COURSE STRUCTURE FOR FOUR YEAR UNDERGRADUATE PROGRAMME IN STATISTICS FOR BATCH 2022

SEMESTER	COURSE CODE	TYPES OF COURSE	TITLEOFCOURSE	CREDITS	
				THEORY	PRACTICAL
I	STS122J	CT-1	DESCRIPTIVESTATISTICS	4	2
II	STS222J	CT-1	PROBABILITY THEORY&PROBABILITY DISTRIBUTIONS	4	2
III	STS322J	CT-1	MATHEMATICAL STATISTICS	4	2
1V	STS422J1	CT-1	TESTING OF HYPOTHESIS	3	1
	STS422J2	CT-2	APPLIED STATISTICS	4	2
	STS422J3	CT-3	VITAL STATISTCS	4	2
V	STS522J1	CT-1	STATISTICS: SAMPLING THEORY	3	1
	STS522J2	CT-2	STATISTICS: OPERATION RESEARCH-I	4	2
	STS522J3	CT-3	STATISTICS: NON PARAMETRIC TESTS	4	2
VI	STS622J1	CT-1	STATISTICS: STATISTICAL COMPUTING - I	3	1
	STS622J2	CT-2	STATISTICS: STATISTICAL INFRENCE	4	2
	STS622J3	CT-3	STATISTICS: DESIGN OF EXPERIMENTS	4	2

MINOR

SEMESTER	COURSE CODE	TYPES OFCOURSE	TITLEOFCOURSE	CREDITS	
				THEORY	PRACTICAL
I	STS122N	CT-1	DESCRIPTIVESTATISTICS	4	2
II	STS222N	CT-1	PROBABILITY THEORY&PROBABILITY DISTRIBUTIONS	4	2
III	STS322N	CT-1	MATHEMATICAL STATISTICS	4	2
IV	STS422N	CT-1	TESTING OF HYPOTHESIS	3	1
V	STS522N	CT-1	STATISTICS: SAMPLING THEORY	3	1
VI	STS622N	CT-1	STATISTICS: STATISTICAL COMPUTING - I	3	1

MD & SEC

SEMESTER	COURSE CODE	TYPES OFCOURSE	TITLEOFCOURSE	CREDITS	
				THEORY	PRACTICAL
I-III	STS022I	MD	INTRODUCTORY STATISTICS	3	0
I	STS122S	SKILL	PICTORIAL ANALYSIS OF DATA	2	2
II	ST222S	SKILL	ANALYTICAL REPRESENTATION OF DATA	2	2
III	ST322S	SKILL	COMPUTATIONAL STATISTICS USING EXCEL	2	2

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR
SEMESTER 1st
MAJOR COURSE

STS123J: DESCRIPTIVE STATISTICS **Credits: 4+2**

Course Objectives:

The learning objectives include:

- To understand the Statistics, its scope and importance in various fields .
- To understand the Knowledge of methods for summarizing data sets, including common graphical tools (such as boxplots, histograms and stem plots). Interpret histograms and boxplots.

Course Outcomes:

After completing this course, a student will have:

- Knowledge of Statistics, its scope and importance in various fields
- Ability to understand concepts of sample vs. population and difference between different types of data.
- Knowledge of methods for summarizing data sets, including common graphical tools (such as boxplots, histograms and stem plots). Interpret histograms and boxplots.
- Ability to describe data with measures of central tendency and measures of dispersion

THEORY: 04 CREDITS

UNIT I

Introduction to Statistics: Meaning, origin, definition, limitations and applications of Statistics. Primary and secondary data, different methods of collection of primary data with merits and demerits. Sources of secondary data. Classification: meaning, objectives, types of classifications, Formation of discrete and continuous frequency distributions.

UNIT II

Diagrammatic and Graphical representation of Data: Diagrams: Meaning, importance of diagrams and general rules of construction. Types of Diagrams - simple, multiple, component, percentage bar diagrams and pie diagrams with simple illustrations.

Graphs: Types of Graphs - Histogram, frequency Polygon, frequency curve and Ogives, simple problems, location of mode, median and partition values from the graphs. Difference between diagrams and graphs.

UNIT III

Central Tendency: Meaning of central tendency and essentials of a good measure of central tendency: Arithmetic mean, Median, Mode, Geometric mean and Harmonic mean - definition, merits and demerits and their important Properties. Empirical relation between mean median and mode. Problems on both grouped and ungrouped data of all the measures.

UNIT IV

Dispersion: Meaning of measures of dispersion. Essentials of a good measure of dispersion, absolute and relative measures of dispersion. Range, Quartile deviation, Mean deviation and standard deviation with relative measures - definition, merits and demerits and their important properties. Properties of Standard deviation, simple problems on ungrouped and grouped data.

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR

PRACTICAL: 02 CREDITS **Preferably Computers Using Excel**

I. Problems based on graphical representation of data by Histogram, Frequency polygons,
II. Problems based on graphical representation of data by Ogives, Stem andLeaf Plot, Box Plot.
III. Problems based on calculation of Measures of Central Tendency.
IV. Problems based on calculation of Measures of Dispersion.

BOOKS RECOMMENDED:

1. Gupta S. C. Fundamentals of Statistics, Himalaya Publishing House, Bombay
2. Mukhopadhaya, P. Applied Statistics, New Central Book Agency (P) Ltd., Calcutta
3. Gupta S P. and V K Kapoor Fundamentals of Mathematical Statistics, Sultan Chand, New Delhi
4. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2013). Fundamental of Statistics, Vol I, World Press, Kolkata.
5. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2011). Fundamental of Statistics, Vol II, World Press, Kolkata.
6. Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10th ed.), Sultan Chand and Sons.
7. Hanagal, D. D. (2009). Introduction to Applied Statistics: A Non-Calculus Based Approach. Narosa Publishing Comp. New Delhi.
8. Miller, I. and Miller, M. (2006). John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
9. Mood, A.M. Graybill, F.A. and Boes, D.C. (2011). Introduction to the Theory of Statistics, 3rd Edn., Tata McGraw-Hill Pub. Co. Ltd.
10. Weatherburn, C.E. (1961). A First Course in Mathematical Statistics, The English Lang. Book Society and Cambridge Univ. Press.
11. Paratha SarathiBishnu and Vandana Bhattacherjee(2019): Data Analysis: Using Statistics and Probability with R Language, PHI Learning Pvt. Ltd. New Delhi.

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR

SEMESTER 1st
MINOR COURSE

STS123N: DESCRIPTIVE STATISTICS **Credits: 4+2**

Course Objectives:

The learning objectives include:

- To understand the Statistics, its scope and importance in various fields .
- To understand the Knowledge of methods for summarizing data sets, including common graphical tools (such as boxplots, histograms and stem plots). Interpret histograms and boxplots.

Course Outcomes:

After completing this course, a student will have:

- Knowledge of Statistics, its scope and importance in various fields
- Ability to understand concepts of sample vs. population and difference between different types of data.
- Knowledge of methods for summarizing data sets, including common graphical tools (such as boxplots, histograms and stem plots). Interpret histograms and boxplots.
- Ability to describe data with measures of central tendency and measures of dispersion

THEORY: 04 CREDITS

UNIT I

Introduction to Statistics: Meaning, origin, definition, limitations and applications of Statistics. Primary and secondary data, different methods of collection of primary data with merits and demerits. Sources of secondary data. Classification: meaning, objectives, types of classifications, Formation of discrete and continuous frequency distributions.

UNIT II

Diagrammatic and Graphical representation of Data: Diagrams: Meaning, importance of diagrams and general rules of construction. Types of Diagrams - simple, multiple, component, percentage bar diagrams and pie diagrams with simple illustrations.

Graphs: Types of Graphs - Histogram, frequency Polygon, frequency curve and Ogives, simple problems, location of mode, median and partition values from the graphs. Difference between diagrams and graphs.

UNIT III

Central Tendency: Meaning of central tendency and essentials of a good measure of central tendency: Arithmetic mean, Median, Mode, Geometric mean and Harmonic mean - definition, merits and demerits and their important Properties. Empirical relation between mean median and mode. Problems on both grouped and ungrouped data of all the measures.

UNIT IV

Dispersion: Meaning of measures of dispersion. Essentials of a good measure of dispersion, absolute and relative measures of dispersion. Range, Quartile deviation, Mean deviation and standard deviation with relative measures - definition, merits and demerits and their important properties. Properties of Standard deviation, simple problems on ungrouped and grouped data.

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR

PRACTICAL: 02 CREDITS **Preferably Computers Using Excel**

I. Problems based on graphical representation of data by Histogram, Frequency polygons,
II. Problems based on graphical representation of data by Ogives, Stem andLeaf Plot, Box Plot.
III. Problems based on calculation of Measures of Central Tendency.
IV. Problems based on calculation of Measures of Dispersion.

BOOKS RECOMMENDED:

1. Gupta S. C. Fundamentals of Statistics, Himalaya Publishing House, Bombay
2. Mukhopadhaya, P. Applied Statistics, New Central Book Agency (P) Ltd., Calcutta
3. Gupta S P. and V K Kapoor Fundamentals of Mathematical Statistics, Sultan Chand, New Delhi
4. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2013). Fundamental of Statistics, Vol I, World Press, Kolkata.
5. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2011). Fundamental of Statistics, Vol II, World Press, Kolkata.
6. Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10th ed.), Sultan Chand and Sons.
7. Hanagal, D. D. (2009). Introduction to Applied Statistics: A Non-Calculus Based Approach. Narosa Publishing Comp. New Delhi.
8. Miller, I. and Miller, M. (2006). John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
9. Mood, A.M. Graybill, F.A. and Boes, D.C. (2011). Introduction to the Theory of Statistics, 3rd Edn., Tata McGraw-Hill Pub. Co. Ltd.
10. Weatherburn, C.E. (1961). A First Course in Mathematical Statistics, The English Lang. Book Society and Cambridge Univ. Press.
11. Paratha SarathiBishnu and Vandana Bhattacherjee(2019): Data Analysis: Using Statistics and Probability with R Language, PHI Learning Pvt. Ltd. New Delhi.

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR
SEMESTER 1st to 2nd
MULTIDISCIPLINARY COURSE

STS023I: STATISTICS (INTRODUCTORY STATISTICS) Credits: 3+0

Course Objectives:

The learning objectives include:

- To understand the Statistics, its scope and importance in various fields .
- To understand the Knowledge of methods for summarizing data sets, including common graphical tools (such as boxplots, histograms and stem plots).
- To understand the concept of moments with their inter-relations with properties.
- To have a clear understanding of when to apply various descriptive statistics and correlation and Regression Analysis for the real life data sets and draw appropriate conclusions from the analysis.

Course Outcomes:

After completing this course, a student will have:
To understand the Statistics, its scope and importance in various fields.

- To understand the Knowledge of methods for summarizing data sets, including common graphical tools (such as boxplots, histograms and stem plots).
- Ability to understand the concept of moments with their inter-relations with properties.
- Ability to understand the concept of Measures of skewness and kurtosis.
- Ability to understand the correlation and its methods.

THEORY (3 CREDITS)

UNIT-I

Introduction to Statistics and Basic Concepts: Meaning, origin, definition, functions, limitations and applications of Statistics. Primary and secondary data, different methods of collection of primary data with merits and demerits. Sources of secondary data. Classification: meaning, objectives, types of classifications- Chronological, Geographical, Qualitative and Quantitative classifications with illustrations. Formation of discrete and continuous frequency distributions. Tabulation: meaning, rules of tabulation, format of a statistical table and its parts. Diagrammatic and Graphical representation of Data: Diagrams, general rules of construction of diagrams. Types of Diagrams with simple illustrations. Graphs: Types of Graphs - Histogram, frequency Polygon, frequency curve and Ogives, simple problems, location of mode, median and partition values from the graphs. Difference between diagrams and graphs.

UNIT-II: Measures of Central Tendency:

Meaning of central tendency and essentials of a good measure of central tendency. Types of measures of central tendency: Arithmetic mean, Median, Mode, Geometric mean and Harmonic mean - definition, merits and demerits. Properties of arithmetic mean. Problems on both grouped and ungrouped data for all the measures.

UNIT-III: Measures of Dispersion: Meaning and objectives of measures of dispersion. Essentials of a good measure of dispersion, absolute and relative measures of dispersion. Types of measures of dispersion- Range, Quartile deviation, Mean deviation and standard deviation with relative measures - definition, merits and demerits. Simple problems on ungrouped and grouped data.

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR

BOOKS RECOMMENDED:

1. Gupta S. C. Fundamentals of Statistics, Himalaya Publishing House, Bombay
2. Mukhopadhaya, P. Applied Statistics, New Central Book Agency (P) Ltd., Calcutta
3. Gupta S P. and V K Kapoor Fundamentals of Mathematical Statistics, Sultan Chand, New Delhi
4. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2013). Fundamental of Statistics, Vol I, World Press, Kolkata.
5. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2011). Fundamental of Statistics, Vol II, World Press, Kolkata.
6. Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10th ed.), Sultan Chand andSons.
7. Hanagal, D. D. (2009). Introduction to Applied Statistics: A Non-Calculus Based Approach. NarosaPublishing Comp. New Delhi.
8. Miller, I. and Miller, M. (2006). John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR

SEMESTER 1ST
SKILL COURSE (NON-NSQF)

STS123S: Visualization of Data

Credits: 2+2

Course Objectives:

The objective of the course is to express the students to the real-life skill for statistical computing analysis and graphical interpretation using software skill. Hands on training on the following problem can be done on any one of the statistical software/excel to enhance data analysis skill.

Course Outcomes:

After completing this course, a student will have:

- Knowledge of Statistics, its scope and importance in various fields
- Ability to understand concepts of sample vs. population and difference between different types of data.
- Knowledge of methods for summarizing data sets, including common graphical tools (such as boxplots, histograms and stem plots). Interpret histograms and boxplots.
- Ability to describe data with measures of central tendency and measures of dispersion

THEORY (2 CREDITS)

UNIT-I

Introduction to Computers: Historical evolution of Computers. Generations of Computers. Classification of Computers, Applications of Computers, Computer Memory: Primary and Secondary Memory, Hardware: CPU, I/O Devices.

Primary and secondary data, different methods of collection of primary data with merits and demerits. Sources of secondary data. Classification: meaning, objectives, types of classifications. Formation of discrete and continuous frequency distributions.

UNIT II:

Diagrammatic and Graphical representation of Data: Diagrams: Meaning, importance of diagrams and general rules of construction of diagrams. Types of Diagrams - simple, multiple, component, percentage bar diagrams and pie diagrams with simple illustrations.

Graphs: Types of Graphs - Histogram, frequency Polygon, frequency curve and Ogives, simple problems, location of mode, median and partition values from the graphs. Difference between diagrams and graphs.

PRACTICALS (02 CREDITS) **Preferably Computers Using Excel/Software**

I. Problems based on graphical representation of data by bar diagrams and pie diagrams
II. Problems based on graphical representation of data by Histogram
III. Problems based on graphical representation of data by Frequency polygons,
IV. Problems based on graphical representation of data by frequency curves
V. Problems based on graphical representation of data by Ogives,

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR

BOOKS RECOMMENDED:

1. Gupta S. C. Fundamentals of Statistics, Himalaya Publishing House, Bombay
2. Mukhopadhaya, P. Applied Statistics, New Central Book Agency (P) Ltd., Calcutta
3. Gupta S P. and V K Kapoor Fundamentals of Mathematical Statistics, Sultan Chand, New Delhi
4. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2013). Fundamental of Statistics, Vol I, World Press, Kolkata.
5. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2011). Fundamental of Statistics, Vol II, World Press, Kolkata.
6. Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10th ed.), Sultan Chand and Sons.
7. Paratha SarathiBishnu and Vandana Bhattacherjee(2019): Data Analysis: Using Statistics and Probability with RLanguage, PHI Learning Pvt. Ltd. New Delhi.

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR

SEMESTER 2nd
MAJOR COURSE

STS223J: CORRELATION AND REGRESSION ANALYSIS **Credits: 4+2**

Course Objectives:

The learning objectives include:

- To understand the concept of moments with their inter-relations with properties.
- To have a clear understanding of when to apply various descriptive statistics and correlation and Regression Analysis for the real life data sets and draw appropriate conclusions from the analysis.

Course Outcomes:

After completing this course, a student will have:

- Ability to understand the concept of moments with their inter-relations with properties.
- Ability to understand the concept of Measures of skewness and kurtosis.
- Ability to understand the correlation and its methods.

THEORY: 04 CREDITS

UNIT I

Partition Values, Moments-Meaning and their inter-relations with properties- problems on ungrouped andgrouped data, factorial moments, Shephard's correction for moments (without Proof). Relationship between raw and central moments.

UNIT II

Skewness and Kurtosis: Definition, objectives and types of skewness, explanation of positive and negative skewness. Measure of skewness based on moment.

Skewness- Measures of skewness- Karl Pearson's coefficient of skewness and Bowley's coefficient of skewness. Simple problems. Kurtosis: Definition and types of kurtosis. Explanation of types of kurtosis. Difference between skewness and kurtosis.

UNIT III

Bivariate Data: Concept of correlation and its types. Scatter diagram method and product moment method of studying correlation. Properties of a correlation coefficient (limits of the correlation coefficient, effect of change of origin and scale).Concept of rank correlation, derivation of Spearman's rank correlation coefficient and its limits.

UNIT IV

Regression: Regression curve and regression equation, linear &nonlinear regression, lines of regression, regression coefficients and properties, angle between two lines of regression. Mean value, regression coefficients, correlation coefficient from two lines of regression, correlation vs regression. Principle of least squares and fitting of polynomials and exponential curves.

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR

PRACTICAL: 02 CREDITS **Preferably Computers Using Excel**

I. Practicals based on calculation of Moments.
II. Practicals based on Measures of Skewness .
III. Practicals based on Kurtosis.
IV. Practicals based Correlation on bivariate data.
V. Practicals based on Regression on bivariate data.

BOOKS RECOMMENDED:

1. Gupta S. C. Fundamentals of Statistics, Himalaya Publishing House, Bombay
2. Mukhopadhaya, P. Applied Statistics, New Central Book Agency (P) Ltd., Calcutta
3. Gupta S P. and V K Kapoor Fundamentals of Mathematical Statistics, Sultan Chand, New Delhi
4. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2013). Fundamental of Statistics, Vol I, World Press, Kolkata.
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8. Miller, I. and Miller, M. (2006). John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
9. Mood, A.M. Graybill, F.A. and Boes, D.C. (2011). Introduction to the Theory of Statistics, 3rd Edn., Tata McGraw-Hill Pub. Co. Ltd.
10. Weatherburn, C.E. (1961). A First Course in Mathematical Statistics, The English Lang. Book Society and Cambridge Univ. Press.
11. Paratha SarathiBishnu and Vandana Bhattacherjee(2019): Data Analysis: Using Statistics and Probability with R Language, PHI Learning Pvt. Ltd. New Delhi.

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR
SEMESTER 2nd
MINOR COURSE

STS223N: CORRELATION AND REGRESSION ANALYSIS **Credits: 4+2**

Course Objectives:

The learning objectives include:

- To understand the concept of moments with their inter-relations with properties.
- To have a clear understanding of when to apply various descriptive statistics and correlation and Regression Analysis for the real life data sets and draw appropriate conclusions from the analysis.

Course Outcomes:

After completing this course, a student will have:

- Ability to understand the concept of moments with their inter-relations with properties.
- Ability to understand the concept of Measures of skewness and kurtosis.
- Ability to understand the correlation and its methods.

THEORY: 04 CREDITS

UNIT I

Partition Values, Moments-Meaning and their inter-relations with properties- problems on ungrouped andgrouped data, factorial moments, Shephard's correction for moments (without Proof). Relationship between raw and central moments.

UNIT II

Skewness and Kurtosis: Definition, objectives and types of skewness, explanation of positive and negative skewness. Measure of skewness based on moment.

Skewness- Measures of skewness- Karl Pearson's coefficient of skewness and Bowley's coefficient of skewness. Simple problems. Kurtosis: Definition and types of kurtosis. Explanation of types of kurtosis. Difference between skewness and kurtosis.

UNIT III

Bivariate Data: Concept of correlation and its types. Scatter diagram method and product moment method of studying correlation. Properties of a correlation coefficient (limits of the correlation coefficient, effect of change of origin and scale).Concept of rank correlation, derivation of Spearman's rank correlation coefficient and its limits.

UNIT IV

Regression: Regression curve and regression equation, linear &nonlinear regression, lines of regression, regression coefficients and properties, angle between two lines of regression. Mean value, regression coefficients, correlation coefficient from two lines of regression, correlation vs regression. Principle of least squares and fitting of polynomials and exponential curves.

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR

PRACTICAL: 02 CREDITS **Preferably Computers Using Excel**

I. Practicals based on calculation of Moments.
II. Practicals based on Measures of Skewness .
III. Practicals based on Kurtosis.
IV. Practicals based Correlation on bivariate data.
V. Practicals based on Regression on bivariate data.

BOOKS RECOMMENDED:

1. Gupta S. C. Fundamentals of Statistics, Himalaya Publishing House, Bombay
2. Mukhopadhaya, P. Applied Statistics, New Central Book Agency (P) Ltd., Calcutta
3. Gupta S P. and V K Kapoor Fundamentals of Mathematical Statistics, Sultan Chand, New Delhi
4. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2013). Fundamental of Statistics, Vol I, World Press, Kolkata.
5. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2011). Fundamental of Statistics, Vol II, World Press, Kolkata.
6. Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10th ed.), Sultan Chand and Sons.
7. Hanagal, D. D. (2009). Introduction to Applied Statistics: A Non-Calculus Based Approach. Narosa Publishing Comp. New Delhi.
8. Miller, I. and Miller, M. (2006). John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
9. Mood, A.M. Graybill, F.A. and Boes, D.C. (2011). Introduction to the Theory of Statistics, 3rd Edn., Tata McGraw-Hill Pub. Co. Ltd.
10. Weatherburn, C.E. (1961). A First Course in Mathematical Statistics, The English Lang. Book Society and Cambridge Univ. Press.
11. Paratha SarathiBishnu and Vandana Bhattacherjee(2019): Data Analysis: Using Statistics and Probability with R Language, PHI Learning Pvt. Ltd. New Delhi.

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR

SEMESTER 2nd
SKILL COURSE (NON-NSQF)

STS223S: ANALYSIS OF DATA **Credits: 2+2**

Course Objectives:

The objective of the course is to express the students to the real-life skill for statistical computing analysis and graphical interpretation using software skill. Hands on training on the following problem can be done on any one of the statistical software/excel to enhance data analysis skill.

Course Outcomes:

After completing this course, a student will have:

- Ability to understand the concept of moments with their inter-relations with properties.
- Ability to understand the concept of Measures of skewness and kurtosis.
- Ability to understand the correlation and its methods.

THEORY (2 CREDITS)

UNIT-I

Central Tendency: Meaning of central tendency and essentials of a good measure of central tendency. Arithmetic mean, Median, Mode, Geometric mean and Harmonic mean - definition, merits and demerits. Properties of arithmetic mean. Empirical relation between mean median and mode. Problems on both grouped and ungrouped data for all the measures.

UNIT II:

Dispersion: Meaning and objectives of measures of dispersion. Essentials of a good measure of dispersion, absolute and relative measures of dispersion. Range, Quartile deviation, Mean deviation and standard deviation with relative measures - definition, merits and demerits. Properties of Standard deviation, simple problems on ungrouped and grouped data.

PRACTICALS (02 CREDITS) Preferably Computers Using Excel/Software

I. Problems based on calculation of Measures of Central Tendency: Arithmetic mean, Median, Mode, Geometric mean and Harmonic mean.
II. Problems based on calculation of Measures of Dispersion: Quartile deviation, Mean deviation and standard deviation

BOOKS RECOMMENDED:

1. Gupta S. C. Fundamentals of Statistics, Himalaya Publishing House, Bombay
2. Mukhopadhaya, P. Applied Statistics, New Central Book Agency (P) Ltd., Calcutta
3. Gupta S P. and V K Kapoor Fundamentals of Mathematical Statistics, Sultan Chand, New Delhi
4. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2013). Fundamental of Statistics, Vol I, World Press, Kolkata.
5. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2011). Fundamental of Statistics, Vol II, World Press, Kolkata.
6. Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10th ed.), Sultan Chand and Sons.
7. Paratha SarathiBishnu and Vandana Bhattacherjee(2019): Data Analysis: Using Statistics and Probability with RLanguage, PHI Learning Pvt. Ltd. New Delhi.

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR
SEMESTER 3rd
MAJOR COURSE

STS322J: Mathematical Statistics **CREDITS: 4+2**

Course Objectives:

Mathematical Statistics serves as a building block that will enable students to learn more advanced techniques that will help them to solve problems more quickly and easily.

Course Outcomes:

After completing this course, a student will have:

- Ability to understand concept of Concept of multiple correlation, Partial correlation with their applications.
- Ability to understand the concept of Concept of multiple regression and partial regression with their applications.
- Ability to deal with problems of attributes.
- Ability to understand the concept of Curve Fitting.

THEORY: 04 CREDITS

UNIT I

Multiple and Partial Correlation: Concept of multiple correlation, Partial correlation and its Importance, assumptions and applications. Yules notation, residual, primary and secondary subscripts, Properties of residuals without proof, Coefficient of multiple correlation and partial correlation. Multiple correlation in terms of total and partial correlation. Important properties of multiple correlation coefficient (without proof).

UNIT II

Curve Fitting: Concept, dependent and independent variable, Types of curves, Method of least square for fitting straight line, fitting of parabola, Fitting of exponential curvey $= ab^x$. Fitting of Power curve of the form $y = ax^b$ and related examples.Free-hand method of curve fitting.

UNIT III

Multiple Regression: Concept of multiple regression its Importance, applications and assumptions, Formulation of the multiple regression model, Interpretation of regression coefficients, Multiple correlation coefficient (R) and coefficient of determination (R-squared), Adjusted R-squared and its interpretation, Introduction to nonlinear regression models

UNIT IV

Analysis of Categorical Data: Level of Measurements, Notations, Classes and class frequencies, order of classes, Relation between class frequencies, Consistency of categorical data, Independence of attributes, Association of attributes, Yule's coefficient of association, Coefficient of colligation.

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR

PRACTICAL: 02 CREDITS (PREFERABLY THROUGH COMPUTERS)

List of Practical's:

I. Practical Problems based on Concept of multiple correlation.
II. Practical Problems based on Partial correlation.
III. Practical Problems based on multiple regression
IV. Practical Problems based on partial regression .
V. Fitting of 1st degree line to the data set.
VI. Fitting 2nd degree parabola to the data set.
VII. Predicting value of dependent variable in case of straight line and second degree parabola for data set.

BOOKS RECOMMENDED:

1. Hogg, R. V., McKean, J. and Craig, A. T. (2012). Introduction to Mathematical Statistics.
2. Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10th ed.), Sultan Chand and Sons.
3. Das N,G. Statistical Methods Vol I, McGraw Hill Education India.
4. S.P Gupta. Statistical Methods, Sultan Chand and Sons.
5. Kapur, J.N. and Saxena, H.C. (1976). Mathematical Statistics, Sultan Chand and sons.
6. Mood, A.M. Graybill, F.A. and Boes, D.C. (1974). Introduction to the Theory of Statistics, 3rd Edn., Tata McGraw-Hill Pub. Co. Ltd.
7. Rohatgi, V.K. and Saleh, A.E. (2008). An introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
8. Prasad, G. (1997). Differential Calculus, 14th Ed., Pothishala Pvt. Ltd., Allahabad.
9. Prasad, G. (2000). Integral Calculus, 14th Ed., Pothishala Pvt. Ltd., Allahabad.
10. Ahsan, Z. (2004). Differential Equations and their Applications, 2nd Ed., Prentice- Hall of India Pvt. Ltd., New Delhi

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR
SEMESTER 3rd
MINOR COURSE

STS322N: Mathematical Statistics **CREDITS: 4+2**

Course Objectives:

Mathematical Statistics serves as a building block that will enable students to learn more advanced techniques that will help them to solve problems more quickly and easily.

Course Outcomes:

After completing this course, a student will have:

- Ability to understand concept of Concept of multiple correlation, Partial correlation with their applications.
- Ability to understand the concept of Concept of multiple regression and partial regression with their applications.
- Ability to deal with problems of attributes.
- Ability to understand the concept of Curve Fitting.

THEORY: 04 CREDITS

UNIT I

Multiple and Partial correlation: Concept of multiple correlation, Partial correlation and its Importance, assumptions and applications. Yules notation, residual, primary and secondary subscripts, Properties of residuals without proof, Coefficient of multiple correlation and partial correlation. Multiple correlation in terms of total and partial correlation. Important properties of multiple correlation coefficient (without proof).

UNIT II

Curve Fitting: Concept, dependent and independent variable, Types of curves, Method of least square for fitting straight line, fitting of parabola, Fitting of exponential curvey $= ab^x$. Fitting of Power curve of the form $y = ax^b$ and related examples.Free-hand method of curve fitting.

UNIT III

Multiple Regression: Concept of multiple regression its Importance, applications and assumptions, Formulation of the multiple regression model, Interpretation of regression coefficients, Multiple correlation coefficient (R) and coefficient of determination (R-squared), Adjusted R-squared and its interpretation, Introduction to nonlinear regression models

UNIT IV

Analysis of Categorical Data: Level of Measurements, Notations, Classes and class frequencies, order of classes, Relation between class frequencies, Consistency of categorical data, Independence of attributes, Association of attributes, Yule's coefficient of association, Coefficient of colligation.

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PRACTICAL: 02 CREDITS (PREFERABLY THROUGH COMPUTERS)

List of Practical's:

I. Practical Problems based on Concept of multiple correlation.
II. Practical Problems based on Partial correlation.
III. Practical Problems based on multiple regression
IV. Practical Problems based on partial regression .
V. Fitting of 1st degree line to the data set.
VI. Fitting 2nd degree parabola to the data set.
VII. Predicting value of dependent variable in case of straight line and second degree parabola for data set.

BOOKS RECOMMENDED:

1. Hogg, R. V., McKean, J. and Craig, A. T. (2012). Introduction to Mathematical Statistics.
2. Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10th ed.), Sultan Chand and Sons.
3. Das N,G. Statistical Methods Vol I, McGraw Hill Education India.
4. S.P Gupta. Statistical Methods, Sultan Chand and Sons.
5. Kapur, J.N. and Saxena, H.C. (1976). Mathematical Statistics, Sultan Chand and sons.
6. Mood, A.M. Graybill, F.A. and Boes, D.C. (1974). Introduction to the Theory of Statistics, 3rd Edn., Tata McGraw-Hill Pub. Co. Ltd.
7. Rohatgi, V.K. and Saleh, A.E. (2008). An introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
8. Prasad, G. (1997). Differential Calculus, 14th Ed., Pothishala Pvt. Ltd., Allahabad.
9. Prasad, G. (2000). Integral Calculus, 14th Ed., Pothishala Pvt. Ltd., Allahabad.
10. Ahsan, Z. (2004). Differential Equations and their Applications, 2nd Ed., Prentice- Hall of India Pvt. Ltd., New Delhi

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR
SEMESTER 4th
MAJOR COURSE (Major Type 1)

STS422J1: TESTING OF HYPOTHESIS **Credits: 3+1**

Course Objectives:

The learning objectives include:

- To understand the concept of sampling distributions and their applications in statistical inference.
- To understand the process of hypothesis testing.
- To have a clear understanding of when to apply various tests of hypothesis about population parameters using sample statistics and draw appropriate conclusions from the analysis.

Course Learning Outcomes:

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

- Basic concepts of hypothesis testing, including framing of null and alternative hypothesis.
- Hypothesis testing based on a single sample and two samples using both classical and pvalue approach.

THEORY: 03 CREDITS

UNIT I

Concept of population, sample, Statistic, parameter and sampling distribution. Standard error of sample means and sample proportion. Statistical hypothesis and its types. One tail and two tail tests. Types of errors, level of significance and critical region, P Value, Procedure for testing of hypothesis.

UNIT II

Estimation and Estimate, Point Estimation and Interval Estimation, confidence Interval.
Large sample tests: Tests of significance and confidence Interval for testing of a single mean, single proportion, difference of two means and two proportions.

UNIT III

Exact sampling distributions: t- Statistics. Test for single mean and difference between two means. Paired t-test for difference between two means. F- Statistics or Variance Ratio Test. Assumptions in F-test. Tests of hypothesis of the variance of two populations.

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DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR

PRACTICAL: 01 CREDIT (PREFERABLY THROUGH COMPUTERS)

List of Practical's:

I. Large Sample Tests : Testing of significance and confidence intervals for single proportion and differenceof two proportions.
II. Testing of significance and confidence intervals for single mean and difference oftwo means. .
III. Small sample tests: Testing of significance and confidence intervals for single mean and difference oftwo means and paired t – test.
IV. Testing and confidence intervals of equality of two population variances.

BOOKS RECOMMENDED:

1. Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10th ed.), Sultan Chand and Sons.
2. Das N,G. Statistical Methods Vol I, McGraw Hill Education India.
3. S.P Gupta. Statistical Methods, Sultan Chand and Sons.
4. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2003). *An Outline of Statistical Theory*,Vol. I, 4th Ed., World Press, Kolkata.
5. Hogg, R.V. and Tanis, E.A. (2009). *A Brief Course in Mathematical Statistics*. PearsonEducation.
6. Johnson, R.A. and Bhattacharya, G.K. (2001). *Statistics-Principles and Methods*, 4thEd., John Wiley and Sons.
7. Mood, M.A., Graybill, F.A. and Boes, C.D. (2007). *Introduction to the Theory of Statistics*, 3rd Ed., (Reprint).Tata McGraw-Hill Pub. Co. Ltd.
8. Rohatgi, V. K. and Saleh, A.K. Md. E. (2009). *An Introduction to Probability and Statistics*, 2nd Ed., (Reprint) John Wiley

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR

SEMESTER 4th
MAJOR COURSE (Major Type 2)

STS422J2: APPLIED STATISTICS **CREDITS: 4+2**

Course Objectives:

The learning objectives include:

- This course will help students to know the applications of Statistics and learn and applythese techniques in the core course of their study.
- This course will give exposure to four applied fields of statistics viz. Time Series, IndexNumbers
- They will be having hands on practice of working on the data related to above mentioned fields

Course Learning Outcomes:

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

- Time series data, components of time series data, study the behavior and identifying thevariation due to different components in the data.
- They will study to identify and measure various components of time series data.
- The fundamental concepts of Index Numbers, Construction of price and quantity Indexnumbers.
- Construction of Wholesale and Consumer price Index and its significance.

THEORY: 04 CREDITS

UNIT I

Introduction to times series data, application of time series from various fields, Components of a times series, Decomposition of time series. Estimation of trend by free hand curve method, method of semi averages, fitting mathematical curve and growth curves. Estimation of trend by method of moving averages. Detrending: effect of elimination of trend on other components of a time series.

UNIT II

Seasonal Component: Estimation of seasonal component by the methods of - simple averages, Ratio to Trend, Ratio to Moving Averages and Link Relative method. Deseasonalization. Cyclic Component: Harmonic Analysis.

UNIT III

Economic statistics: Index number, its definition and applications. Criteria for good index numbers, Problems involved in computation of index number, Construction of wholesale price index number, fixed base index number and Consumer price index number with interpretation. Uses and limitations of index numbers.

UNIT IV

Price relatives and quantity or volume relatives, link and chain relatives, Uses of averages, simple aggregative and Weighted average methods, Lasperey's, Passche's , Marshall-Edgeworth's and Fisher's index numbers, time and factor reversal tests of index number.

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PRACTICAL: 02 CREDITS (PREFERABLY THROUGH COMPUTERS)

List of Practical's:

I. Fitting of trend by Moving Average Method for given extent and for estimated extent.
II. Measurement of Seasonal indices:
    a. Simple Averages method
    b. Ratio-to-Trend method
    c. Ratio-to-Moving Average method
    d. Link Relative method
III. Construction of index number by Laspeyre's, Passche's and Fisher's method.
IV. Computation of reversal tests.

BOOKS RECOMMENDED:

1. Kendall, M.G. (1976). Time Series, 2nd Ed., Charles Griffin and Co Ltd., London and High Wycombe.
2. Chatfield, C. (1980). The Analysis of Time Series –An Introduction, Chapman & Hall.
3. Mukhopadhyay, P. (2011). *Applied Statistics*, 2nd Ed., Revised reprint, Books and Allied
4. Goon, A. M., Gupta, M. K. and Dasgupta, B. (2003). *Fundamentals of Statistics*, 6thEd., Vol II Revised,Enlarged.
5. Gupta, S.C. and Kapoor, V.K. (2014). *Fundamentals of Applied Statistics*, 11th Ed., Sultan Chand and Sons.
6. Montgomery, D. C. and Johnson, L. A. (1967). *Forecasting and Time Series Analysis*,1st Ed. McGraw-Hill, New York.

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR
SEMESTER 4th
MAJOR COURSE (MAJOR TYPE 3)

STS422J3: VITAL STATISTICS **Credits: 4+2**

Course Objectives:
The learning objectives include:

- To collect valid Demographic data using different methods.
- To learn basic of Role of Ministry of Statistics & Program Implementation
- To learn basic of measures of Mortality, Fertility and Population Growth.

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

- Methods of collection of official statistics Control chars for variables and Attributes
- Distinction between Vital Statistics and Demography.
- Basic measures of Mortality.
- Basic measures of Fertility.

THEORY: 04 CREDITS

UNIT I
Present official statistical system in India, Methods of collection of official statistics, their reliability and limitations. Role of Ministry of Statistics & Program Implementation (MoSPI), Central Statistical Office (CSO), National Sample Survey Office (NSSO), and National Statistical Commission. Government of India's Principal publications containing data on the topics such as population, industry and finance.

UNIT II
Introduction and definition of vital Statistics, Introduction and sources of collecting data on vital statistics, errors in census and registration data. Measurement of population, rate and ratio of vital events.Coverage and content errors in demographic data, use of balancing equations, Chandrasekharan-Deming formula to check completeness of registration data. Dependency ratio. Accuracy of age data on sex and age: Whipple's and Myer's indices

UNIT III
Measurements of Mortality: Crude Death Rate (CDR), Specific Death Rate (SDR), Infant Mortality, Rate (IMR) and Standardized Death Rates. Stationary and Stable population, Central Mortality Rates and Force of Mortality. Life(Mortality) Tables: Assumption, description, construction of Life Tables and Uses of Life Tables.

UNIT IV

Measurements of Fertility: Crude Birth Rate (CBR), General Fertility Rate (GFR), Specific Fertility Rate (SFR) and Total Fertility Rate (TFR). Measurement of Population Growth: Crude rates of natural increase, Pearl's Vital Index, Gross Reproduction Rate (GRR) and Net Reproduction Rate (NRR), Relation between CBR, GFR and TFR. Dandekars Binomial and Poisson Models, William Brass Model.

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PRACTICAL: 02 CREDITS (PREFERABLY THROUGH COMPUTERS)

List of Practical's:

I. To calculate CDR and Age Specific death rate for a given set of data.
II. To find standardized death rate by: (i) Direct method (ii) Indirect method.
III. To construct a complete life table.
IV. To calculate CBR, GFR, SFR, TFR for a given set of data.
V. To calculate Crude rate of Natural Increase and Pearle's Vital Index for a given set of data.
VI. Calculate GRR and NRR for a given set of data and compare them.

BOOKS RECOMMENDED:

1. Biswas, S. (1988). *Stochastic Processes in Demography & Application*, Wiley EasternLtd.
2. Croxton, Fredrick, E. Cowden, Dudley J. and Klein, S. (1973). *Applied General Statistics*, 3rd Ed., Prentice Hall of India Pvt. Ltd.
3. Gun, A.M., Gupta, M.K. and Dasgupta, B. (2008). *Fundamentals of Statistics*, Vol. II,9thEd., World Press.
4. Keyfitz, N. and Beekman,J.A. (1985). *Demography through Problems*. S-Verlag, NewYork.
5. Mukhopadhyay, P. (1999). *Applied Statistics*, Books and Allied (P) Ltd.
6. Gupta and Mukhopadhay P.P: Applied Statistics, Central Book Agency
7. Cowden D.J (1960): Statistics Methods in Quality Control, Asia Publishing Society

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR

SEMESTER 4th
MINOR COURSE

STS422N: TESTING OF HYPOTHESIS **Credits: 3+1**

Course Objectives:

The learning objectives include:

- To understand the concept of sampling distributions and their applications in statistical inference.
- To understand the process of hypothesis testing.
- To have a clear understanding of when to apply various tests of hypothesis about population parameters using sample statistics and draw appropriate conclusions from the analysis.

Course Learning Outcomes:

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

- Basic concepts of hypothesis testing, including framing of null and alternative hypothesis.
- Hypothesis testing based on a single sample and two samples using both classical and pvalue approach.

THEORY: 03 CREDITS

UNIT I

Concept of population, sample, Statistic, parameter and sampling distribution. Standard error of sample means and sample proportion. Statistical hypothesis and its types. One tail and two tail tests. Types of errors, level of significance and critical region, P Value, Procedure for testing of hypothesis.

UNIT II

Estimation and Estimate, Point Estimation and Interval Estimation, confidence Interval.
Large sample tests: Tests of significance and confidence Interval for testing of a single mean, single proportion, difference of two means and two proportions.

UNIT III

Exact sampling distributions: t- Statistics. Test for single mean and difference between two means. Paired t-test for difference between two means. F- Statistics or Variance Ratio Test. Assumptions in F-test. Tests of hypothesis of the variance of two populations.

DEPARTMENT OF STATISTICS
UNIVERSITY OF KASHMIR, SRINAGAR

PRACTICAL: 01 CREDIT (PREFERABLY THROUGH COMPUTERS)

List of Practical's:

I. Large Sample Tests: Testing of significance and confidence intervals for single proportion and differenceof two proportions.
II. Testing of significance and confidence intervals for single mean and difference of two means. .
III. Small sample tests: Testing of significance and confidence intervals for single mean and difference oftwo means and paired t – test.
IV. Testing and confidence intervals of equality of two population variances.

BOOKS RECOMMENDED:

1. Gupta, S.C. and Kapoor, V.K. (2000). Fundamentals of Mathematical Statistics (10th ed.), Sultan Chand and Sons.
2. Das N,G. Statistical Methods Vol I, McGraw Hill Education India.
3. S.P Gupta. Statistical Methods, Sultan Chand and Sons.
4. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2003). *An Outline of Statistical Theory*,Vol. I, 4th Ed., World Press, Kolkata.
5. Hogg, R.V. and Tanis, E.A. (2009). *A Brief Course in Mathematical Statistics*. PearsonEducation.
6. Johnson, R.A. and Bhattacharya, G.K. (2001). *Statistics-Principles and Methods*, 4thEd., John Wiley and Sons.
7. Mood, M.A., Graybill, F.A. and Boes, C.D. (2007). *Introduction to the Theory of Statistics*, 3rd Ed., (Reprint).Tata McGraw-Hill Pub. Co. Ltd.
8. Rohatgi, V. K. and Saleh, A.K. Md. E. (2009). *An Introduction to Probability and Statistics*, 2nd Ed., (Reprint) John Wiley

BACHELORS WITH STATISTICS AS MAJOR

5thSEMESTER

STS522J1: STATISTICS:SAMPLING THEORY

Credits: 3 Theory +1 Practical THEORY: 45 HOURS & PRACTICAL: 30 HOURS

Course Objectives:

To understand the concept of sampling technique and their applications in statisticalinference.

Course Learning Outcomes:

Aftercompletingthiscourse,studentsmust be able:

- To understand the concept of census and sampling process, reasons for opting the sampling methods, sampling and non-sampling errors.
- To understand the concept of probability sampling with their applications in various fields.

THEORY: 03 CREDITS

UNITI

Sampling Theory: Concept of population and sample, Need for sampling, Census and sample survey, basic concept in sampling, Principles of sample survey, Principle Steps of Sample Survey, advantages of sample survey over census. Sampling and non-Sampling errors, Types of sampling: non-probability (definition only) and probability sampling, samplesizedetermination.

UNIT II

Simple random sampling (SRS) with and without replacement. Merits and demerits of Simple random sampling (SRS). Methods of selecting SRS. Estimation of mean andvariance.

UNIT III

Stratified random sampling: Need for stratification. Principles of stratification. Advantages of stratified sampling over simple random sampling. Estimation of mean and variance. Proportion and equal allocation: Allocation of sample size under proportional and equal allocation and variance under these allocation.

PRACTICAL: 01 CREDIT Using Statistical / Computational Software's

Problems based on:

I. Selection of sample and determination of sample size.
II. Estimation of mean and variance under SRSWR
III. Estimation of mean and variance under SRSWOR
IV. Estimation of mean and variance under Stratified sampling
V. Allocation of sample size in stratified sampling

BOOKS RECOMMENDED:

1. Murthy M.N: Sampling theory and Methods, Statistical Publisher Society, Calcutta,(1967).
2. Des Raj: sample Survey Theory, Narosa publishing house,India(2000).
3. Sampath S.: Sampling theory and Methods. Narosa Publishing House,India (2000).
4. Sukhatme B.V.: Sample Survey methods and its Applications, Indian Society of Agricultural Statistics(1984).
5. S.C Gupta and V.K Kapoor: Fundamentals of Applied Statistics.10th Edition; Sultan Chand & Sons,(2002).
6. William G Cochran: Sampling Techniques: 3rd Edition; John Wiley and Sons,(1977).

BACHELORS WITH STATISTICS AS MAJOR

5thSEMESTER

STS522J2:STATISTICS:OPERATIONS RESEARCH-I

Credits: 4 Theory +2 Practical THEORY: 60 HOURS & PRACTICAL: 60 HOURS

CourseObjectives:

- Tohaveaclearunderstandingofwhentoapplyvariousoptimization techniques like Simplex Methods, Transportation and Assignment Problems.

Course Learning Outcomes:

- Aftercompletingthiscourse,studentsmust be able:
- To understand the concept of linear programming its formulation and applications.
- To understand the concept of Graphical method, Simplex method and Transportation problems.

THEORY: 04 CREDITS

UNITI

Operations Research (OR): Introduction to Operations Research its Development, characteristics and scope. Importance of Operations Research in industry. Limitations of OR. Linear programming: Introduction to linear programming (LPP), basic solution,basic feasible solution, non-feasible solution and optimum solution. Slack & surplus variables in LPP's.

UNIT II

Mathematical formulation of LPP,Concept of Convex set,graphical method of solving LPP, Standard form of LPP. Simplex Method: Iterative nature of simplex method, basic computational details of simplex algorithm and summary. Concept of duality with simple examples.

UNIT III

Artificial variable techniques (Two-phase and Big-M techniques) for solving a general LPP.Transportation Problem (TP): Balanced and unbalanced Transportation Problem,Mathematical formulation and tabular representation. Concept of feasible, Basic feasible and optimal solutions with reference to T.P.

UNIT IV

Methods for finding initial basic feasible solution: North West Corner Rule, Lowest Cost Entry, Vogel's Approximation method.Modified Distribution method to find the optimal solution. Assignment problem: Balanced and unbalanced Assignment Problem, Hungarian method to find optimal assignment.

PRACTICAL: 02 CREDITS **Using Statistical / Computational Software's**

Problems based on:

I. Formulation of LPPs.
II. Solving LPPs by graphical and simplex methods.
III. Solving LPPs by artificial technique.
IV. Problems based on transportation problems.
V. Problems based on Assignment problems.

BOOKS RECOMMENDED:

1. Gass S.I: Linear Programming Methods and Applications, McGraw Hill,(1975).
2. S.D. Sharma: Operations Research, Kedar Nath Ram Nath & Co, Meerut,(1994).
3. P. K. Gupta and D.S. Hira: Operations Research, S. Chand New Delhi,(2009).
4. H.A. Taha: Operations Research: An introduction Person Prentice Hall,(2009).
5. KantiSwarup, Gupta, P.K. and Manmohan: Operations Research, 13th Edition, Sultan Chand and Sons,(2007).

BACHELORS WITH STATISTICS AS MAJOR

5th SEMESTER

STS522J3:STATISTICS:NON-PARAMETRIC TESTS

Credits: 4 Theory +2 Practical THEORY: 60 HOURS & PRACTICAL: 60 HOURS

Course Objectives:

To have a clear understanding of the concepts and applications of non-parametric tests and measures of association with multiple classifications.

Course Outcomes:

Aftercompletingthiscourse,studentsshall be able:

- To Understand the concept of sign tests, median tests, and Wilcoxon-Signed Rank tests with their applications.
- To test the equality of k independent samples using the Kruskal-Wallis test.
- To test the Kendall's Tau and Spearman's coefficient for measuring association in bivariate samples.
- To test the Friedman's two-way ANOVA by ranks with multiple classifications.

THEORY: 04 CREDITS

UNIT I

Non- Parametric Inference: Introduction, Advantages and disadvantages of non- parametric tests. Sign Test-one sample and two samples: assumptions, applications and importance. Median test assumptions: applications and importance.

UNIT II

Wilcoxon-Signed rank test- one sample and two samples,assumptions, applications and importance , Wilcoxon –Mann Whitney test :assumptions, applications and importance. Test of randomness based on total number of runs:assumptions, applications and importance.

UNIT-III

Wald –Wilfwitz run test, Kolmogorov-Smirnov- one sample and two samples test (for samples of equal size)::assumptions, applications and importance. Tests for equality of k independent samples: Kruskal-Wallis one way ANOVA test.

UNIT-IV

Measures of Association for bivariate samples: Kendall's Tau coefficient, Spearman's coefficient of Rank correlation, Measures of association in multiple classifications: Friedman's two-way ANOVA by ranks in a k x n table.

PRACTICAL: 02 CREDITS Using Statistical / Computational Software's

Problems based on:

I. Conduct a Median Test using two samples.
II. Apply the Wilcoxon-Signed Rank Test on a one-sample dataset.
III. Conduct a Wilcoxon–Mann–Whitney test on two independent samples.
IV. Perform a Wald–Wolfowitz Run Test for randomness based on a given dataset.
V. Apply the Kolmogorov-Smirnov Test for two independent samples of equal size.
VI. Conduct a Kruskal-Wallis One-Way ANOVA Test on a dataset with more than two independent samples.
VII. Calculate Kendall's Tau coefficient for a bivariate dataset.
VIII. Perform a Friedman's Two-Way ANOVA by ranks.

BOOKSRECOMMENDED:

1. Johnston, J.. Econometric Methods, Mc Graw Hill Kogakusha Ltd,(1984).
2. Judge, G.C., Hill, R,C. Griffiths, W.E., Lutkepohl, H. and Lee, T-C. Introduction to the Theory and Practice of Econometrics, Second Edition, John Wiley & Sons(1988).
3. Kendall, M.G. and Stuart, A.. The Advanced Theory of Statistics (Vol. III), Second Edition, Charles Griffin(1968).
4. Kmenta, J.. Elements of Econometrics, Second Edition, Mac millan,(1986).
5. Medhi, J.. Stochastic Processes, Second Edition, Wiley Eastern, New Delhi,(1994)
6. Montgomery, D.C. and Johnson, L.A.. Forecasting and Time Series Analysis, Mc Graw Hill, New York,(1976).
7. Peter J. Brockwell and Richard A. Daris. Introduction to time Series and Forecasting, Second Edition. Springer-Verlag, New York, Inc.(2002) (Springer Texts in Statistics)

BACHELORS WITH STATISTICS AS MAJOR

5th SEMESTER

STS522N: STATISTICS:SAMPLING THEORY

Credits: 3 Theory +1 Practical THEORY: 45 HOURS & PRACTICAL: 30 HOURS

Course Objectives:

To understand the concept of sampling technique and their applications in statisticalinference.

Course Learning Outcomes:

Aftercompletingthiscourse,studentsmust be able:

- To understand the concept of census and sampling process, reasons for opting the sampling methods, sampling and non-sampling errors.
- To understand the concept of probability sampling with their applications in various fields.

THEORY: 03 CREDITS

UNITI

Sampling Theory: Concept of population and sample, Need for sampling, Census and sample survey, basic concept in sampling, Principles of sample survey, Principle Steps of Sample Survey, advantages of sample survey over census. Sampling and non-Sampling errors, Types of sampling: non-probability (definition only) and probability sampling, samplesizedetermination.

UNIT II

Simple random sampling (SRS) with and without replacement. Merits and demerits of Simple random sampling (SRS). Methods of selecting SRS. Estimation of mean andvariance.

UNIT III

Stratified random sampling: Need for stratification. Principles of stratification. Advantages of stratified sampling over simple random sampling. Estimation of mean and variance. Proportion and equal allocation: Allocation of sample size under proportional and equal allocation and variance under these allocation.

PRACTICAL: 01 CREDIT Using Statistical / Computational Software's

Problems based on:

I. Selection of sample and determination of sample size.
II. Estimation of mean and variance under SRSWR
III. Estimation of mean and variance under SRSWOR
IV. Estimation of mean and variance under Stratified sampling
V. Allocation of sample size in stratified sampling.

BOOKS RECOMMENDED:

1. Murthy M.N: Sampling theory and Methods, Statistical Publisher Society, Calcutta,(1967).
2. Des Raj: sample Survey Theory, Narosa publishing house,India(2000).
3. Sampath S.: Sampling theory and Methods. Narosa Publishing House,India (2000).
4. Sukhatme B.V.: Sample Survey methods and its Applications, Indian Society of Agricultural Statistics(1984).
5. S.C Gupta and V.K Kapoor: Fundamentals of Applied Statistics.10th Edition; Sultan Chand & Sons,(2002).
6. William G Cochran: Sampling Techniques: 3rd Edition; John Wiley and Sons,(1977).

BACHELORS WITH STATISTICS AS MAJOR

6thSEMESTER

STS622J1: STATISTICS:STATISTICAL COMPUTING-I

Credits: 3 Theory +1 Practical THEORY: 45 HOURS & PRACTICAL: 30 HOURS

Course Objectives:

To express the students to the real-life skill for statistical computing analysis and graphical interpretation using software skill. Hands on training onthe real-life problems can be done on any one of the statistical software/excel to enhance data analysis skills.

Course Outcomes:

After completing this course, studentsmust be able:

- To understand the Graphical representation of data sets.
- To understand the descriptive statistics and Correlation analysis.
- To understand the usages of statistical and computational software's.

THEORY: 03 CREDITS

UNIT-I

Introduction to Computers: Historical evolution of Computers. Generations of Computers. Classification of Computers, Applications of Computers, Computer Memory: Primary and Secondary Memory, Hardware: CPU, I/O Devices.

UNIT II

Word Processing: Creating and Saving a Document, Editing the Text: Printing, Saving and Importing Documents. Basics of Excel: Data Entry, Data sorting, Data validation, filtering of data, built in statistical and Mathematical Functions in Excel.

UNIT III

Diagrammatic and Graphical representation of Data in excel: bar diagrams and pie diagrams,Histogram, frequency Polygon, frequency curve,Working with data manipulation, descriptive statistics, simple Correlation.

PRACTICAL: 01 CREDIT Using Statistical / Computational Software's

I. Problemsbasedongraphicalrepresentationofdatabybardiagramsandpiediagrams
II. Problemsbasedongraphicalrepresentationofdataby Histogram
III. ProblemsbasedongraphicalrepresentationofdatabyFrequencypolygons,
IV. ProblemsbasedoncalculationofMeasuresofCentralTendency.
V. ProblemsbasedoncalculationofMeasuresofDispersion.
VI. ProblemsbasedoncalculationofCorrelation.

BOOKSRECOMMENDED:

1. Moore, D.S. and McCabe, G.P. and Craig, B.A.: Introduction to the Practice ofStatistics, W.H. Freeman,(2014).
2. Cunningham, B.J:Using SPSS: An Interactive Hands-on approach,(2012).
3. Cho, M,J., Martinez, W.L.: Statistics in MATLAB: A Primer, Chapman andHall/CRC,(2014).
4. E.J. Dudewicz and S.N. Mishra. : Modern Mathematical Statistics, Willy, Int'l Students edition,(1988).
5. John Verzani.: Using R for Introductory Statistics. Chapman & Hall/CRC,(2005).

6. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand & Sons,(2012).

BACHELORS WITH STATISTICS AS MAJOR

6thSEMESTER

STS622J2: STATISTICS:STATISTICAL INFRENCE

Credits: 4 Theory +2 Practical THEORY: 60 HOURS & PRACTICAL: 60 HOURS

CourseObjectives:

To express the students tothe concept of good requirements of good estimators and its relations with different theorems and inequalities.

- To express the students tothe concept of estimation of Parameters and its practical utility in real life problems.

Course Learning Outcomes:

Aftercompletingthiscourse,studentsmust be able:

- To understand the concept of good estimators and their applications in practical world.
- To understand the concept of estimation techniques and their applicability in real data sets.

THEORY: 04 CREDITS

UNIT I

Statistical Inference: Parameter, Parameter space, Statistic and its sampling distribution. Types of Estimation (Point and Interval estimation), Confidence Interval. Estimate and estimator. Requirements of a good estimator with examples. Unbiasedness, consistency, efficiency and sufficiency.

UNIT-II

Methods of Estimation: Maximum likelihood Estimation (MLE), method of moments, method of minimum chi-square, method of minimum variances and method of least square properties and applications. Examples on MLE and method of moments.

UNIT- III

Complete statistic, Minimum variance unbiased estimator (MVUE), Factorization theorem (statement and applications) with examples. Rao-Blackwell statement and applications, Cramer-Rao inequality statement and applications.

UNIT IV

Test of significance: Null and alternative hypotheses (simple and composite), review of Type-I and Type-II errors with examples, critical region, level of significance, size and power, best critical region, most powerful test, uniformly most powerful test, Neyman Pearson Lemma (statement and applications to construct most powerful test).

PRACTICAL: 02 CREDITS Using Statistical / Computational Software's

Problems based on:

I. Unbiased estimators,Consistent estimators, efficient estimators and relative efficiency of estimators.
II. Sufficient Estimators , Complete Sufficient estimators
III. Maximum Likelihood Estimation.
IV. Estimation by the method of moments.

BooksRecommended:

1. GoonA.M.,GuptaM.K.:DasGupta.B.:FundamentalsofStatistics,Vol.I,WorldPress,Calcutta,(2005).
2. RohatgiV.K.andSaleh,A.K.Md.E.:AnIntroductiontoProbabilityandStatistics.2nd Edn.(Reprint) JohnWileyandSons,(2009).
3. Miller,I.andMiller,M.:JohnE.Freund'sMathematicalStatistics(6thaddition,lowpriceedition),PrenticeHallofIndia,(2002).
4. Dudewicz,E.J.,andMishra,S.N.: ModernMathematicalStatistics.JohnWiley&Sons,(1988).
5. BhatB.R,SrivenkatramanaTandRaoMadhavaK.S.: Statistics:ABeginner'sText,Vol.I,NewAgeInternational(P)Ltd,(1997).
6. SnedecorG.WandCochranW.G: StatisticalMethods.lowaStateUniversityPress,(1967).

BACHELORS WITH STATISTICS AS MAJOR

6thSEMESTER

STS622J3: STATISTICS:DESIGN OF EXPERIMENTS

Credits: 4 Theory +2 Practical THEORY: 60 HOURS & PRACTICAL: 60 HOURS

CourseObjectives:

- To express the students to the real-life skill for statistical of concept of Completely Randomized Design, Randomized Block Design and Latin Square Design.

Course Learning Outcomes:

Aftercompletingthiscourse,studentsshouldmust be able:

- To understand the concept of Analysis of Variance and their applications.
- To understand the concept of Completely Randomized Design, Randomized Block Design and Latin Square Design and its applications.

THEORY: 04 CREDITS

UNIT I

Analysis of Variance (ANOVA): Assumptions and applications, ANOVA for one way and two way classification (using Principle of LSE). ANOVA table its interpretation.

UNIT-II

Design of Experiments: Introduction, Terminology in experimental designs. Experiment, Experimental unit, Experimental Error, Treatments, Blocks, Replication, Precision, Contour Map, Yield, Uniformity Trials. Principles of Experimental Design: Randomization, Replication and Local control.

UNIT- III

Completely Randomized Design (CRD): layout, analysis, advantages and disadvantages. Randomized Block Design (RBD): layout, analysis, advantages and disadvantages of RBD over CRD.

UNIT- IV

Latin Square Design (LSD) layout, analysis of mxm LSD for one observation per experimental unit; advantages and disadvantages. Single missing observation analysis for LSD and RBD. Relative efficiency of LSD over RBD & CRD.

PRACTICAL: 02CREDITS Using Statistical / Computational Software's

Problem based on:

I. Analysis of variance in one-way classification.
II. Analysis of variance in two-way classification
III. Analysis of CRD.
IV. Analysis of RBD.
V. Analysis of LSD

BooksRecommended:

1. Croton F.E and Cowden D.J: Applied General Statistics, Prentice Hall of India,(1969).
2. Goon A.M., Gupta M.K. Das Gupta B.: Fundamentals of Statistics, Vol. II, World Press, and Calcutta,(1986).
3. Croton F.E and Cowden D.J: Applied General Statistics, Prentice Hall of India,(1969).
4. S.C Gupta and V.K Kapoor: Fundamentals of Applied Statistics. S. Chand New Delhi,(2002).
5. Cochran W.G and Cox G.M: Experimental Designs, John Wiley and sons(1957).
6. Das M.N and Girl: Design and Analysis of Experiments, Springer Verlag,(1986).

BACHELORS WITH STATISTICS AS MAJOR

6thSEMESTER

STS622N: STATISTICS:STATISTICAL COMPUTING-I

Credits: 3 Theory +1 Practical THEORY: 45 HOURS & PRACTICAL: 30 HOURS

Course Objectives:

To express the students to the real-life skill for statistical computing analysis and graphical interpretation using software skill. Hands on training on the real-life problems can be done on any one of the statistical software/excel to enhance data analysis skills.

Course Outcomes:

After completing this course, studentsmust be able:

- To understand the Graphical representation of data sets.
- To understand the descriptive statistics and Correlation analysis.
- To understand the usages of statistical and computational software's.

THEORY: 03 CREDITS

UNIT-I

Introduction to Computers: Historical evolution of Computers. Generations of Computers. Classification of Computers, Applications of Computers, Computer Memory: Primary and Secondary Memory, Hardware: CPU, I/O Devices.

UNIT II

Word Processing: Creating and Saving a Document, Editing the Text: Printing, Saving and Importing Documents. Basics of Excel: Data Entry, Data sorting, Data validation, filtering of data, built in statistical and Mathematical Functions in Excel.

UNIT III

Diagrammatic and Graphical representation of Data in excel: bar diagrams and pie diagrams,Histogram, frequency Polygon, frequency curve,Working with data manipulation, descriptive statistics, simple Correlation.

PRACTICAL: 01 CREDIT Using Statistical / Computational Software's

I. ProblemsbasedongraphicalrepresentationofdatabybardiagramsandpiediagramsII. Problemsbasedongraphicalrepresentationofdataby HistogramIII. ProblemsbasedongraphicalrepresentationofdatabyFrequencypolygons,IV. ProblemsbasedoncalculationofMeasuresofCentralTendency.V. ProblemsbasedoncalculationofMeasuresofDispersion.VI. ProblemsbasedoncalculationofCorrelation.

BOOKS RECOMMENDED:

1. Moore, D.S. and McCabe, G.P. and Craig, B.A.: Introduction to the Practice ofStatistics, W.H. Freeman,(2014).
2. Cunningham, B.J:Using SPSS: An Interactive Hands-on approach,(2012).
3. Cho, M,J., Martinez, W.L.: Statistics in MATLAB: A Primer, Chapman andHall/CRC,(2014).
4. E.J. Dudewicz and S.N. Mishra. : Modern Mathematical Statistics, Willy, Int'l Students edition,(1988).
5. John Verzani.: Using R for Introductory Statistics. Chapman & Hall/CRC,(2005).

7. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand & Sons,(2012).

MAJOR AND MINOR COURSE FOR GROUP III: SEMESTER-VII-VIII

SEMESTER	COURSE CODE	TYPES OF COURSE	TITLE OF COURSE	CREDITS		
				THEORY	PRACTICAL	TUTORIAL
VII	STS722J1	MAJOR TYPE 1	Sampling Techniques-I	**3**	**1**	**0**
	STS722J2	MAJOR TYPE 2	Advanced Probability Theory	**4**	**2**	**0**
	STS722J3	MAJOR TYPE 3	Mathematical Methods	**4**	**0**	**2**
	STS722N	MINOR	Sampling Techniques-I	**3**	**1**	**0**
4 YRS UG HON'S WITH RESEARCH						
VIII	STS822J1	MAJOR TYPE 1	Statistics with R	**3**	**1**	**0**
	STS822P	MAJOR TYPE 2	**Research Project/ Dissertation**	**0**	**12**	**0**
	STS822N	MINOR	Statistics with R	**3**	**1**	**0**
4 YRS UG Hon's						
VIII	STS822J1	MAJOR TYPE 1	Statistics with R	**3**	**1**	**0**
	STS822J2	MAJOR TYPE 2	Linear Models And Regression Analysis	**4**	**2**	**0**
	ST822J3	MAJOR TYPE 3	Operation Research-II	**4**	**2**	**0**
	STS822N	MINOR	Statistics with R	**3**	**1**	**0**

BACHELORS WITH STATISTICS AS MAJOR

7th SEMESTER (Hon's)

Course Code: STS722J1 **Course Title: Sampling Techniques-I**

Theory: 3 Credits **Practical: 1 Credit**

Course Objectives: To introduce concepts of sampling theory.

Course Learning outcomes: Students who successfully complete this course will be able to:

- Formulate and calculate estimators of population mean, population ratio, population total for Systematic and cluster sampling.
- Estimate the convenient sample size under different sampling strategies.
- Compare various sampling procedures in terms of variance of estimators.
- Handle the practical uses of arising in sampling studies.

UNIT I

Systematic Sampling: types of systematic sampling, Advantages and disadvantages of systematic sampling. Applications of systematic sampling. Sample mean and its variances. Comparison of systematic with simple random and stratified sampling in the general case and also in the case of linear trend.

UNIT II

Cluster sampling: Estimation of mean and its variance for equal and unequal clusters. Efficiency in terms of intra-class correlation. Optimum unit of sampling. Sampling with replacement and unequal probabilities. Estimation of mean and its variance.

UNIT III

Ratio and Regression methods of Estimation: Variance of the estimates, estimation of variances, optimum property of ratio and regression estimator. Ratio and regression estimator in stratified random sampling. Comparison among regression, ratio and simple unbiased estimates. Unbiased ratio type estimates.

PRACTICAL: 01 CREDIT **(PREFERABLY THROUGH COMPUTERS)**

Practical based on:

1. Estimation of mean and variance and mean square error under Systematic Sampling and Cluster Sampling in real life data sets.
2. Estimation of mean and variance and mean square error of Ratio and Regression estimators in real life data sets.

RECOMMENDED TEXT BOOKS & REFERENCES:

I. Cochran, W. G: Sampling Techniques, 3rd edition, Wiley.

II. Mukhopadhyay, P. (2000): Theory and Methods of Survey Sampling,Prentice Hall of India, Private limited, New Delhi

III. Des Raj &Chandak(1998): Sampling Theory, Narosa.

IV. Murthy, M. N. (1977): Sampling Theory and Methods, Statistical Publishing Society,Calcutta.

V. Skate teal (1984): Sampling Theory of Surveys with Applications, Iowa State University Press, & IARS.

VI. Singh, D and Chuddar, F. S. (1986): Theory and Analysis of Sample Survey Design.

VII. Sirjendar Singh (2022): Advanced Sampling Theory with Applications; Springer Publishing House.

BACHELORS WITH STATISTICS AS MAJOR
7th SEMESTER (Hon's)

Course Code: STS722J2 **Course Title: Advanced Probability Theory**
Theory :4 Credits **Practical: 2 Credits**

Course objectives: To Introduce the advanced concepts of probability theory.
Course Learning outcomes: On successful completion of this course, the students will be able to

- Describe the advanced techniques of Probability theory.
- Apply the results of advanced Probability in statistical theory.

UNIT-I

Fisher's Z-distribution, Fisher's Z transformation with properties and applications. Sampling distributions: Student's t distribution, Fisher's t distribution, derivation, properties and applications. Mean and variance through moment generating function, Relation of z & t distribution with the other distributions. Non-central t-distribution: assumptions, properties and applications.

UNIT-II

Sampling distributions: Chi-square distribution: derivation, constants, conditions, yates' correction, grouping when individual frequency are small, properties and applications. Mean and variance through moment generating function, Limiting case and additive property of chi-square distribution. Relation of Chi-square distribution with the other related distributions. Non-central Chi-square distribution; assumptions, properties and applications.

UNIT-III

F distribution: Introduction, derivation, constants, mode, point of inflexion, properties and applications. Relation of F distribution with the t and Chi-square distributions. Non-central F-distribution: assumptions, properties and applications.

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UNIT-IV

Bivariate distributions: Bivariate normal distribution and multinomial distributions and their properties, marginal and conditional distributions. Expectations and conditional expectations, covariance with examples.

PRACTICAL: 02 CREDITS (PREFERABLY THROUGH COMPUTERS)

Practical's based on:

1. Tests based on Chi-Square Distribution:
    a. To test if the population variance has a specific value and its confidence intervals.
    b. To test the goodness of fit.
    c. To test the independence of attributes.
    d. Test based on 2 x 2 contingency table.
2. Tests based on t- Distribution and F- Distribution:
    a. Testing of significance and confidence intervals for single mean and difference of two means and paired t – test.
    b. Testing and confidence intervals of equality of two population variances.
3. Tests based on Z transformation and Fisher's Z distribution.

RECOMMENDED TEXT BOOKS & REFERENCES:

I. Dudewicz, E.J. and Mishra, S.N. (1988): Modern Mathematical Statistics, Willy, Int'l Students edition
II. Rohatgi, V.K. (1994): An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
III. Rao, R.C. (1973): Linear Statistical Inference and its Applications, 2/e, Wiley Eastern
IV. Ash, Robert. (1972): Real Analysis and Probability, Academic Process
V. Dudley, R.M. (1989): Real Analysis and Probability, Wads worth and Brooks /Cole
VI. Pitman, J. (1993): Probability, Narosa Publishing House.
VII. Johnson, S.andKotz, (1972): Distributions in Statistics, vol. III, Houghton and I, II And Miffin.
VIII. Johnson, Kotz and Kemp (1992): Univariate discrete distribution, John Willy.
IX. S C Gupta (2016):Fundamental of Mathematical Statistics: S Chand and Sons.

BACHELORS WITH STATISTICS AS MAJOR
7th SEMESTER (Hon's)

Course Code: STS722J3 Course Title: Mathematical Methods

Theory: 04 Credits Tutorial :02 Credits

Course Objectives: To introduce the concepts of linear algebra and Real Analysis.

Course Learning outcomes: On successful completion of this course, the students will be able to:

- the study of matrices, Linear function and their representations through the survey of matrices and vector spaces.
- make students aware of representing statistical data in the matrix forms and then analyzing in terms of linear algebraic tools and techniques.
- study the behavior and properties of Real numbers, Sequence and Series of real numbers and real valued functions in order to tackle daily life problems arising from physical phenomenon.

UNIT-I

Algebra of Matrices, trace of a matrix, tr(AB)= tr(BA), types of matrices: symmetric, skew symmetric, Hermitian, Skew-Hermitian, idempotent, nilpotent, orthogonal and Unitary matrices. Inverse of square matrix, Inverse of partitioned matrices. Rank of matrix, characteristic and minimal equation, Cayley-Hamilton Theorem and its Applications. Eigen values and Eigen vectors.

UNIT-II

Linear equations, solution of homogenous and non-homogenous equations. Vector spaces, basis and Dimensions. Linear Transformations and their matrix representation. Inner product spaces, orthogonal and orthonormal basis. Quadratic forms, reduction and classification of quadratic forms.

UNIT-III

Finite, countable and uncountable sets, bounded and unbounded sets, Archimedean property, ordered field, completeness of R, sequence and series, limit supremum and limit infimum of a bounded sequence. Convergence and divergence of positive term series, comparison, root and ratio tests for the convergence of series. Cauchy-Schwarz Inequality, Chebyshev's Inequality, Central limit theorem.

UNIT-IV

Limit, Continuity, uniform continuity of functions of one variable, the algebra of continuous functions, monotonic functions, types of discontinuities, infinite limits and limits at infinity. Differentiability, Rolle's Theorem, Mean Value Theorems, Riemann sum and integral (simple problems). Functions of several variables. Limit and continuity of functions of several variables.

TUTORIAL: 02 CREDITS

Tutorial based on:

1. Cayley-Hamilton Theorem, solution of homogenous and non-homogenous linear equations.
2. Central limit theorem, Rolle's Theorem and Mean Value Theorems.

RECOMMENDED TEXT BOOKS & REFERENCES:

I. Grabill, Walter(1976). Matrices with Applications in Statistics, 2nd Ed.Wadsworth.
II. Roa,C.R.(1973), Linear Statistical Inference and its Applications, 2nd Ed.John Wileyand Sons,Inc.
III. Searel, S.R.(1982).Matrix Algebra useful for Statistics. John Wiely and Sons,Inc.
IV. Aziz, A, Rather, N.A. and Zargar, B.A.: Elementary Matrix Algebra, KBD(Kashmir Book Depo)
V. Shanti Narayan, A text book of matrices, Narosa Publ. linear independence and linear dependence of row (column) vectors.
VI. Apostol, T.M (1985), Mathematical Analysis, Narosa, India Ed.
VII. Courant, R.and John, F.(1965), Introduction to Calculus and Analysis, Wiley. S.C.Malik, Mathematical Analysis, New Age International Limited.
VIII. Miller, K.S(1975)Advanced Real Calculus, Harper, New York.
IX. Rudin, Walter(1976). Principles of Mathematical Ananlysis, McGraw Hill.

BACHELORS WITH STATISTICS AS MAJOR

7th SEMESTER (Hon's)

Course Code: STS722N **Course Title: Sampling Techniques-I**

Theory :3 Credits **Practical: 1 Credit**

Course Objectives: To introduce concepts of sampling theory.

Course Learning outcomes: Students who successfully complete this course will be able to:

- Formulate and calculate estimators of population mean, population ratio, population total for Systematic and cluster sampling.
- Estimate the convenient sample size under different sampling strategies.
- Compare various sampling procedures in terms of variance of estimators.
- Handle the practical uses of arising in sampling studies.

UNIT I

Systematic Sampling: types of systematic sampling, Advantages and disadvantages of systematic sampling. Applications of systematic sampling. Sample mean and its variances. Comparison of systematic with simple random and stratified sampling in the general case and also in the case of linear trend.

UNIT II

Cluster sampling: Estimation of mean and its variance for equal and unequal clusters. Efficiency in terms of intra-class correlation. Optimum unit of sampling. Sampling with replacement and unequal probabilities. Estimation of mean and its variance.

UNIT III

Ratio and Regression methods of Estimation: Variance of the estimates, estimation of variances, optimum property of ratio and regression estimator. Ratio and regression estimator in stratified random sampling. Comparison among regression, ratio and simple unbiased estimates. Unbiased ratio type estimates.

PRACTICAL: 01 CREDIT **(PREFERABLY THROUGH COMPUTERS)**

Practical based on:

1. Estimation of mean and variance and mean square error under Systematic Sampling and Cluster Sampling in real life data sets.
2. Estimation of mean and variance and mean square error of Ratio and Regression estimators in real life data sets.

RECOMMENDED TEXT BOOKS & REFERENCES:

I. Cochran, W. G: Sampling Techniques, 3rd edition, Wiley.

II. Mukhopadhyay, P. (2000): Theory and Methods of Survey Sampling,Prentice Hall of India, Private limited, New Delhi

III. Des Raj &Chandak(1998): Sampling Theory, Narosa.

IV. Murthy, M. N. (1977): Sampling Theory and Methods, Statistical Publishing Society,Calcutta.

V. Skate teal (1984): Sampling Theory of Surveys with Applications, Iowa State University Press, & IARS.

VI. Singh, D and Chuddar, F. S. (1986): Theory and Analysis of Sample Survey Design.

VII. Sirjendar Singh (2022): Advanced Sampling Theory with Applications; Springer Publishing House.

BACHELORS WITH STATISTICS AS MAJOR (Hon's)
8th SEMESTER

Course Code: STS822J1

Course Title: Statistics with R

Theory: 03 Credits **Practical :01 Credit**

Course objectives: This Course is developed to help the students to learn various advanced techniques of data analysis in R Software.

Course Learning outcomes: After successful completion of this course, the students will be able to:

- Have full knowledge of R software.
- Find solutions of problems of optimization through R.
- Articulate statistical modelling using R.
- Apply these modelling tools in Statistical learning.

UNIT-I

Introduction to R language, R as a calculator, Vectorization, notation and naming. Creation ofdata object, vector, factor and data frame. Extraction operators in R, data import/export, manipulation of data, Summary of data and statistical graphics with R. Representation of Multivariate data in R. Managing matrices in R: creating matrices, adding on to matrices, adding attributes to matrices, sub-setting matrices.

UNIT-II

Correlation and Regression analysis in R: simple and multiple. Tests of significance, Test of single proportion, Test of significance of difference of proportions. Chi-Square tests in R, Chi-Square goodness of fit tests, Chi-Square tests of independence of attributes, inference about population variance homogeneity of independent estimates of the population variance.

UNIT-III

Using R Software's: t-test for single mean, difference of means and paired t-test. Test for correlation in sampling from normal population, F-test, testing of two variances of two univariate normal population.

Simulation Studies using R Software, random number generation of various probability distributions. Codes for different programmes in R-Software.

PRACTICAL: 01 CREDIT

Practical based on:

1. Descriptive statistics, data manipulation functions and operation of matrices for simulated and real-life data sets.
2. Correlation and Regression analysis, test of significances using Z, t, F and chi-square tests for simulated and real-life data sets.

RECOMMENDED TEXT BOOKS & REFERENCES:

I. Bradley C. Boehmke (2016): Data Wrangling with R. Springer.
II. E.J. Dudewicz and S.N. Mishra. (1988): Modern Mathematical Statistics, Willy,Int'l Students edition.
III. John Verzani. (2005): Using R for Introductory Statistics. Chapman & Hall/CRC.
IV. S.C. Gupta and V.K. Kapoor (2012): Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
V. Michael J.Crawley (2007): The R book: Wiley.

BACHELORS WITH STATISTICS AS MAJOR (Hon's)
8th SEMESTER

Course Code: STS822J2

Course Title: Linear Models and Regression Analysis

Theory: 04 Credits **Practical: 02 credits**

Course objectives: To introduce basic and advance concepts of general linear model.
Course Learning outcomes: On successful completion of this course, the students will be able to:

- Describe the concepts of linear models in real applications of statistics modelling.
- Apply concepts of linear models to illustrate its application areas like design of experiments, econometrics, survival analysis and demography.

UNIT-I

Linear models; Gauss Markov set up, Model classification, Normal equations and least squares estimates, Error and estimation space, Variance and covariance of least square estimates, Estimation of error variance, estimation with correlated observations, least square estimates with restriction on parameters.

UNIT-II

Test of hypotheses for one and more than one linear parametric functions, Tests of linear hypotheses, estimable linear hypotheses, confidence intervals and prediction intervals, Generalized F test, generalized t test.

UNIT-III

Experimental Design models; Introduction, point estimation, Re-parameterization, Variance and Covariance of estimable function, testing of hypotheses, Regression models.

UNIT-1V

Simple linear and multiple regression fit of polynomials, Residual and their plot as tests for departure from assumption such as fitness of model, normality, and homogeneity of variances and detectionof outliers, Analysis of covariance, estimation and testing, o n e way model with one covariance, two-way model with two covariance.

PRACTICAL: 02 CREDITS (PREFERABLY THROUGH COMPUTERS)

Practical based on:

1. Least square estimators in linear models for real life data sets.
2. generalized F test and t test in linear models for real life data sets.
3. Simple linear regression and multiple linear Regression for real life data sets.
4. Experimental design models for real life data sets.

RECOMMENDED TEXT BOOKS & REFERENCES:

I. Cookers.and Weisberg, S (1982). Residual and Influence in Regression. Chapman and Hall
II. Draper,N.R. and Smith, R.L. (1998). Applied Regression Analysis.3rd Ed. Wiley.
III. Gunst, R.F. and Mason, R.L. (1980). Regression Analysis and its Applications- A Data Oriented Approach. Marcel and Decker.
IV. Roa, C.R. (1973). Linear Statistical Inference and its Applications. Wiley Eastern.
V. Weisberg, S. (1985). Applied Linear Regression.Wiley.
VI. Rencher,A.C And Schaalje,G.B(2007),Linear Model in Statistics, John Wiely and Sons
VII. Graybill, Franklin A (1961): An introduction to linear statistical models, New York : McGraw-Hill

BACHELORS WITH STATISTICS AS MAJOR
8th SEMESTER (Hon's)

Course Code: STS822J3 Course Title: Operations Research - II
Theory: 04 Credits Practical:02 credits

Course objectives: To introduce the basic and advanced concepts of Operations Research

Course Learning outcomes: After successful completion of this course, the students will be able to:

- Formulate the LPP of the industrial problems.
- Describe the technique of Operations Research.
- Apply the Operation Research game theory and project networking in decision making.
-

UNIT I

Review of Linear programming problems (LPP). Methods of solving LPP: Two-phase method and Extreme point theorems; Revised Simplex Method, Assignment Problems: balanced and unbalanced Assignment Problems, Hungarian method.

UNIT II

Duality in Linear programming problem, Symmetric and asymmetric dual problems, Unrestricted variables in dual LPP. Relationship between Primal and Dual LPP. Duality theorems: Weak duality theorem, Optimality criterion theorem, Unboundedness theorem, Fundamental theorem of duality, Complementary Slackness theorem and Complementary Slackness conditions and their applications. Dual Simplex Method.

UNIT III

Introduction to game theory. Strategy and its types. Decision Making in the face of competition, payoff matrix , two–person zero sum games,. Maximin and Minimax principle. Games with pure and mixed strategies, existence of solution and uniqueness of value in zero-sum games, finding solutions of 2x2 payoff matrices. Dominance principle, finding solutions of 2 x m and mx2 type games, Equivalence between game theory and linear programming problem.

UNIT IV

Sequencing and scheduling problems: 2 machine n-job; 3 machine n-job problems with identical machine sequence for all jobs; 2-job n-machine problem with different routings. Project management; PERT and CPM; rules of network construction, determination of ES and EF times, determination of LS and LF times, determination of float. Probability of project completion. Project Crashing.

PRACTICAL: 02 CREDITS

Practical's based on:

1. LPP's using Two phase, Revised Simplex Method and dual simplex method for case studies.
2. Game theory by using Graphical solution to mx2 / 2xn rectangular game and Mixed strategy for case studies.
3. project networking problems through CPM and PERT for case studies.
4. Sequencing and scheduling problems using 2 machines n jobs, 3 machines n jobs and 2 jobs and n machines for case studies.

RECOMMENDED TEXT BOOKS & REFERENCES:

I. Taha H.A. (1982) Operational Research: An introduction; Macmillan.

II. Philips D.T., Ravindran A. and Solberg J. Operation Research, Principles and Practice.

III. Kanti Swarup, P.K. and Singh,M.M.. (1985) Operation Research; Sultan Chand & Sons.

IV. Hillier F.S. and Lieberman G.J. (1962) Introduction to Operation Research; HoldenDay.

V. Churchman C.W, Ackoff R.L. and Arnoff E.L. (1957) Introduction to Operations Research

VI. R. Panneerselvam(2002): Operations Research: Prentice Hall

VII. S D Shrama (2014): Operations Research (Theory Methods & Applications)

BACHELORS WITH STATISTICS AS MAJOR (Hon's)
8th SEMESTER

Course Code: STS822N

Course Title: Statistics with R

Theory: 03 Credits **Practical :01 Credit**

Course objectives: This Course is developed to help the students to learn various advanced techniques of data analysis in R Software.

Course Learning outcomes: After successful completion of this course, the students will be able to:

- Have full knowledge of R software.
- Find solutions of problems of optimization through R.
- Articulate statistical modelling using R.
- Apply these modelling tools in Statistical learning.

UNIT-I

Introduction to R language, R as a calculator, Vectorization, notation and naming. Creation ofdata object, vector, factor and data frame. Extraction operators in R, data import/export, manipulation of data, Summary of data and statistical graphics with R. Representation of Multivariate data in R. Managing matrices in R: creating matrices, adding on to matrices, adding attributes to matrices, sub-setting matrices.

UNIT-II

Correlation and Regression analysis in R: simple and multiple. Tests of significance, Test of single proportion, Test of significance of difference of proportions. Chi-Square tests in R, Chi-Square goodness of fit tests, Chi-Square tests of independence of attributes, inference about population variance homogeneity of independent estimates of the population variance.

UNIT-III

Using R Software's: t-test for single mean, difference of means and paired t-test. Test for correlation in sampling from normal population, F-test, testing of two variances of two univariate normal population.

Simulation Studies using R Software, random number generation of various probability distributions. Codes for different programmes in R-Software.

PRACTICAL: 01 CREDIT

Practical based on:

1. Descriptive statistics, data manipulation functions and operation of matrices for simulated and real-life data sets.
2. Correlation and Regression analysis, test of significances using Z, t, F and chi-square tests for simulated and real-life data sets.

RECOMMENDED TEXT BOOKS & REFERENCES:

I. Bradley C. Boehmke (2016): Data Wrangling with R. Springer.
II. E.J. Dudewicz and S.N. Mishra. (1988): Modern Mathematical Statistics, Willy, Int'l Students edition.
III. John Verzani. (2005): Using R for Introductory Statistics. Chapman & Hall/CRC.
IV. S.C. Gupta and V.K. Kapoor (2012): Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
V. Michael J.Crawley (2007): The R book: Wiley.

BACHELORS WITH STATISTICS AS MAJOR with Research
8th SEMESTER

Course Code: STS822J1

Course Title: Statistics with R

Theory: 03 Credits **Practical :01 Credit**

Course objectives: This Course is developed to help the students to learn various advanced techniques of data analysis in R Software.

Course learning outcomes: After successful completion of this course, the students will be able to:

- Have full knowledge of R software.
- Find solutions of problems of optimization through R.
- Articulate statistical modelling using R.
- Apply these modelling tools in Statistical learning.

UNIT-I

Introduction to R language, R as a calculator, Vectorization, notation and naming. Creation ofdata object, vector, factor and data frame. Extraction operators in R, data import/export, manipulation of data, Summary of data and statistical graphics with R. Representation of Multivariate data in R. Managing matrices in R: creating matrices, adding on to matrices, adding attributes to matrices, sub-setting matrices.

UNIT-II

Correlation and Regression analysis in R: simple and multiple. Tests of significance, Test of single proportion, Test of significance of difference of proportions. Chi-Square tests in R, Chi-Square goodness of fit tests, Chi-Square tests of independence of attributes, inference about population variance homogeneity of independent estimates of the population variance.

UNIT-III

Using R Software's: t-test for single mean, difference of means and paired t-test. Test for correlation in sampling from normal population, F-test, testing of two variances of two univariate normal population.

Simulation Studies using R Software, random number generation of various probability distributions. Codes for different programmes in R-Software.

PRACTICAL: 01 CREDIT

Practical based on:

1. Descriptive statistics, data manipulation functions and operation of matrices for simulated and real-life data sets.
2. Correlation and Regression analysis, test of significances using Z, t, F and chi-square tests for simulated and real-life data sets.

RECOMMENDED TEXT BOOKS & REFERENCES:

I. Bradley C. Boehmke (2016): Data Wrangling with R. Springer.

II. E.J. Dudewicz and S.N. Mishra. (1988): Modern Mathematical Statistics, Willy, Int'l Students edition.

III. John Verzani. (2005): Using R for Introductory Statistics. Chapman & Hall/CRC.

IV. S.C. Gupta and V.K. Kapoor (2012): Fundamentals of Mathematical Statistics, Sultan Chand & Sons.

V. Michael J.Crawley (2007): The R book: Wiley.

BACHELORS WITH STATISTICS AS MAJOR with Research
8th SEMESTER

Course Code: STS822P

Course Title: Research Project / Dissertation

Practical: 12 Credits

Note: The Project work will be based on Research Methodology followed by analyzing the real-life problems using statistical Techniques.

BACHELORS WITH STATISTICS AS MAJOR with Research
8th SEMESTER

Course Code: STS822N

Course Title: Statistics with R

Theory: 03 Credits **Practical :01 Credit**

Course objectives: This Course is developed to help the students to learn various advanced techniques of data analysis in R Software.

Course learning outcomes: After successful completion of this course, the students will be able to:

- Have full knowledge of R software.
- Find solutions of problems of optimization through R.
- Articulate statistical modelling using R.
- Apply these modelling tools in Statistical learning.

UNIT-I

Introduction to R language, R as a calculator, Vectorization, notation and naming. Creation ofdata object, vector, factor and data frame. Extraction operators in R, data import/export, manipulation of data, Summary of data and statistical graphics with R. Representation of Multivariate data in R. Managing matrices in R: creating matrices, adding on to matrices, adding attributes to matrices, sub-setting matrices.

UNIT-II

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UNIT-III

Using R Software's: t-test for single mean, difference of means and paired t-test. Test for correlation in sampling from normal population, F-test, testing of two variances of two univariate normal population.

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PRACTICAL: 01 CREDIT

Practical based on:

1. Descriptive statistics, data manipulation functions and operation of matrices for simulated and real-life data sets.
2. Correlation and Regression analysis, test of significances using Z, t, F and chi-square tests for simulated and real-life data sets.

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V. Michael J.Crawley (2007): The R book: Wiley.