**KURUKSHETRA UNIVERSITY, KURUKSHETRA**

**(Established by the State Legislature Act XII of 1956)**

(**‘A+’ Grade, NAAC Accredited)**

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Scheme of Examination and Syllabus of

B.Sc. with Statistics CBCS LOCF w.e.f. session 2020-21 in Phased manner

CBCS CURRICULUM (2020-21)

Program Name: B.Sc. with Statistics CBCS LOCF

**KURUKSHETRA UNIVERSITY, KURUKSHETRA**

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**Credit Distribution for Statistics subject in the programme B.Sc. with Statistics under Choice Based Credit System (CBCS LOCF) w.e.f. the session 2020-21.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Core Courses (DSC) | Ability Enhancement Courses | Discipline Specific Elective Courses(DSE) | Skill Enhancement Courses(SEC) | Total Credits |
| Theory | 24 | - | 08 | 4 | 32 |
| Practical | 08 | - | 04 | - | 12 |
| Total | 32 | - | 12 | 4 | 48 |

**Semester wise Distribution of Credits**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | First year Credit | | Second year Credit | | Third year  Credit | | |  | Total Credits | | |
| 1st Sem | 2nd Sem | 3rd Sem | 4th Sem | 5thSem |  | 6thSem | | |  |  |
| Ability Enhancement Courses  (AECC) | - | - |  |  | - |  | - | | |  | - |
| Core Courses | 08 | 08 | 08 | 08 | - |  | - | | |  | 32 |
| Discipline Specific Elective Courses(DSC) | - | - | - | - | 06 |  | 06 | | |  | 12 |
| Skill Enhancement Courses(SEC) | - | - | 2 | - | - |  | 2 | | |  | 4 |
| Total | 08 | 08 | 10 | 08 | 06 | 20 | 08 | | |  | 48 |

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**Scheme of Examination of B. Sc with Statistics under CBCS w.e.f. 2020-2021 in phased manner**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Semester-I** | | | | | | | | | | | | | | | | | |
| **Paper**  **Code** | | | **Course opted** | **Nomenclature** | | **Credits** | | | **Hours/ week** | **Marks (B.Sc.)** | | | | | | **Duration of Exam (hours)** | |
| **Ext.** | | **Int.** | | | **Total** |
| DSCS-118 | | | Statistics-I | Statistical Method-I | | 3 | | | 3 | 60 | | 15 | | | 75 | Three | |
| DSCS-119 | | | Statistics-II | Probability Theory | | 3 | | | 3 | 60 | | 15 | | | 75 | Three | |
| DSCS-120 | | | Statistics Practical-I | Practical-I | | 2 | | | 4 | 40 | | 10 | | | 50 | Three | |
| **Semester-II** | | | | | | | | | | | | | | | | | |
| DSCS-218 | | | Statistics-III | Statistical Method-II | | 3 | | | 3 | 60 | | 15 | | | 75 | Three | |
| DSCS-219 | | | Statistics-IV | Probability Distributions | | 3 | | | 3 | 60 | | 15 | | | 75 | Three | |
| DSCS-220 | | | Statistics Practical-II | Practical-II | | 2 | | | 2 | 40 | | 10 | | | 50 | Three | |
| **Semester-III** | | | | | | | | | | | | | | | | | |
| SEC-301 | Skill Enhancement Course-I | | | Programming Skills With C | | 2 | | | 2 | 40 | | 10 | | | 50 | Three | |
| DSCS-318 | Statistics-V | | | Elementary Inference | | 3 | | | 3 | 60 | | 15 | | | 75 | Three | |
| DSCS-319 | Statistics-VI | | | Sample Surveys | | 3 | | | 3 | 60 | | 15 | | | 75 | Three | |
| DSCS-320 | Statistics Practical-III | | | Practical-III | | 2 | | | 4 | 40 | | 10 | | | 50 | Three | |
| **Semester-IV** | | | | | | | | | | | | | | | | | |
| DSCS-418 | | Statistics-VII | | Parametric and Non- parametric Tests | | 3 | | | 3 | 60 | | 15 | | | 75 | Three | |
| DSCS-419 | | Statistics-VIII | | Design of Experiments | | 3 | | | 3 | 60 | | 15 | | | 75 | Three | |
| DSCS-420 | | Statistics Practical-IV | | Practical-IV | | 2 | | | 4 | 40 | | 10 | | | 50 | Three | |
| **Semester-V** | | | | | | | | | | | | | | | | | |
| DSES1-518 | | Statistics Elective-1 | | | Applied Statistics-1 | | 2 | 2 | | | 40 | | 10 | 50 | | | Three |
| DSES2-518 | | Bio-Statistics | |
| DSES3-519 | | Statistics Elective-1I | | | Numerical Methods and Fundamentals of Computers | | 2 | 2 | | | 40 | | 10 | 50 | | | Three |
| DSES4-519 | | Econometrics | |
| DSES-520 | | Statistics Practical-V | | | Practical-V | | 2 | 4 | | | 40 | | 10 | 50 | | | Three |

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|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Semester-VI** | | | | | | | | |
| SECS1-601 | Skill Enhancement Course-IV (Statistics) | Statistical Data Analysis using R | 2 | 2 | 40 | 10 | 50 | Three |
| SECS2-601 | Statistical Simulation |
| DSES5-618 | Statistics Elective-III | Applied Statistical-II | 2 | 2 | 40 | 10 | 50 | Three |
| DSES6-618 | Linear Models |
| DSES7-619 | Statistics Elective-IV | Operations Research | 2 | 2 | 40 | 10 | 50 | Three |
| DSES8-619 | Actuarial Statistics |
| DSES-620 | Statistics Practical- VI | Practical-VI | 2 | 4 | 40 | 10 | 50 | Three |

**Note:-The course (paper) SECS1-601 or SECS2-601Skill Enhancement Course IV (Statistics) of the Programme B.Sc. Physical Sciences: (Physics, Mathematics, Statistics), which will be offered in the 6th Semester of the Programme,   is same as the course SECS1-401 or SECS2-402 Skill Enhancement Course II (Statistics) of the Programme B.Sc. Physical Sciences: (Statistics, Mathematics, Computer Science) which will be offered in the 4th semester of that Programme. So, the paper with two different codes (SECS1-601/ SECS1-401) but having exactly same syllabus can be taught simultaneously and only one question paper by printing both the codes SECS1-601/ SECS1-401 will be set. Similarly, one question paper by printing both the codes SECS2-601/ SECS2-401 will be set.**

**Program Outcomes (PO) for Under Graduate Programmes (CBCS) in the Faculty of**

**Sciences, Kurukshetra University, Kurukshetra**

|  |  |  |
| --- | --- | --- |
| **PO1** | Knowledge | Capable of demonstrating comprehensive disciplinary knowledge gained during course of study |
| **PO2** | Communication | Ability to communicate effectively on general and scientific topics with the scientific community and with society at large |
| **PO3** | Problem Solving | Capability of applying knowledge to solve scientific and other problems |
| **PO4** | Individual and Team Work | Capable to learn and work effectively as an individual, and as a member or leader in diverse teams, in multidisciplinary settings. |
| **PO5** | Investigation of Problems | Ability of critical thinking, analytical reasoning and research based knowledge including design of experiments, analysis and interpretation of data to provide conclusions |
| **PO6** | Modern Tool usage | Ability to use and learn techniques, skills and modern tools for scientific practices |
| **PO7** | Science and  Society | Ability to apply reasoning to assess the different issues related to society and the consequent responsibilities relevant to the professional scientific practices |
| **PO8** | Life-Long Learning | Aptitude to apply knowledge and skills that are necessary for participating in learning activities throughout the life |
| **PO9** | Environment and Sustainability | Ability to design and develop modern systems which are environmentally sensitive and to understand the importance of sustainable development. |
| **PO10** | Ethics | Apply ethical principles and professional responsibilities in scientific practices |
| **PO11** | Project Management | Ability to demonstrate knowledge and understanding of the scientific principles and apply these to manage projects |

**PSO for Under Graduate CBCS LOCF Programme in the subject of Statistics**

1. The programme is designed to equip students with all the major concepts of Statistics along with the tools required to implement them.

2. Having practical Component with every course invokes their exploratory side and fine tunes the interpretation abilities.

3. The structure of the programme motivates the students to pursue Careers in public & private sectors.

**B.Sc.-I Semester-I**

**DSCS-118 Statistical Methods-I**

**Course Objectives:**

The learning objectives include:

Introduction to Statistics, different measurement scales, various types of data, to analyze and interpret data, to organize data into frequency distribution graphs, including bar graphs, histograms, polygons, and Ogives, Students should be able to understand the purpose for measuring central tendency, dispersion, skewness, kurtosis and should be able to compute them as well, understanding the concept of moments and attributes.

**Course Outcomes:**

Upon successful completion of this course students will demonstrate knowledge of:

* Fundamental concepts of statistics.
* Tabular and graphical representation of data based on variables.
* Measures of central tendency, measures of Dispersion, Skewness and Kurtosis, Moments and their use in studying various characteristics of data.
* Theory of attributes: conditions for the consistency and criteria for the independence of data for attributes.

**B.Sc.-I Semester-I**

**DSCS-118 Credits: 3**

Time: 3 Hours **Statistical Methods-I**  M.M.: 60+15\*

\*Internal Assessment

**Note**: There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 5 to 8 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. The weightage of all the questions will be the same.

**UNIT-I**

**Introduction of Statistics**: Origin, development, definition, scope, uses and limitations.

**Types of Data**: Qualitative and quantitative data, nominal and ordinal data, time series data, discrete and continuous data, frequency and non-frequency data.

**Collection and Scrutiny of Data**: Collection of primary and secondary data- its major sources including some government publications, scrutiny of data for internal consistency and detection of errors of recording, classification and tabulation of data.

**UNIT-II**

**Presentation of Data**: Frequency distribution and cumulative frequency distribution, diagrammatic and graphical presentation of data, construction of bar, pie diagrams, histograms, frequency polygon, frequency curve and ogives.

**Measures of Central Tendency and Location**: Arithmetic mean, median, mode, geometric mean, harmonic mean; partition values-quartiles, deciles, percentiles and their graphical location along with their properties, applications, merits and demerits.

**UNIT-III**

**Measures of Dispersion**: Concept of dispersion, characteristics for an ideal measure of dispersion. Absolute and relative measures based on: range, inter quartile range, quartile deviation, coefficient of quartile deviation, Mean deviation, coefficient of mean deviation, variance, standard deviation (σ), coefficient of variation and properties of these measures, root mean square deviation and their relationship, variance of the combined series.

**Moments:**  Moments about mean and about any point and derivation of their relationships, effect of change of origin and scale on moments, Sheppard’s correction for moments (without derivation), Charlier’s checks; Pearson’s β and γ coefficients.

**UNIT-IV**

**Skewness and Kurtosis:** Coefficients of Skewness and Kurtosis with their interpretations.

**Theory of Attributes**: Symbolic notations, dichotomy of data, class frequencies, order of class frequencies, consistency of data, independence and association of attributes, Yule’s coefficient of association and coefficient of colligation and their relationship.

# Books recommended:

**S. No. Title of Book Name of author Publisher & Year**

1. Fundamental of Goon A.M., Gupta M.K., World Press,

Statistics Vol.I Dasgupta B. Calcutta, (2016)

2. Statistics Johnson R. Wiley Publishers

(1995)

3. Basic Statistics Aggarwal B.L. New Age

International (2013)

4. Fundamentals of Gupta S.C.& Sultan Chand &

Mathematical Kapoor V.K. Sons (2014)

Statistics

5. Programmed Aggarwal B.L. New Age

Statistics International (2017)

**B.Sc.-I Semester-I**

**DSCS-119 Probability Theory**

**Course Objectives:**

To understand the concepts of probability, its applications, the concept of random variables, probability functions, expectation and generating functions, properties of random variables like expectation, moment generating function, cumulative generating function etc. , introduction to p.m.f, p.d.f and c.d.f.

### Course Outcomes:

After completing this course, students should have developed a clear understanding of:

* The fundamental concepts of Probability Theory, solving probabilistic problems.
* Random variables and its probability functions, joint, marginal and conditional probability distribution.
* Concept of expectation for the random variables with their distributions and properties.
* Moment generating function, cumulant generating function and characteristic function.

**B.Sc.-I Semester-I**

**DSCS-119 Credits: 3**

Time: 3 Hours **Probability Theory** M.M.: 60+15\*

\*Internal Assessment

**Note**: There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 5 to 8 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. The weightage of all the questions will be the same.

**UNIT-I**

**Concepts in Probability:** Random experiment, trial, sample point, sample space, operation of events, exhaustive, equally likely, mutually exclusive and independent events; Definition of probability-classical, relative frequency, statistical and axiomatic approach.

**UNIT-II**

Conditional probability. Addition and multiplication laws of probability and their extension to n events. Boole’s inequality; Baye’s theorem and its applications.

**UNIT-III**

**Random Variable and Probability Functions:** Definition of random variable, discrete and continuous random variable, probability function, probability mass function and probability density functions, distribution function and its properties, functions of random variables, joint, marginal and conditional probability distribution function.

**UNIT-IV**

**Mathematical Expectation**: Definition and its properties-moments, addition and multiplication theorem of expectation. Conditional expectation and conditional variance.

**Generating Functions:** Moments generating function, cumulant generating function, probability generating function along with their properties. Characteristic function.

# Books recommended:

**S. No. Title of Book Name of author Publisher & Year**

1. Fundamentals of Gupta S.C.& Sultan Chand

Mathematical Kapoor V.K. & Sons (2014)

Statistics

2. Elementary David S. Oxford Press (2003)

Probability

3. Introduction to Hoel P.G. Asia Pub. House (2018)

Mathematical

Statistics

4. New Mathematical BansiLal& Satya Prakashan

Statistics Arora S.

5. Introduction to Kapoor & Sexena. S.Chand (1960)

Mathematical

Statistics

# B.Sc.-I Semester-I

**DSCS-120 Practical-I**

**Course Objectives:**

The learning objectives include:

To motivate students towards intrinsic interest in statistical thinking, to represent, analyze and interpret data, also to understand the concept of attributes.

# Course Outcomes:

On completion of this course students will be able to:

1. Tabulate and represent the data graphically.
2. Compute different measures of central tendency, Dispersion, Skewness and Kurtosis along with their interpretation.
3. Compute moments and their use in studying various characteristics of data
4. Find association for qualitative data.

# B.Sc.-I Semester- I

**DSCS-120 Credit: 2**

Time: 3 Hours  **Practical-I** M.M.: 40+10\*

**\***Internal Assessment

**Note: Five questions will be set. The candidate will be required to attempt any three.**

1. To construct frequency distributions using exclusive and inclusive methods
2. Representation of data using Bar and pie diagrams
3. Representation of data using Histogram, Frequency Polygon, Frequency Curve and Ogives.
4. To compute various measures of central tendency and dispersion.
5. To obtain first four moments for the given grouped frequency distribution.
6. To apply Charlier’s checks while computing the moments for a given frequency distribution.
7. To obtain moments applying Sheppard’ s correction.
8. To obtain various coefficients of skewness and kurtosis.
9. To toss a coin at least 100 times and plot a graph of heads with respect to number of tosses.
10. To discuss the association of attributes for a 2x2 contingency table using Yule’s coefficient of association and colligation.

**B.Sc.-I Semester-II**

**DSCS-218 Statistical Methods-II**

**Course Objectives:**

The learning objectives include**:**

To understand and compute various statistical measures of correlation, fitting of curve and regression.

### Course Outcomes:

Upon successful completion of this course students will demonstrate knowledge of:

* Correlation, its properties and its implementation in real life problems.
* Principle of least square, curve fitting of different curves.
* Linear Regression analysis, its properties and its implementation in real life problems.
* Multivariate Regression analysis, its properties and multiple corelation.

**B.Sc.-I Semester-II**

**DSCS-218 Credits: 3**

Time: 3 Hours  **Statistical Methods-II** M.M.: 60+15\*

\*Internal Assessment

**Note**: There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 5 to 8 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. The weightage of all the questions will be the same.

**UNIT-I**

**Correlation**: Concept and types of correlation, methods of finding correlation - scatter diagram, Karl Pearson’s Coefficient of correlation (r), its properties, coefficient of correlation for a bivariate frequency distribution. Rank correlation with its derivation, its merits and demerits, limits of rank correlation coefficient, tied or repeated ranks.

**UNIT-II**

**Curve Fitting**: Principle of least squares, fitting of straight line, second degree parabola, power curves of the type Y=aXb, exponential curves of the types Y=abX and Y=aebX.

**UNIT-III**

**Linear Regression**: Two lines of regression, regression coefficients, properties of regression coefficients, angle between two regression lines, standard error of estimate obtained from regression line, correlation coefficient between observed and estimated values, distinction between correlation and regression.

**UNIT-IV**

**Multivariate Data:** Plane of regression, properties of residuals, variance of the residual. Multiple and partial correlation for three variables: coefficient of multiple correlation and its properties, coefficient of partial correlation and its properties, multiple correlation in terms of total and partial correlations and coefficient of determination.

# Books recommended:

**S. No. Title of Book Name of author Publisher & Year**

1. Introduction to Mood A.M., Graybill McGraw Hill (2017)

Theory of F.A. & Boes D.C.

Statistics

2. Applied General Croxton F.E., Cowden Prentice Hall (1968)

Statistics D.J. &Kelin S.

3. Introduction to Kapoor & Sexena. S.Chand (1960)

Mathematical

Statistics

4. Statistical Methods Snedecor G.W. & Iowa State Uni.

Cochran W.G. Press (2014)

5. Fundamentals of Gupta S.C.& Sultan Chand &

Mathematical Kapoor V.K. Sons (2014)

Statistics

**B.Sc.-I Semester-II**

**DSCS-219 Probability Distributions**

**Course Objectives:**

The learning objectives include:

Explaining different probability distributions (discrete and continuous) with their properties and applications

### Course Outcomes:

After completing this course, students should have developed a clear understanding of:

* Discrete and continuous distributions.
* Some important discrete probability distributions, with their characteristics, and their implementation at realistic models.
* Some important continuous probability distributions, with their characteristics, and their implementation at realistic models
* Normal distribution, its derivation and different characteristics.

**B.Sc.-I Semester-II**

**DSCS-219 Credits: 3**

Time: 3 Hours **Probability Distributions** M.M.: 60+15\*

\*Internal Assessment

**Note**: There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 5 to 8 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. The weightage of all the questions will be the same.

**UNIT-I**

Bernoulli distribution and its moments, Binominal distribution: Moments, recurrence relation for the moments, mean deviation about mean, mode, moment generating function (m.g.f), characteristic function, additive property and recurrence relation for the probabilities of Binominal distribution.

**UNIT-II**

Poisson distribution: Poisson distribution as a limiting case of Binomial distribution, moments, mode, recurrence relation for moments, m.g.f., additive property of independent Poisson variates. Negative Binominal distribution: m.g.f., deduction of moments of negative binominal distribution from those of binominal distribution. Geometric distribution: moments, m.g.f,and lack of memory.

**UNIT-III**

Continuous uniform distribution: Moments, m.g.f., characteristic function and mean deviation. Gamma distribution: m.g.f., and additive property. Exponential distribution: m.g.f., moments and lack of memory.

**UNIT-IV**

Normal distribution as a limiting form of binominal distribution, chief characteristics of Normal distribution; mode, median, m.g.f. and moments of Normal Distribution, A linear combination of independent normal variates, points of inflexion, mean deviation about mean, area property of Normal distribution, importance and fitting of normal distribution.

# Books recommended:

**S. No. Title of Book Name of author Publisher & Year**

1. Statistics: A Bhat B.R., New Age

Beginner’s Srivenkatramana T. & International

Text Vol. II RaoMadhava K.S.

2. Fundamentals of Gupta S.C. & Sultan chand

Mathematical Kapoor V.K. & Sons (2014)

Statistics

3. Introduction to Kapoor & Sexena. S.Chand (1960)

Mathematical

Statistics

4. Statistics Johnson R. Wiley (1995)

Publishers

5. Mathematical Freund’s J.E. Prentice Hall (2013)

Statistics With

Applications

# B.Sc.-I Semester-II

**DSCS-220 Practical-II**

**Course Objectives:**

The learning objectives include:

To understand the concepts of correlation, regression, probability distributions along with their applicability in real-life situations.

# Course Outcomes:

On completion of this course students will be able to:

1. Calculate various coefficients of correlation.
2. Find line and curve of best fit for given observations.
3. Estimate unknown values from known values through regression equations.
4. Fit different probability distributions such as binomial, Poisson and normal distributions

# B.Sc.-I Semester- II

**DSCS-220 Credit: 2**

Time: 3 Hours **Practical-II** M.M.: 40+10\*

**\***Internal Assessment

**Note: Five questions will be set. The candidate will be required to attempt any three.**

1. To compute Karl Pearson’s coefficient of correlation for given bivariate frequency distribution.
2. To find Spearman’s rank correlation coefficient for given data.
3. To fit the straight line for the given data on pairs of observa tions.
4. To fit the second degree curve for the given data.
5. To fit the curve of the type Y=aXb for the given data on pairs of observations.
6. To obtain the regression lines for given data.
7. To compute partial and multiple correlation coefficients for the given tri-variate data.
8. To obtain plain of regression for the given tri - variate data.
9. To fit binomial distribution to given data.
10. To fit Poisson distribution to given data.
11. To fit normal distribution to given distribution using area under the normal curve
12. To fit normal distribution to given distribution using method of ordinates

**B.Sc.-II Semester-III**

**DSCS-318 Elementary Inference**

**Course Objectives:**

The learning objectives include:

Explaining the concept of statistical Estimation and drawing inference about the unknown population parameters based on random samples, validating our estimation/ inference about the population using hypothesis testing, concept of Testing of hypothesis and estimation theory, concept of large sample tests.

## Course Outcomes:

After completing this course, students will possess skills concerning:

* Introduction to estimation and basic terminologies; parameter, statistic, standard error, sampling distribution of a statistic, characteristics of a good estimator etc.
* Different methods of estimation, estimation of parameters for some distributions.
* Testing of Hypotheses and related terms.
* Large sample tests, determination of confidence interval.

**B.Sc.-II Semester-III**

**DSCS-318 Credits: 3**

Time: 3 Hours  **Elementary Inference** M.M.: 60+15\*

\*Internal Assessment

**Note**: There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 5 to 8 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. The weightage of all the questions will be the same.

**UNIT-I**

**Statistical Estimation**: Parameter and statistic, Basic concept of sampling distribution. Point and interval estimate of a parameter, concept of bias and standard error of an estimate. Standard errors of sample mean, sample proportion, standard deviation, Properties of a good estimator: Unbiasedness, Efficiency, Consistency and Sufficiency (definition and illustrations).

**UNIT-II**

**Methods of Estimation**: Method of moments, method of maximum likelihood and its properties (without proof). Estimation of parameters of Binomial, Poisson and Normal distributions

**UNIT-III**

**Testing of Hypotheses**: Statistical Hypothesis:- Simple and composite, test of statistical hypothesis, Null and alternative hypotheses, critical region, types of errors, level of significance, power of a test, one tailed and two tailed testing, p-value, BCR, most powerful test, Neyman-Pearson Lemma, Test of simple hypothesis against a simple alternative in case of Binomia and Normal distributions.

**UNIT-IV**

**Large Sample Tests**: Testing of a single mean, single proportion, difference of two means, two standard deviations and two proportions. Fisher’s Z transformation. Determination of confidence interval for mean, variance and proportion.

# Books recommended:

**S. No. Title of Book Name of author Publisher & Year**

1. A First Course on Kale B.K. Narosa (2005)

Parametric

Inference

2. Introduction to Mood A.M., Graybill McGraw Hill (2017)

Theory of Statistics F.A. &Boes D.C.

3. Mathematical Freund’s J.E. Prentice Hall (2013)

Statistics With

Applications

4. Fundamentals of Gupta S.C. & Sultan chand

Mathematical Kapoor V.K. & Sons (2014)

Statistics

**B.Sc.-II Semester-III**

**DSCS-319 Sample Surveys**

**Course Objectives:**

The learning objectives include**:**

Explaining the concept of sample surveys, its need, objectives and different sampling techniques.

## Course Outcomes:

After completing this course, students have a clear understanding of:

* The basic concept of sample survey and its need.
* Simple random sampling along with its practical applicability
* Stratified random sampling along with its practical applicability
* Systematic sampling along with its practical applicability

**B.Sc.-II Semester-III**

**DSCS-319 Credits: 3**

Time: 3 Hours **Sample Surveys** M.M.: 60+15\*

\*Internal Assessment

**Note**: There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 5 to 8 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. The weightage of all the questions will be the same.

**UNIT-I**

Concepts of census and sample survey, basic concepts in sampling. Sampling and Non-sampling errors. Principal steps involved in a sample survey; bias, precision and accuracy, advantages of sampling over complete census, limitations of sampling, different methods of data collection.

**UNIT-II**

**Basic sampling methods: S**imple random sampling (SRS) with and without replacement, use of random number tables, estimation of mean and variance in case of SRS. Simple random sampling of attributes, size of simple random sample.

**UNIT-III**

Stratified random sampling, estimation of population mean, variance of the estimate of population mean in stratified random sampling, allocation of sample size, proportional allocation, optimum allocation. Comparison of Stratified random sampling with SRS.

**UNIT-IV**

**S**ystematic random sampling, estimation of mean and variance. Comparison of **S**ystematic random sampling with SRS and Stratified random sampling, Ratio and regression methods of estimation under SRSWOR.

# Books recommended:

**S. No. Title of Book Name of author Publisher & Year**

1. Sampling Cochran W.G. Wiley Publishers (2007)

Techniques

2. Sampling Theory Des Raj and Chandok Narosa (2013)

3 Sample Theory of Sukhatmeet. all Iowa State Uni.

Surveys with Press & IARS (1984)

Applications

4. Fundamentals of Gupta S.C.& Sultan Chand

Applied Statistics Kapoor V.K. & Sons (2014)

5. Sampling Daroga Singh & New age

Techniques Chaudhry, F.S International (2020)

# B.Sc.-II Semester-III

**DSCS-320 Practical-III**

**Course Objectives:**

The learning objectives include:

Concept of large sample tests, to understand the process of hypothesis testing, identifying the test for a given problem, recognizing the types of sampling available and using them practically.

# Course Outcomes:

On completion of this course students will be able to:

1. Frame null and alternative hypothesis for given problems, performing the right test and finally interpreting them.
2. Evaluate confidence interval.
3. Perform different types sampling procedures, evaluate standard error of estimates.
4. Compare these estimates and to find the gain in precision.

# B.Sc.-II Semester-III

**DSCS-320 Credit: 2**

Time: 3 Hours **Practical-III** M.M.: 40+10\*

**\***Internal Assessment

**Note: Five questions will be set. The candidate will be required to attempt any three.**

1. To apply large sample test of significance for single proportion and difference of two proportions and obtained their confidence intervals.
2. To apply large sample test of significance for single mean and to obtained confidence interval.
3. To apply large sample test of significance for difference between two means and standard deviations.
4. To find standard error of estimate of population mean in case of SRSWR & SRSWOR and comparison of these estimates.
5. To find standard error of estimate of population mean in case of stratified random sampling.
6. To find standard error of estimate of population mean in case of systematic sampling.
7. To select a SRS with and without replacement for a population of size 5, estimate population mean, population mean square and population variance. Enumerate all possible samples of size 2 by WR and WOR and establish all properties relative to SRS. For SRSWOR, estimate mean, standard error, the sample size
8. Stratified Sampling: allocation of sample to strata by proportional and Neyman’s Methods. Compare the efficiencies of above two methods relative to SRS. Estimation of gain in precision in stratified sampling.

**B. Sc-II Semester-IV**

**DSCS-418 Parametric and Non-parametric Tests**

**Course Objectives:**

The learning objectives include:

To understand the concept of Chi-Square distribution, its measures, test for goodness of fit, test of independence of attributes in a contingency table, Sampling Distributions; Student’s-t & Snedecor’s-F Statistics, their derivations and various measures, applications i.e. testing of hypothesis based on‘t’ & ‘F’, and Non-Parametric Tests with their applications**.**

### Course Outcomes:

After completing this course, students should have developed a clear understanding of:

* Chi-Square distribution with derivation and its application
* Parametric and Non-Parametric Tests, their differences and their field of applicability
* Sampling distributions; Student’s ‘t’ and Snedecor's 'F' statistics
* Setting of hypothesis, testing of hypothesis for both Parametric and Non-Parametric tests.

**B.Sc.-II Semester-IV**

**DSCS-418 Credits: 3**

Time: 3Hours **Parametric and Non-parametric Tests** M.M.: 60+15\*

\*Internal Assessment

**Note**: There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 5 to 8 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. The weightage of all the questions will be the same.

**UNIT-I**

**Chi-square distribution**: Definition, derivation, moment generating function, cumulant generating function, mean, mode, skewness, additive property, conditions for the validity, chi-square test for goodness of fit. Contingency table, coefficient of contingency, test of independence of attributes in a contingency table.

**UNIT-II**

**Student’s ‘t’ and Snedecor's 'F' statistics:**  Definition and derivation of Student’s ‘t’, constants of t-distribution, limiting form of t-distribution. Definition & derivation of Snedcor’s F-distribution, constants of F-distribution, mode of F-distribution. Relationship between t, f and chi-square distribution.

**UNIT-III**

Testing for the mean and variance of univariate normal distribution, testing of equality of two means and testing of equality of two variances of two univariate normal distributions. Testing for the significance of sample correlation coefficient and **regression coefficient** in sampling from bivariate normal distribution.

**UNIT-IV**

**Nonparametric Tests:** Concept of non-parametric tests, advantages of non-parameteric test over parametric test, Definition of order statistics. Sign test for univariate and bivariate distribution, run test, median test, Kolmogorov-Smirnov one sample test, Kolmogorov-Smirnov two sample test, Mann Whitney U-test (only applications without derivation).

# Books recommended

**S. No. Title of Book Name of author Publisher & Year**

1. Fundamentals of Goon A.M., Gupta M.K. World Press

Statistics, Vol.I &Dasgupta B. Calcutta (2016)

2. Random Variable Cramer H. Cambridge Uni.

and Probability Press (2004)

Distribution

3. Fundamentals of Gupta S.C. & Sultan Chand

Mathematical Kapoor V.K. & Sons (2014)

Statistics

4. Practical W.J. Conover Wiley Publisher

Nonparametric (2006)

**B.Sc.-II Semester-IV**

**DSCS-419 Design of Experiments**

**Course Objectives:**

The learning objectives include:

To design and conduct experiments and to analyze and interpret the result.

### Course Outcomes:

After completing this course, students should have developed a clear understanding of:

* Analysis of variance for both one-way and two-way classifications.
* The fundamental concepts of design of experiments.
* Completely randomized design &Randomized block design.
* Latin square design & Fractional factorial designs with two levels.

**B.Sc.-II Semester-IV**

**DSCS-419 Credits: 3**

Time: 3 Hours **Design of Experiments** M.M.:60+15\*

\*Internal Assessment

**Note**: There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 5 to 8 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. The weightage of all the questions will be the same.

**UNIT-I**

**Analysis of variance (ANOVA):** Definition and assumptions for ANOVA. Analysis of variance for one-way classification and two-way classifications for fixed effect models with one observation per cell.

**UNIT-II**

Introduction to design of experiments, terminology: experiment, treatment, experimental unit, blocks, experimental error, replication, precision, efficiency of a design, need for design of experiments, size and shape of plots and blocks. Fundamental principles of design: randomization, replication and local control.

**UNIT-III**

Completely randomized design (CRD), Randomized Block Design (RBD), their layout, statistical analysis, applications, advantages and disadvantages. Efficiency of RBD relative to CRD.

**UNIT-IV**

Latin square design (LSD): Layout, statistical analysis, applications, merits and de-merits of LSD. Factorial designs: Definition, advantages and disadvantages, concept of mean effects and interaction in 22 design.

# Books recommended:

**S. No. Title of Book Name of author Publisher & Year**

1. Design and Analysis Das M.N. &Giri Springer Verlage

Of Experiments (1987)

2. Linear Models Searle S.R. John Wiley &

Sons (2014)

3. Linear Estimation Joshi D.D. Wiley Eastern

And Design of (2020)

Experiments

4. Fundamentals of Gupta S.C. &. Sultan Chand

Applied Statistics Kapoor V.K. & Sons (2014)

# B.Sc.-II Semester-IV

**DSCS-420 Practical-IV**

**Course Objectives:**

The learning objectives include:

Sampling distribution, test based on them, different non-parametric tests and using them practically. Different designs of experiment, and their implementation.

# Course Outcomes:

On completion of this course students will be able to:

1. Perform small sample test and evaluate confidence intervals.
2. Apply Chi-Square test for a given population distribution, goodness of fit.
3. Apply other non-parametric tests and recognizing situations where they are to be used.
4. Perform ANOVA for different designs.

# B.Sc.-II Semester-IV

**DSCS-420 Credit: 2**

Time: 3 Hours **Practical-IV** M.M.: 40+10\*

\*Internal Assessment

**Note: Five questions will be set. The candidate will be required to attempt any three.**

* 1. To apply t -test for testing single mean and difference between means and to obtain their confidence intervals.
  2. To apply paired t-test for difference between two means.
  3. To apply Chi- square test for goodness of fit.
  4. To apply Chi- square test for independence of attributes.
  5. To apply test of significance of sample correlation coefficient.
  6. To apply F-test for testing difference of two variances.
  7. To apply sign test for given data.
  8. To apply Run test for given data.
  9. To apply Median test for given data.
  10. To apply Mann Whitney U-test for given data.
  11. Analysis of Variance of a one way classified data
  12. Analysis of Variance of a two way classified data with one observation per cell
  13. To perform ANOVA in case of CRD and test whether the treatments/ varieties are equally effective.
  14. To perform ANOVA for an RBD.
  15. To perform ANOVA for an LSD.

**B.Sc.-III Semester-V**

**DSES1-518 Applied Statistics-I**

**Course Objectives:**

The learning objectives include:

To know the applications of Statistics, to learn and apply statistical techniques in the core course of their study. This course will give exposure to three applied fields of statistics viz. Time Series, Index Numbers, and Demographic methods. They will be having hands on practice of working on the data related to above mentioned fields.

### Course Outcomes:

After completing this course, students should have developed an understanding of:

* The fundamental concepts of Index Numbers, Construction of price and quantity Index numbers. Construction of Wholesale and Consumer price Index and its significance.
* Time series data, components of time series data. Behavior and identification of the variation due to different components in the data.
* Different demographic methods. Measurement of mortality and fertility rates, reproduction and population growth measures.
* Construction and importance of Life Table.

**B.Sc.-III Semester-V**

**DSES1-518 Credits: 2**

Time: 3 Hours **Applied Statistics-I** M.M.: 40+10\*

\*Internal Assessment

**Note**: There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 5 to 8 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. The weightage of all the questions will be the same.

**UNIT-I**

**Index Number**: Definition, problems involved in the construction of index numbers, calculation of index numbers-simple aggregate method, weighted aggregates method, simple average of price relatives, weighted average of price relatives, link relatives, chain indices, value index numbers, price and quantity index numbers.

**UNIT-II**

Laspeyre’s, Paasche’s, Marshall-Edgeworth and Fisher’s index numbers, time and factor reversal tests of index numbers, consumer price index number and its uses. Base shifting, splicing and deflating of index numbers.

**UNIT-III**

**Time Series Analysis**: Definition, components of time series-trend, seasonal variations, cyclic variations, irregular component, illustrations, additive and multiplicative models, determination of trend: graphic method, semi-averages method, method of curve fitting by principle of least squares, moving average method. Analysis of seasonal fluctuations, construction of seasonal indices using method of simple averages, ratio to trend method and ratio to moving average method.

**UNIT-IV**

**Demographic methods**: Sources of demographic data-census, register, adhoc survey, hospital records, measurement of mortality, crude death rate, specific death rate, standardized death rates, complete life tables and its main features, assumptions, descriptions and construction of life tables, uses of life tables, stationary and stable population, measurement of fertility-crude birth rate, general fertility rate, specific fertility rate, total fertility rate, measurement of population growth, gross reproduction rate, net reproduction rate.

**Books recommended**

**S. No. Title of Book Name of author Publisher & Year**

1. Applied General Croxton F.E., Cowden Prentice Hall (1968)

Statistics D.J. &Kelin S.

2. Demography Cox P.R. Cambridge Uni.

Press (1976)

3. Technical Ramakumar R. New Age

Demography International (2018)

4. Fundamentals of Gupta S.C. & Sultan Chand

Applied Statistics Kapoor V.K. & Sons (2014)

**B.Sc.-III Semester-V**

**DSES2-518 Bio-Statistics**

**Course Objectives:**

The learning objectives include:

Biostatistics is one area of Applied Statistics that concerns itself with the application of statistical methods to medical, biological, epidemiological and health related problems.

### Course Outcomes:

After completing this course, students should have developed a clear understanding of:

* Designing and analysis of epidemiologic studies.
* Planning and design of clinical trials
* Using software to analyze the data of different study designs.
* Estimation of survival functions.

**B.Sc.-III Semester-V**

**DSES2-518 Credits: 2**

Time: 3 Hours **Bio-Statistics** M.M.: 40+10\*

\*Internal Assessment

**Note**: There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 5 to 8 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. The weightage of all the questions will be the same.

**UNIT I**

Introduction to epidemiology, principles of epidemiologic investigation, Epidemiologic measures. Design and analysis of epidemiologic studies: types of studies, case-control studies, cohort studies, quantitative methods in screening.

**UNIT II**

Introduction of clinical trials: Definition and type of trials, phases of clinical trials, designs of randomized controlled clinical trial (RCT), the need and ethics of clinical trials, overview of Phase I – IV trials, multicenter trials. Estimation and importance of sample size in research design.

**UNIT III**

Planning Research and Data Generation: Research design, Primary and secondary data; Making survey-questionnaire, Data collection methods and arrangement; analysis of data using different study designs using statistical software like SPSS and R. National Sample survey, survey sampling and its methods.

**UNIT IV**

SURVIVAL ANALYSIS: life table techniques, estimation of survival function – actuarial estimator, Kaplan – Meier estimator, total time on test, estimation under the assumption of IFR/DFR, tests of exponentiality against hazard function; Ageing classes( IFR,IFRA,NBU,NBUE) and their properties, Dual classes .

**Books recommended:**

1. Rothman ,K. J. and Geenland, S. (ed.) (1988):Modern Epidemiology, Lippincott-Raven.

2. Selvin, S. (1996): Statistical Analysis of Epidemiologic Data, Oxford University Press.

3. McNeil ,D. (1996): Epidemiological Research Methods. Wiley and Sons.

4. Jekel, J. F., Elmore, J. G. Katz ,D.L.: (1996). Epidemiology, Biostatistics and Preventive Medicine. WB Saunders Co.

5. Cox, and Oakes, D. (1984): Analysis of Survival Data, Chapman and Hall, New York.

6. Deshpande J. V. and Purohit S.G. (2015): Life time data / Statistical models and methods, 2nd Edition, word scientific

7. Gross A. J. and Clark, V.A. (1975): Survival Distribution: Reliability applications in the Biomedical Sciences, John Wiley and Sons.

8. Elandt – Johnson, R.E. Johnson N. L.: Survival Models and Data Analysis, John Wiley and Sons.

9. Miller, R. G. (1998): Survival Analysis, Wiley Interscience.

10. Kalbfleisch J. D. and Prentice R. (1980): The Statistical Analysis of failure Time data, John Wiley.

**B.Sc.-III Semester-V**

**DSES3-519 Numerical Methods and Fundamentals of Computers**

**Course Objectives:**

The learning objectives include:

To know about the concept of interpolation and extrapolation, methods of interpolation, Divided differences and their properties, Numerical integration, General quadrature formula for equidistant ordinates, Basics of Computer, Computer Arithmetic, Concepts of flow chart, algorithm and programming, Elementary idea of statistical software: SPSS.

### Course Outcomes:

After completing this course, students should have developed an understanding of:.

* Interpolation and extrapolation, methods of interpolation with equal and unequal intervals,
* General quadrature formula & Numerical integration
* Basic introduction of computers
* Binary operations and conversions and elementary idea of statistical software SPSS

**B.Sc.-III Semester-V**

**DSES3-519 Numerical Methods and Fundamentals of Computers Credits: 2**

Time: 3 Hours M.M.: 40+10\*

\*Internal Assessment

**Note**: There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 5 to 8 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. The weightage of all the questions will be the same.

**UNIT-I**

**Numerical Methods:** Concept of interpolation and extrapolation, difference tables for operators, forward, backward and shift, and their relationship , methods of interpolation, Newton’s formula for forward and backward interpolation with equal intervals, factorial notations, equiate distant terms with one or more missing terms.

**UNIT-II**

Divided differences and their properties, Newton formula for unequal intervals, Lagrange’s method of interpolation, Numerical integration, General quadrature formula for equidistant ordinates, Trapezoidal rule, Simpson’s  and  formulae.

**UNIT-III**

**Basics of Computer:** Introduction, origin, development, uses and limitation of computers. Types of computers, computer structure, input-unit, CPU, output unit, secondary storage, High Level and low level languages, compiler and interpreter.

**Computer Arithmetic**: Floating point representation of numbers, arithmetic operations with normalized floating point numbers. Number systems- Binary, decimal, octal and hexadecimal number systems and their conversions into each other. Binary arithmetic’s, (Addition, subtraction, multiplication & division).

**UNIT-IV**

**Flow charts and Algorithms:** Concepts of flow chart, algorithm and programming. Flow charts and algorithms for the following: Mean, median, mode, variance, covariance, coefficient of correlation and Straight line fitting. Trapezoidal rule, Simpson’s 1/3 and 3/8th rules. Elementary idea of statistical software: SPSS

**Books recommended:**

**S. No. Title of Book Name of author Publisher & Year**

1. Computer Sinha P.K. BPB Publication

Fundamentals (2010)

2. Introductory Sastry S.S. Prentice Hall

Methods of (2012)

Numerical

Analysis

3. Computer Based Krishnamurthy E.V. Affiliated East

Numerical & Sen S.K. West Press

Algorithms (2009)

4. Computer Oriented Rajaraman V. Prentice Hall

Numerical Methods (2019)

**B.Sc.-III Semester-V**

**DSES4-519 Econometrics**

**Course Objectives:**

The learning objectives include**:**

A broad knowledge of regression analysis relevant for analyzing economic data, interpretation and critical evaluation of the outcomes of empirical analysis, distinguish the results of violating the assumptions of classical regression model. To judge the validity of the economic theories and carry out their evaluation in numerical terms. To extract useful information about important economic policy issues from the available data.

### Course Outcomes:

After completing this course, students should have developed a clear understanding of:

* The fundamental concepts of econometrics & Specification of the model.
* Extensions of two variable Linear Regression Model.
* Autocorrelation, Multicollinearity & Heteroscedasticity.
* Autoregressive and Lag models.

**B.Sc.-III Semester-V**

**DSES4-519 Econometrics Credits: 2**

Time: 3 Hours M.M.: 40+10\*

\*Internal Assessment

**Note**: There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 5 to 8 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. The weightage of all the questions will be the same.

**UNIT I**

Econometrics – definition, scope, methodology and types. Simple Linear Regression Model, Estimation of model by method of ordinary least squares, Desirable Properties of an Estimator, Multiple Regression.

**UNIT II**

Extensions of the two-variable linear regression model: Regression through the origin, r2 for regression-through-origin model, scaling and units of measurement, regression on standardized variable, functional forms of regression models.

**UNIT III**

Tests and Remedial Measures for Heteroscedasticity, Autocorrelation and Multicollinearity, Specification Errors

**UNIT IV**

Autoregressive and Distributed Lag Models – Estimation methods, Koyck and Almon’s Approach to distributed- lag models. Qualitative (dummy) independent variables, dummy variables and interaction effects.

**Books recommended:**

1. Gujarati, D.N. and Sangeetha, S.(2007), Basic Econometrics (4th Edition) McGraw Hill ,New Delhi.
2. Johnson J.and Dinardo,J.(1994), Econometric Methods, McGraw Hall Book Co., London
3. Kmenta J. (1998), Elements of Econometrics, University of Michigan Press, New York
4. Koutsoyiannis, A. (2004), Theory of Econometrics, (2nd edition)Palgrave Macmillan Limited.
5. Maddala G.S. and Lahiri, K.(2009), Introduction to Econometrics (4th edition), John Wiley and Sons.

# B.Sc.-III Semester-V

**DSES-520 Practical-V**

**Based on Applied Statistics-I**

**Course Objectives:**

The learning objectives include:

Applications of Statistics, to learn and apply statistical techniques in the core course of their study.

# Course Outcomes:

On completion of this course students will be able to:

1. Construct price and quantity Index numbers, Wholesale and Consumer price Index
2. Find trend using different methods.
3. Obtain other components of time series.
4. Measure different mortality and fertility rates, reproduction rates, population growth measures and construction of Life Table.

# Or

**Based on Bio-Statistics**

**Course Objectives:**

The learning objectives include:

Application of statistical methods to medical, biological, epidemiological and health related problems.

# Course Outcomes:

On completion of this course students will be able to:

1. Estimate the sample size in different research designs.
2. Prepare the survey questionnaire & analyze the data.
3. Prepare the reports of surveys.
4. Estimate survival functions.

**And**

# Based on Numerical Methods

**Course Objectives:**

The learning objectives include:

To know about the concept of interpolation and extrapolation, methods of interpolation, Divided differences and their properties, Numerical integration,

# Course Outcomes:

On completion of this course students will be able to:

1. Construct difference table and to find missing value.
2. Solve interpolation for equal intervals.
3. Solve interpolation for unequal intervals.
4. Solve Numerical integration

# Or

**Based on Econometrics**

**Course Objectives:**

The learning objectives include:

A broad knowledge of regression analysis relevant for analyzing economic data, interpretation and critical evaluation of the outcomes of empirical analysis.

# Course Outcomes:

On completion of this course students will be able to:

1. Solve, test and forecast problems based on General linear model.
2. Solve problems related to consequences of Multicollinearity, Autocorrelation, Heteroscedasticity.
3. Estimate General linear model under Autocorrelation, Heteroscedastic disturbance terms.
4. Solve problems related to General linear model under Autoregressive and Lag models.

# B.Sc.-III Semester-V

**DSES-520 Practical-V Credit: 2**

Time: 3 HoursM.M.: 40+10\*

**\***Internal Assessment

**Note: Five questions will be set. The candidate will be required to attempt any three.**

**Based on Applied Statistics-I**

1. To calculate price and quantity index numbers using the formulae given by Laspyre, Paasche, Marshal- Edgeworth and Fisher.
2. To obtain cost of living index numbers for the given data using (i) Aggregate Expenditure Method. (ii) Family Budget Method
3. To test the given data using the formulae given by Laspyre, Paasche, Marshal-Edgeworth and Fisher, satisfy reversal tests.
4. To work out trends using curve fitting method for given data.
5. To work out trends using moving average method for given data.
6. To obtain seasonal variation indices using simple average method.
7. To obtain seasonal variation indices using ratio to moving average method.
8. To calculate the crude and standardized death rates of the population using Direct Method and Indirect Method regarding one of the population as standard population.
9. To calculate the following for the given data CDR, CBR, Sex/Age SDR, GFR, TFR, GRR, NRR.
10. . To complete the given incomplete life table by computing various elements of life table.

# Or

**Based on Bio-Statistics**

1. Estimation of epidemiologic studies.
2. Estimation of sample size in different research designs.
3. Planning and design of randomized controlled clinical trial (RCT).
4. Preparation of survey-questionnaire, Data collection methods, statistical analysis and interpretation of collected data using statistical software.
5. Summary reports of different National surveys in India.
6. Estimation of life table and survival analysis.

# And

**Based on Numerical Methods**

1. To interpolate the required value for the given data using Newton’ s
   1. Forward interpolation formula for equal intervals
   2. Backward interpolation formula for equal intervals.
2. To interpolate the required value for the given data of using

(i) Newton’ s divided difference formula

(ii) Lagrange’s interpolation formula.

1. To evaluate the integral of the type using

* 1. Trapezodial rule, (ii) Simpson’ s one-third rule

# Simpson’s three- eight rule

# Or

**Based on Econometrics**

1. Problems based on estimation of General linear model
2. Testing of parameters of General linear model
3. Forecasting of General linear model
4. Problems concerning specification errors
5. Problems related to consequences of
   1. Multicollinearity
   2. Autocorrelation (AR(I))
   3. Heteroscedasticity
6. Estimation of problems of General linear model under Heteroscedastic distance terms.
7. Problems on Autoregressive and Lag models.

**B.Sc.-III Semester-VI**

**SECS1-601 Statistical Data Analysis Using R**

**Course Objectives:**

The learning objectives include:

Review and expand upon core topics in probability and statistics, practice of graphical interpretation, probability distribution and data analysis using`R’.

### Course Outcomes:

After completing this course, students should have developed a clear understanding of:

* Various Graphical representation and interpretation of data.
* Automated reports giving detailed descriptive statistics.
* Flow controls ,Random number generation and sampling procedures, Multiple regression.
* Testing of hypothesis, p-value and confidence interval, Importing data, Code editing in R.

**B.Sc.-III Semester-VI**

**SECS1-601 Statistical Data Analysis Using R Credits: 2**

Time: 3 Hours M.M.: 40+10\*

\*Internal Assessment

**Note**: There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 5 to 8 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one.

**UNIT I**

Learn how to load data, plot a graph: bar-plot, pie-chart, and box plot, stem-leaf, histograms (equal class intervals and unequal class intervals), frequency polygon, ogives with graphical summaries of data.

### UNIT II

Generate automated reports giving detailed descriptive statistics, scatter plot; correlation and lines of regression, curvilinear regression.

### UNIT III

Introduction to flow control: if (), for () and while () loop; Random number generation and sampling procedures. Application problems based on fitting of suitable distribution, Q-Q plot, Multiple Regression.

### UNIT IV

Basics of statistical inference in order to understand hypothesis testing, compute p-values and confidence intervals. Simple analysis and create and manage statistical analysis projects, import data, code editing.

**Books recommended:**

1. Braun, W. J., and Murdoch, D. J. (2007). A First Course in Statistical Programming with R. Cambridge University Press. NewYork.
2. Crawley, M. J. (2012). The R Book. 2nd Ed., John Wiley &Sons.
3. Dalgaard, P. (2008). Introductory Statistics with R. 2nd Ed., Springer.
4. Gardener, M. (2012). Beginning R: The Statistical Programming Language, Wiley Publications.

**B.Sc.-III Semester-VI**

**SECS2-601 Statistical Simulation**

**Course Objectives:**

The learning objectives include:

Concept of simulation and simulation modeling, generation of Pseudo random number generators as well as from standard statistical distributions, Monte-Carlo simulation technique, application of simulation techniques.

### Course Outcomes:

After completing this course, students should have developed a clear understanding of:

* How simulation may be used to understand the behavior of real world systems by utilizing mathematical models with an emphasis on simulation.
* How to generate random numbers by the different methods.
* Various applications of simulation.
* Advantages and disadvantages of simulation, Scope of simulation technique.

**B.Sc.-III Semester-VI**

**SECS1-601 Credits: 2**

Time: 3 Hours **Statistical Simulation** M.M.: 40+10\* \*Internal Assessment

**Note**: There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 5 to 8 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one.

**Unit I:**

Introduction: Need for simulation, general principles, simulation models, event type simulation.

**Unit II:**

Random numbers generation: Pseudo random number generators; the inverse transform method, Discrete and Continuous distributions, Transformation of random variables.

**Unit III:**

Applications of simulation: Monte Carlo simulation technique. Inventory problems, Queueing systems.

**Unit IV:**

Advantages and disadvantages of simulation, simulation of languages, Scope of simulation technique.

**Books recommended:**

1. Fishman,G.S.(1996).MonteCarlo-Concepts,AlgorithmsandApplications,Springer.
2. Taha, H. A. (2010). Operations Research. An Introduction, 9thEd, Pearson.
3. Reitman, J. (1971). Computer simulation Applications, John Wiley &Sons.
4. Swarup, K. Gupta, P.K. and Mohan, M. (2014). Operations Research, 15thEd, Sultan Chand &Sons.
5. Payer T.A. (1982). Introduction to simulation, McGraw Hill.
6. Voss, J. (2013). An introduction to statistical computing: A simulation-based approach, 1stEd., Wiley series in computational statistics.

**B.Sc.-III Semester-VI**

**DSES5-618 Applied Statistics-II**

**Course Objectives:**

The learning objectives include:

To know about official statistical system in India and functions of different agencies, will help students to know the applications of Statistics and to learn and apply the learned techniques in the core course of their study, concept of Statistical Quality Control, its characteristics and applications, will also be having hands on practice of working on the data related to above mentioned fields.

### Course Outcomes:

After completing this course, students should have developed an understanding of:

* Present official statistical system in India, functions of C.S.O. and N.S.S.O
* Statistical Quality Control, Use of Statistical methods in industrial research and practice.
* Statistical process control tools- Control charts for variables and attributes.
* Acceptance Sampling Plan, important definitions related to it, single and double sampling plans

**B.Sc.-III Semester-VI**

**DSES5-618 Applied Statistics-II Credits: 2**

Time: 3 Hours M.M.: 40+10\*

\*Internal Assessment

**Note**: There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 5 to 8 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. The weightage of all the questions will be the same.

**UNIT-I**

**Indian official statistics:** Introduction. Indian statistical system. Statistical offices at the centre. Statistical offices in the states.Populationstatistics.Agriculturalstatistics.Industrialstatistics.Tradestatistics.Pricestatistics.Statistics of labour and employment. Statistics of transport and communication. Financial and banking statistics.

**UNIT-II**

**Statistical Quality Control**: Meaning and uses of SQC, causes of variations in quality, product and process control, control charts, 3-σ control limits, control chart for variables- and R chart, criteria for detection of lack of control in & R Charts, Interpretation of & R charts.

**UNIT-III**

Control chart for standard deviation (σ chart), control charts for attributes: ‘p’ chart and ‘c’ chart, natural tolerance and specification limits.

**UNIT-IV**

**Acceptance sampling** : Problem of lot acceptance, stipulation of good and bad lots, producer’s and consumers risks, single and double sampling plans, their OC functions, concepts of AQL, LTPD, AOQL, average amount of inspection and ASN function.

# Books recommended

**S. No. Title of Book Name of author Publisher & Year**

1. Statistical Quality Grant E.L. McGraw Hill

Control (2017)

2. Statistical Methods Cowden D.J. Asia Pub.

in Quality Control Society (1957)

3. Fundamentals of Gupta S.C. & Sultan Chand

Applied Statistics Kapoor V.K. & Sons (2018)

4. Fundamentals of Goon A.M., Gupta M.K. World Press

Statistics, Vol. II & Dasgupta B. Calcutta (2016)

**B.Sc.-III Semester-VI**

**DSES6-618 Linear Models**

**Course Objectives:**

The learning objectives include:

Developing a clear understanding of the fundamental concepts of linear models and a range of associated skills allowing the students to work effectively with them.

### Course Outcomes:

After completing this course, students should have developed a clear understanding of:

* Theory and estimation of Linear Models and Distribution of quadratic forms.
* Simple and Multiple linear regression models and their applications.
* Techniques for Analysis of Variance and Covariance under fixed effects model.
* Assessment of the quality of the fit using classical diagnostics, prediction from a fitted model, Residuals and Outliers, Lack of fit and pure error and remedies to deal with them.

**B.Sc.-III Semester-VI**

**DSES6-618 Linear Models Credits: 2**

Time: 3 Hours M.M.:40+10\*

\*Internal Assessment

**Note**: There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 5 to 8 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. The weightage of all the questions will be the same.

**UNIT I**

Linear Estimation: Gauss-Markov setup, normal equations and least squares estimators, variances and covariance of least squares estimators, estimations of error variance, properties of least squares estimators, distribution of quadratic forms.

### UNIT II

Regression analysis: Simple Regression analysis, Estimation and hypothesis testing in case of simple and multiple regression analysis, Confidence intervals and Prediction intervals, Concept of model matrix and its use in estimation. Effect of orthogonal columns in the X matrix, Partial F-test and Sequential F-test, Bias in regression estimates.

### UNIT III

Analysis of Variance and Covariance: Definition of fixed, random and mixed effect models, analysis of variance and covariance in one-way classified data for fixed effect models, analysis of variance in two-way classified data with equal number of observations per cell for fixed effect models.

### UNIT IV

Model checking: Prediction from a fitted model, Residuals and Outliers, Lack of fit and pure error, Violation of usual assumptions concerning normality, Homoscedasticity and collinearity, Diagnostics using quantile-quantile plots.

Model Building: Techniques for Variable selection. Polynomial Regression models: Orthogonal Polynomials.

**Books recommended:**

1. Draper, N. R. and Smith, H. (1998): Applied Regression Analysis, 3rd Ed., John Wiley and Sons.
2. Montgomery, D. C., Peck, E. A. and Vining, G. G. (2004): Introduction to Linear Regression Analysis, 3rd Ed., John Wiley and Sons.
3. Rencher, A. C. and Schaalje, G. B. (2008): Linear Models in Statistics, 2nd Ed., John Wiley and Sons.
4. Weisberg, S. (2005): Applied Linear Regression, 3rd Ed., John Wiley and Sons.

**B.Sc.-III Semester-VI**

**DSES7-619 Operations Research**

**Course Objectives:**

The learning objectives include:

To explain the meaning of operations research, O.R models, its characteristics, formulation of L.P.P, solving them using Graphical procedure, simplex method, Big-M, Two-phase method, Duality in L.P.P, Transportation Problem, different methods to find initial feasible solutions and finding the optimum solution.

### Course Outcomes:

After completing this course, students should have developed a clear understanding of:

* Fundamental concepts of Operational Research Techniques
* Linear Programming Problems and their formulations.
* Graphical procedure and simplex method, to solve for artificial variables using Big-M & Two-Phase methods, Duality & situations where duality is fruitful
* How to minimize cost for any balanced transportation problem using different methods.

**B.Sc.-III Semester-VI**

**DSES7-619 Operations Research Credits: 2**

Time: 3 Hours M.M.: 40+10\*

\*Internal Assessment

**Note**: There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 5 to 8 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. The weightage of all the questions will be the same.

**UNIT-I**

Objective of O.R., nature and definitions of O.R., Scope of O.R., Meaning and necessity of O.R. models, classification of O.R. models, Advantages & disadvantages of O.R. models. Steps in model formulation, principles of modeling. Characteristics of a good model, Allocation problems.

**UNIT-II**

Linear programming problem (LPP): Definition, objective function, constraints, graphical solution of L.P.P., limitations of graphical method, Simplex method to solve L.P.P., concept of initial basic feasible solution, computation procedure for Simplex method.

**UNIT-III**

Artificial variable techniques: Big-M method, Two-phase method. Duality in Linear Programming; Concept of duality, Fundamental properties of duality.

**UNIT-IV**

Transportation Problem (T.P.): Formulation, Basic feasible solution. Different methods to find initial feasible solution: North-West corner rule, Row minima method, column minima method, Matrix minima method (Least cost entry method), Vogel’s Approximation method (or Unit cost penalty method). UV-method (Modi's method) for finding the optimum solution of T.P.

**Books recommended**

**S. No. Title of Book Name of author Publisher & Year**

1. Linear Hadley G. Narosa (2002)

Programming

2. Operations Taha H.A. Macmillan Pub.

Research: An Co. (2019)

Introduction

3. Operations Goel B.S. & Mittal S.K. Pragati

Research Prakashan (2014)

4. Operations Sharma S.D. KedarNath&

Research Co. (2017)

5. Operations Sharma J.K. Macmillan Pub.

Research (2017)

**B.A/B.Sc.-III Semester-VI**

**(DSES8-619) Actuarial Statistics**

**Course Objectives:**

The learning objectives include:

To learn advanced techniques in Actuarial Science with practical applications in daily life.

### Course Outcomes:

After completing this course, students should have developed a clear understanding of:

* Probability models and loss distributions.
* Principles of compounds interest.
* Assurance and Annuity contracts.
* Computation of premiums and settlement of claims.

**B.A/B.Sc.-III Semester-VI**

**DSES8-619 Credits: 2**

Time: 3 Hours **Actuarial Statistics** M.M.:40+10\*

\*Internal Assessment

**Note**: There will be nine questions in all. Question No.1 will be compulsory covering whole of the syllabus and comprising 5 to 8 short answer type questions. Rest of the eight questions will be set from the four units uniformly i.e. two from each unit. The candidate will be required to attempt five questions in all selecting one question from each unit and the compulsory one. The weightage of all the questions will be the same.

Unit I

Probability Models, Loss distributions: modelling of individual and aggregate losses, fitting distributions to claims data, Risk models: models for individual claims and their sums, Distribution of aggregate claims, Compound distributions and applications, Introduction to Utility theory and Expected Utility Criterion.

Unit II

Survival function, curate future lifetime, force of mortality, life tables with examples. Multiple life functions, joint life and last survivor status. Multiple decrement model.

Principles of compound interest : Nominal and effective rates of interest and discount, force of interest and discount, compound interest, accumulation factor.

Unit III

Assurance and annuity contracts: definitions of benefits and premiums, various types of assurances and annuities and their relationships, present value, formulae for mean and variance of various continuous (payable immediately on death) and discrete (payable at the end of year of death) payments.

Unit IV

Calculation of various payments from life tables: principle of equivalence, net premiums, prospective and retrospective provisions/reserves.

References:

1. Boland, P. (2007). Statistical and Probabilistic Methods in Actuarial Science. Chapman and Hall/CRC.
2. Borowaik, D.S. and Shapiro, A. F. (2013). Financial and Actuarial Statistics: An Introduction. 2nd Edition. Marcel Dekker Inc., New York-Basel.
3. Bowers, N. L., Gerber H. U., Hickman, J. C., Jones, D. A. and Nesbitt, C. J. (1997). Actuarial Mathematics, 2nd Edition, Society of Actuaries, USA.
4. Deshmukh, S.R. (2005). Actuarial Statistics: In Introduction Using R. Narosa Publishing House, New Delhi.
5. Dickson, D.C.M.(2016). Insurance Risk and Ruin, Second Edition, Cambridge University Press.
6. Klugman, S. A., Panjer, H. H. and Willmot, G. E. (2013). Loss Models: Further Topics, 4thEdition. Wiley-Interscience.
7. Promislow, S. D. (2014). Fundamentals of Actuarial Mathematics. 3rd Edition. Wiley.

# B.Sc.-III Semester-VI

**DSES-620 Practical-VI**

**Based on Applied Statistics-II**

**Course Objectives:**

The learning objectives include:

Concept of Statistical Quality Control, different tools of quality control, their construction and interpretation.

# Course Outcomes:

On completion of this course students will be able to:

1. Control charts for variables; X and R- chart with their interpretation
2. Control charts for variables; X and σ- chart with their interpretation
3. Control charts for attributes, d, p and c-chart with their interpretation.
4. Acceptance Sampling Plan, single and double sampling plans

# Or

**Based on Linear Models**

**Course Objectives:**

The learning objectives include:

Developing a clear understanding of the fundamental concepts of linear models and a range of associated skills allowing the students to work effectively with them.

# Course Outcomes:

On completion of this course students will be able to:

* 1. Solve for Distribution of Quadratic forms.
  2. Solve Simple and Multiple linear regression models.
  3. Perform Analysis of Variance and Covariance under fixed effects model.
  4. Assessment of the quality of the fit using classical diagnostics, prediction from a fitted model, Residuals and Outliers

# And

**Based on Operations Research**

**Course Objectives:**

The learning objectives include:

Formulation of L.P.P, solving them using Graphical procedure, simplex method, Big-M, Two-phase method, Duality in L.P.P, Transportation Problem

# Course Outcomes:

On completion of this course students will be able to:

1. Formulate L.P.P and to solve them using graphical method.
2. Solve L. P.P using Simplex method.
3. Artificial variable techniques: Big-M method, Two-phase method.
4. To minimize cost for any balanced transportation problem using different methods.

# Or

**Based on Actuarial Statistics**

**Course Objectives:**

The learning objectives include:

To learn advanced techniques in Actuarial Science with practical applications in daily life.

# Course Outcomes:

On completion of this course students will be able to

1. Fit distributions to claim data, risk models for individual claims.
2. Compute risk for different utility functions.
3. Find mean and variance of various payments for assurance and annuity contracts.
4. Calculate various payments from Life tables using principle of equivalence.

# B.Sc.-III Semester-VI

**DSES-620 Credit: 2**

Time: 3 Hours **Practical-VI**  M.M.: 40+10\*

\*Internal Assessment

**Note: Five questions will be set. The candidate will be required to attempt any three.**

**Based on Applied Statistics-II**

1. To construct X and R- chart, and comment on the state of control of the process.
2. To construct p-chart and d-chart, and comment on the state of control of the process.
3. To obtain control l imits for number of defects and comment on the state of control plotting the appropriate chart.
4. To obtain control l imits for number of defects per unit and comment on the state of control plotting the appropriate chart.
5. Single sample inspection plan: Construction and interpretation of OC, AQL, LTPD, ASN, ATI, AOQ, AOQL curves.
6. Calculation of process capability and comparison of 3-sigma control limits With specification limits

# Or

**Based on Linear Model**

1. Estimation of X, when X is
   1. a full rank matrix.
   2. not a full rank matrix.
2. Distribution of Quadratic forms.
3. Simple and Multiple Linear Regression.
4. Tests for Linear Hypothesis.
5. Bias in regression estimates.
6. Analysis of Covariance of a one way classified data.
7. Residual Analysis.

# And

**Based on Operations Research**

1. Mathematical formulation of L.P.P and solving the problem using graphical Method, Simplex technique, Big M method and Two-Phase method involving artificial variables.
2. Identifying Special cases by Graphical and Simplex method and interpretation of
   1. Degenerate solution
   2. Unbounded solution
   3. Alternate solution
   4. Infeasible solution
3. Allocation problem using Transportation model

# Or

**Based on Actuarial Statistics**

1. Modelling of individual and aggregate losses.
2. Fitting distributions to claims data, Risk models for individual claims and their sums.
3. Finding distribution of aggregate claims, and applications of compound distributions
4. Risk computation for different utility functions.
5. Finding survival function, curate future lifetime, force of mortality and problems based on life tables.
6. Problems on joint life and last survivor status and multiple decrement model.
7. Finding mean and variance of various continuous and discrete payments for assurance and annuity contracts.
8. Calculation of various payments from life tables using principle of equivalence, net premiums, prospective and retrospective provisions/reserves.