enable appropriate decisions and actions in finance matters.

Implementation: The topics under ‘Deterministic Ideas’ to be taught by Mathematics Faculty and those under ‘Stochastic Ideas’ to be taught by Statistics Faculty.

Unit 1: Deterministic Ideas – Introduction to Finance & Securities; Interest rates; Present value analysis; Rate of return; Continuous varying interest rates.

Stochastic Ideas – Brownian & Geometric Brownian Motion; The Arbitrage Theorem; Multi-period Binomial model.

Unit 2: Deterministic Ideas – Options Pricing; Pricing via Arbitrage; The Delta Hedging Arbitrage Strategy; Stochastic Ideas – Black-Scholes Formula; Properties of Black-Scholes Option Cost.

Unit 3: Deterministic Ideas – Call options on Dividend-Paying Securities; Limitations of Arbitrage Pricing; Valuing investments by Expected Utility. Stochastic Ideas – Adding jumps to GB Motion; Estimating the Volatility Parameter; Portfolio selection problem.

Unit 4: Deterministic Ideas – Capital Assets Pricing Model; Deterministic Optimization Model.
Stochastic Ideas – Value at risk & Conditional value at risk; Mean Variance analysis of Risk-Neutral-Priced Call Options; Rate of return: Single Period and GB Motion.

Unit 5: Deterministic Ideas – Exotic options; Barrier Options; Monte Carlo Simulation; Pricing Exotic Options by Simulation. Stochastic Ideas – Probabilistic Optimization Problems; Efficient Simulation Estimators; Options with non-linear payoffs; Pricing Approximations via Multiperiod Binomial Models.

Book for study:

Objectives: 1) To provide both basic and advanced experimental designs applied in Agriculture, Pharmaceutical, Industrial and Biological sciences.

2) To derive solutions for statistical inference problems


Unit 2: Factorial Design – $2^n$; $3^n$ factorial designs. Finite fields and design of experiments. Partial confounding and complete confounding – confounding in more than two blocks. Fractional factorials – construction and analysis-concept of resolution plans.

Unit 3: Asymmetrical factorial designs (AFD)- AFD- confounded asymmetrical factorial design construction of balanced confounded asymmetrical factorials-split and strip-plot experiment.

Unit 4: Incomplete block designs – varietal Trials – incomplete block design balanced incomplete block designs (BIBD) construction of BIBD – analysis of BIBD, Youden square design – Lattice designs. Partially balanced incomplete block design (PBIBD) – analysis and construction of PBIBD - Group divisible- simple-triangular- Latin square type and cyclic PBIBD.


Books for study:

Books for reference:


ST 4814  ADVANCED OPERATIONS RESEARCH

Semester IV  
Category: MC

Hours/Week : 6  
Credits : 5

Objectives: 1) To introduce students the statistical and mathematical formulations for handling a range of business based problems.

2) To develop a broad appreciation of different types of decision-making environments.

Unit 1: General Linear programming problem- Formulation- Solution through Graphical, Simplex, Big-M and Two phase Methods – Duality in Linear programming – Goal programming problem.

Unit 2: Non-linear programming- Kuhn Tucker theorem- Lagrangian multipliers method-Wolfe’s and Beale’s algorithm for solving Quadratic programming problems.
Unit 3: Inventory control: Deterministic Models – Economic Order Quantity – Problems with no shortages – The fundamental EOQ Problems, EOQ problems with several production runs of unequal length – Problems with price breaks – One price break, More than one price break - Probabilistic models – Single Period Problem without set-up cost – I and II.

Unit 4: Queuing theory- (M/M/1): (GD/\infty/\infty), (M/M/1): (GD/N/\infty), (M/M/C): (GD/\infty/\infty), (M/M/C): (GD/N/\infty).

Unit 5: Integer Programming-Branch and Bound and Cutting plane methods- Dynamic Programming - Solution of LPP by DPP. Simulation- Formulating and Implementing a Simulation model.

Books for study:

Books for reference:
Objectives: 1) To develop sound judgment about data applicable to clinical care

2) To emphasize study design and interpretation of results of medical research

Unit 1: Introduction to Medical research – Study Designs – Observational studies; Experimental Studies & Clinical trials; Meta Analysis, Research questions about mean of a group & proportions in a group. Repeated measures design – Paired comparison of means; Kappa statistic; McNemar test. Sign test for median; Wilcoxon Signed Rank test.

Unit 2: Research questions about means and variances of two groups; Levene test; Wilcoxon Rank Sum test. Decisions on proportions in two groups – z-test; Chi-Square test. Diagnostic Procedures with Threshold model. Measuring the accuracy of diagnosis – Sensitivity, Specificity; ROC curve.


Unit 4: Kaplan Meier Survival Curve, Life Table Analysis, Comparison of Survival Distribution – Log Rank Test for comparing two groups, Log rank test for comparing n-groups.

Unit 5: Cox Proportional Hazard Model, Meaning of PH Assumption, ML Estimation of Cox Proportional PH Model, Adjusted Survival Curves using Cox PH Models, Evaluating the Proportional Hazard Assumption – Graphical Approach, Goodness of fit test approach,

Book for Study and Reference:


Book for Reference:
ST 4816 STATISTICS LAB – IV

Semester : IV
Category: MC (Practical)
Hours/Week : 4
Credits : 2

Objectives: 1) To Provide Practical Knowledge in Analysing problems in Design of Experiments, Operations Research, Biostatistics and Survival Analysis

2) To demonstrate hands on experience for problems using statistical software

Design of Experiments

- Complete Randomized Design, Randomized Block Design, Latin Square Design
- Balanced Incomplete Block Design, Split Plot Design
- Factorial Design - $2^2$, $2^3$, $2^4$, $3^2$, $3^3$, $3^4$
- Construction of Contours, Response Surface Methods.
- ANOCOVA
Advanced Operations Research

- Graphical Method, Simplex Method - Linear Programming Problems
- Branch and Bound, Cutting Plan Method – I.P.P
- Queueing Theory – (M|M|1) : (GD|∞|∞), (M|M|1);(GD|N|∞),
  (M|M|C): (GD|∞|∞), (M|M|C): (GD|N|∞)
- Wolf’s Algorithm – Beales Algorithm

Biostatistics and Survival Analysis

- Paired comparison of means; Kappa statistic; McNemar test. Sign test for median
- Wilcoxon Signed Rank test, Levenetest,Wilcoxon Rank Sum test,Chi-Square test
- Survival Function, Hazard Function, Kappa Statistic, Relative Risk, Likelihood Ratio
- Odds Ratio, Sensitivity and Specificity, Mortality Rates, Adjusted Rates,
- Kaplan – Meier Survival Curves, Life Table Method
- Log Rank Test, Wilcoxon Test, Likelihood Ratio Test
- Cox Proportional Hazard Model, Cox Model with time dependent Covariates