Course Contents for Subjects with Code: STAT

This document only contains details of courses having code **STAT**.

Code	Subject Title	Cr. Hrs	Semester
STAT-101	Statistics-I	3	I
Year	Discipline		
1	Statistics-I,II,III, Mathematics-II, Economics		

Code	Subject Title	Cr. Hrs	Semester
STAT-102	Statistics Lab-I	1	I
Year	Discipline		
1	Statistics-I,II,III, Mathematics-II, Economics		

Course Outline

Meaning of Descriptive and Inferential statistics. Population and Sample. Types of variables, Measurement Scales. Sources of Statistical data in Pakistan. Description of data by frequency tables and graphs. Stem and Leaf plots and Box plots. Measures of Central Tendency. A.M. H.M. G.M., Mode, Median, Quantiles. Properties of Mean with proofs. Weighted Arithmetic Mean. Empirical Relation between Mean. Median and Mode. Relative Merits and Demerits of various averages. Measures of Dispersion: Absolute and Relative Measures, Range. Semi-Inter Quartile Range, Mean Deviation, Variance, Standard Deviation. Coefficient of Variation, Coefficient of Mean Deviation, Coefficient of Quartile Deviations, Properties of Variance and Standard Deviation with proofs. Standardized variables, Moments, Moment Ratios, Sheppards Correction, Kurtosis and Skewness.

Index Numbers and Time Series

a) Construction and application of wholesale price Index Numbers. Fixed and chain base methods. Weighted Index Numbers (Laspeyre's, Paasche's Fisher's Ideal and Marshall-Edgeworth Indices). Tests for the consistency of Index Numbers Construction of Consumer price Index Numbers. Sensitive price Indicator.
b) Time series. Components of a time series. Analysis of time series. Measurement of secular trend and seasonal variations by various methods. Deseasonalization of data.

Simple Regression and Correlation

Logic of regression and correlation. Scatter diagram, simple linear regression model, least square estimators and their properties, standard error of estimate. Meaning and application of linear correlation coefficient. Properties of correlation co-efficient. Correlation coefficient for bi-varlate frequency distribution. Meaning derivation and application of Rank correlation, tied ranks.

Recommended Books

1. Chaudhry, S.M. & Kamal, S. (2010). Introduction to Statistical Theory Part I, Ilmi Kitab Khana, Urdu Bazar, Lahore.
2. Wonnacott, T.H. and Wonnacott, R.J. (1998). Introductory Statistics, John Willy & Sons, New York.
3. Clarke G. & Cooke D. (1998). A basic Course in Statistics, Arnold Publisher, London, 4th Edition.

4. Crawshaw, J and Chambers, J. (2001). A concise course in advanced level Statistics with worked examples, Nelson Thornes, 4th Edition.
5. Graybill, Iyer & Burdick (1998). Applied Statistics, A first course in inference. Prentice Hall, New Jersy.
6. Beg, M.A. and Mirza, M.D. (2006). Statistics, Theory and Methods, Volume I, Carven Book House, Kutechery Road, Lahore.
7. Chase W. & Bown F. (1997). General Statistics, 3rd Edition, John Willy & Sons, New York.
8. Macfie, B.P. and Nufrio, P.M. (2006). Applied Statistics for public policy, Prentice Hall of India.
9. Blumen (1997), Elementary Statistics, 3rd Edition, McGraw Hill, New York.
10. Johnson, R.A. and Wichern, D.W. (2003). Business Statistics: Decision making with data, John Wiley & Sons Inc.
11. Levine, D.M., Kschbiel, T.C. and Berenson, M.L. (2003). Business Statistics: A first course, 3rd edition, Pearson Education.
12. Levin, J. and Fox, J.A. (2006). Elementary Statistics in Social Research, 10th edition, Pearson Education.

Code	Subject Title	Cr. Hrs	Semester
STAT-103	Statistics-II	3	II
Year	Discipline		
1	Statistics-I,II,III, Mathematics-II, Economics		

Code	Subject Title	Cr. Hrs	Semester
STAT-104	Statistics Lab-II	1	II
Year	Discipline		
1	Statistics-I,II,III, Mathematics-II, Economics		

Course Outline

Random experiments, sample space and events. Counting techniques. Definitions and axioms of probability. Basic laws of probability. Independence of events. Bayes Theorem (proof and required) and its application.

Discrete Random Variable and Discrete Probability Distributions

Random variable, distribution function, discrete random variable. Probability distribution of a discrete random variable. Joint distribution of two discrete random variables, marginal and conditional distributions, mathematical expectation and its properties, mean, variance and moments. Concept of m.g.f. and its properties. Uniform, Bernoulli, Binomial, Hyper-geometric and Poisson distributions, mean, variance and shape of these distributions and their properties. Application of these distributions with examples from various fields. Multinomial distribution (only application).

Continuous Random Variables & Continuous Probability Distributions

Continuous random variables. Probability distribution of a single continuous random variable, probability density function and distribution function. Mean, variance and moments of continuous random variables. Uniform and Normal distribution. Mean, variance and shape of these distributions and their properties. Application of these distributions. Normal approximation to the Binomial and Poisson distribution (just application). Fitting of Normal distribution by area method.

Recommended Books

1. Chaudhry, S.M. & Kamal, S. (2010). Introduction to Statistical Theory Part I, Ilmi Kitab Khana, Urdu Bazar, Lahore.
2. Crawshaw, J and Chambers, J. (2001). A concise course in advanced level Statistics with worked examples, Nelson Thornes, 4th Edition.
3. Graybill, Iyer & Burdick (1998). Applied Statistics, A first course in inference. Prentice Hall, New Jersy.
4. Beg, M.A. and Mirza, M.D. (2006). Statistics, Theory and Methods, Volume I, Carven Book House, Kutechery Road, Lahore.
5. Chase W. & Bown F. (1997). General Statistics, 3rd Edition, John Willy & Sons, New York.
6. Macfie, B.P. and Nufrio, P.M. (2006). Applied Statistics for public policy, Prentice Hall of India.
7. Blumen (1997), Elementary Statistics, 3rd Edition, McGraw Hill, New York.

8. Johnson, R.A. and Wichern, D.W. (2003). Business Statistics: Decision making with data, John Wiley & Sons Inc.
9. Levine, D.M., Kschbiel, T.C. and Berenson, M.L. (2003). Business Statistics: A first course, 3rd edition, Pearson Education.
10. Levin, J. and Fox, J.A. (2006). Elementary Statistics in Social Research, 10th edition, Pearson Education.
11. Medhi, J. (1992). Statistical Methods: An Introductory text, New Age International Publishers.
12. Chaudhry, R.M. (1998). Polymer Modern Statistics, Polymers.

Code	Subject Title	Cr. Hrs	Semester
STAT-121	Business Statistics	3	II
Year	Discipline		
1	Commerce		

a. Definition, Application in Business and Commerce. Classification and Tabulation. Statistical Enquiries, Diagrams and Graphs.
b. Measures of Central Values. Measures of Dispersion. Skewness.
c. Simple Correlation and Regression. Lines of Regression. Method of least square and curve fitting with application to Business.
d. Index Numbers: Kinds of Index numbers with special emphasis to consumer price Index numbers.
e. Random Variables: Introduction, Discrete and Continuous Random variables. Chi-Square
f. Analysis of Vatiance (ANOVA).

BOOKS RECOMMENDED (*Latest Editions)*

1. Syed Hassan Mirza, Business Mathematic for Management and Finance.
2. L W Stafford, Business Mathematics.
3. Richard Lacava, Business Statistics.
4. Lavin, Business Statistics, Prentice Hall Inc.
5. Nasir Ali Syed, and G H Gill, Statistics & Business Mathematics, Fair Publication, Lahore.
6. Z A Bohra, Business Statistics and Mathematics.

Code	Subject Title	Cr. Hrs	Semester
STAT-201	Statistics-III	3	III
Year	Discipline		
2	Statistics-I,II,III, Mathematics-II		

Code	Subject Title	Cr. Hrs	Semester
STAT-202	Statistics Lab-III	1	III
Year	Discipline		
2	Statistics-I,II,III, Mathematics-II		

Course Outline

Sampling designs of Simple random, Stratified, Systematic and Cluster sampling, Judgment and Quota Sampling. Random Numbers and their uses in sampling. Advantages of sampling.

Probability and non-probability sampling, sampling and non-sampling error. Calculation of sample mean, proportion and variance of simple random samples and stratified random samples. Sampling distribution of a statistic and its standard error. Distribution of sample mean, sample proportion, difference between two proportions and means. Central limit theorem with illustration (Proof not required).

Statistical Inference

Nature of statistical inference, point and interval estimation of parameter, properties of point estimator, confidence interval and its interpretation. Null and alternative hypothesis, simple and composite hypothesis. Type I and Type II errors. Level of significance. P-value and power of test (only concept and definition), Acceptance and rejection regions, one sided and two sided tests, test procedure. Inference about single mean and difference between means for paired and un-paired observations for small and large sample sizes. Inference about proportion and difference between two proportions. Determination of sample size. (Application of Normal distribution and t-distribution).

Inference about Variance

Introduction and application of Chi-square distribution: Interval estimation and test of hypothesis about population variance (Interval estimation for variance – single sample).

Introduction and application of F-distribution: test of hypothesis for equality of two variance.

Recommended Books

1. Chaudhry, S.M. & Kamal, S. (2010). Introduction to Statistical Theory Part II, Ilmi Kitab Khana, Urdu Bazar, Lahore.
2. Macfie, B.P. and Nufrio, P.M. (2006). Applied Statistics for public policy, Prentice Hall of India.
3. Crawshaw, J and Chambers, J. (2001). A concise course in advanced level Statistics with worked examples, Nelson Thornes, 4th Edition.
4. Medhi, J. (1992). Statistical Methods: An Introductory text, New Age International Publishers.

5. Levin, J. and Fox, J.A. (2006). Elementary Statistics in Social Research, 10th edition, Pearson Education.
6. Beg, M.A. and Mirza, M.D. (2006). Statistics, Theory and Methods, Volume II, Carven Book House, Kutechery Road, Lahore.
7. Graybill, Iyer & Burdick (1998). Applied Statistics, A first course in inference. Prentice Hall, New Jersey.
8. Moore D.S., McCabe G.R., (1997). Introduction to the Practice of Statistics, 3rd Edition, Will Freeman & Co., New York.
9. Blumen (1997), Elementary Statistics, 3rd Edition, McGraw Hill, New York.
10. Chaudhry, R.M. (1998). Polymer Modern Statistics, Polymers.
11. Johnson, R.A. and Wichern, D.W. (2003). Business Statistics: Decision making with data, John Wiley & Sons Inc.
12. Levine, D.M., Kschbiel, T.C. and Berenson, M.L. (2003). Business Statistics: A first course, 3rd edition, Pearson Education.

Code	Subject Title	Cr. Hrs	Semester
STAT-203	Statistics-IV	3	IV
Year	Discipline		
2	Statistics-I,II,III, Mathematics-II		

Code	Subject Title	Cr. Hrs	Semester
STAT-204	Statistics Lab-IV	1	IV
Year	Discipline		
2	Statistics-I,II,III, Mathematics-II		

Course Outline

Chi-square test of Independence, Chi square test of goodness of fit, Chi-square test of homogeneity.

Regression and Correlation Analysis

Multiple linear regression with two regressors, coefficient of multiple determination. Partial and multiple correlation up to three variables. Inference of simple correlation and regression, partial and multiple correlation. Interval estimates and tests of hypothesis about parameters, mean prediction and individual prediction. Inference about regression & correlation.

Analysis of Variance and Basic Experimental Designs

Analysis of variance for one-way classification and two-way classification. Multiple comparison tests; least significant difference and Duncans multiple range test. Basic principles of experimental design. Completely randomized, Randomized Complete Block and Latin Square Designs. Descriptions, layout, statistical analysis, advantages and limitations of these designs. Application of these designs (Analysis of all these designs for single observation in each cell).

Recommended Books

1. Chaudhry, S.M. & Kamal, S. (2010). Introduction to Statistical Theory Part II, Ilmi Kitab Khana, Urdu Bazar, Lahore.
2. Macfie, B.P. and Nufrio, P.M. (2006). Applied Statistics for public policy, Prentice Hall of India.
3. Medhi, J. (1992). Statistical Methods: An Introductory text, New Age International Publishers.
4. Beg, M.A. and Mirza, M.D. (2006). Statistics, Theory and Methods, Volume II, Carven Book House, Kutechery Road, Lahore.
5. Crawshaw, J and Chambers, J. (2001). A concise course in advanced level Statistics with worked examples, Nelson Thornes, 4th Edition.
6. Levin, J. and Fox, J.A. (2006). Elementary Statistics in Social Research, 10th edition, Pearson Education.
7. Graybill, Iyer & Burdick (1998). Applied Statistics, A first course in inference. Prentice Hall, New Jersey.
8. Moore D.S., McCabe G.R., (1997). Introduction to the Practice of Statistics, 3rd Edition, Will Freeman & Co., New York.
9. Blumen (1997), Elementary Statistics, 3rd Edition, McGraw Hill, New York.

10. Chaudhry, R.M. (1998). Polymer Modern Statistics, Polymers.
11. Johnson, R.A. and Wichern, D.W. (2003). Business Statistics: Decision making with data, John Wiley & Sons Inc.
12. Levine, D.M., Kschbiel, T.C. and Berenson, M.L. (2003). Business Statistics: A first course, 3rd edition, Pearson Education.
13. Wonnacott T.H. and Wonnacott R.J. (1981). Introductory Statistics, John Willy & Sons, New York.
14. Clarke G. & Cooke D. (1998). A basic Course in Statistics, Arnold Publisher, London, 4th Edition.
15. Moore D.S., McCabe G.R., (1997). Introduction to the Practice of Statistics, 3rd Edition, Will Freeman & Co., New York.

Code	Subject Title	Cr. Hrs	Semester
STAT-211	Elementary Statistics	3	III
			IV
STAT-321			V

Year	Discipline
2	Business Administration, Mass Communication, Urdu
	Social Work
3	Education (Secondary)

Unit 1. What is Statistics?

Definition of Statistics, Population, sample Descriptive and inferential Statistics, Observations, Data, Discrete and continuous variables, Errors of measurement, Significant digits, Rounding of a Number, Collection of primary and secondary data, Sources, Editing of Data. Exercises.

Unit 2. Presentation of Data

Introduction, basic principles of classification and Tabulation, Constructing of a frequency distribution, Relative and Cumulative frequency distribution, Diagrams, Graphs and their Construction, Bar charts, Pie chart, Histogram, Frequency polygon and Frequency curve, Cumulative Frequency Polygon or Ogive, Histogram, Ogive for Discrete Variable. Types of frequency curves. Exercises.

Unit 3. Measures of Central Tendency

Introduction, Different types of Averages, Quantiles, The Mode, Empirical Relation between Mean, Median and mode, Relative Merits and Demerits of various Averages. Properties of Good Average, Box and Whisker Plot, Stem and Leaf Display, definition of outliers and their detection. Exercises.

Unit 4. Measures of Dispersion

Introduction, Absolute and relative measures, Range, The semi-Inter-quartile Range, The Mean Deviation, The Variance and standard deviation, Change of origin and scale, Interpretation of the standard Deviation, Coefficient of variation, Properties of variance and standard Deviation, Standardized variables, Moments and Moments ratios. Exercises.

Unit 5. Probability and Probability Distributions.

Discrete and continuous distributions: Binomial, Poisson and Normal Distribution. Exercises

Unit 6. Sampling and Sampling Distributions

Introduction, sample design and sampling frame, bias, sampling and non sampling errors, sampling with and without replacement, probability and non-probability sampling, Sampling distributions for single mean and proportion, Difference of means and proportions. Exercises.

Unit 7. Hypothesis Testing

Introduction, Statistical problem, null and alternative hypothesis, Type-I and Type-II errors, level of significance, Test statistics, acceptance and rejection regions, general procedure for testing of hypothesis. Exercises.

Unit 8. Testing of Hypothesis- Single Population

Introduction, Testing of hypothesis and confidence interval about the population mean and proportion for small and large samples, Exercises

Unit 9. Testing of Hypotheses-Two or more Populations

Introduction, Testing of hypothesis and confidence intervals about the difference of population means and proportions for small and large samples, Analysis of Variance and ANOVA Table. Exercises

Unit 10. Testing of Hypothesis-Independence of Attributes

Introduction, Contingency Tables, Testing of hypothesis about the Independence of attributes. Exercises.

Unit 11. Regression and Correlation

Introduction, cause and effect relationships, examples, simple linear regression, estimation of parameters and their interpretation. r and R^2. Correlation. Coefficient of linear correlation, its estimation and interpretation. Multiple regression and interpretation of its parameters. Examples

Recommended Books:

1. Walpole, R. E. 1982. "Introduction to Statistics", 3rd Ed., Macmillan Publishing Co., Inc. New York.
2. Muhammad, F. 2005. "Statistical Methods and Data Analysis", Kitab Markaz, Bhawana Bazar Faisalabad.

Code	Subject Title	Cr. Hrs	Semester
STAT-221	Probability and Statistics	3	IV
Year	Discipline		
2	Information Technology		

Objectives

This course is aimed to introduce the concept of statistics, randomness and probability and build on these concepts to develop tools and techniques to work with random variables. The following topics will be covered in this course: Introduction to Statistics, Descriptive Statistics, Statistics in decision making, Graphical representation of Data Stem-and Lead plot, Box- Cox plots, Histograms and Ogive, measures of central tendencies, dispersion for grouped and ungrouped Data, Moments of frequency distribution; examples with real life, use of Elementary statistical packages for explanatory Data analysis. Counting techniques, definition of probability with classical and relative frequency, subjective approaches, sample space, events, laws of probability. General Probability Distributions, Conditional probability, Bayes theorem with application to Random variable (Discrete and continuous) Binomial, Poisson, Geometric, Negative Binomial Distributions, Exponential Gamma and Normal distributions, Regression and Correlation.

Prerequisites

None

Text Book

Walpole, *Introduction to Statistics,* Prentice Hall, 1982, ISBN: 0024241504.

Reference Material:

- G. Cowan G, *Statistical Data Analysis*, Clarendon, Oxford, 1998, ISBN13: 9780198501558
- Mariano R, *Advances in Statistical Analysis and Statistical Computing III*, JAI Press, Greenwich, Conn, 1993

Code	Subject Title	Cr. Hrs	Semester
STAT-301	Parametric and Nonparametric Tests (Theory)	3	V
Year	Discipline		
3	Statistics-I,II,III		

Code	Subject Title	Cr. Hrs	Semester
STAT-302	Parametric and Nonparametric Tests (Lab)	1	V
Year	Discipline		
3	Statistics-I,II,III		

Parametric and Nonparametric Tests

Course Outline

1. Tests of hypothesis: parametric methods, Type I and Type II error, pointer of the test, Z-test,
   t-test, F-test.
2. Analysis of categorized data. Goodness of fit tests. Homogeneity of variance. Bartlett test and Cochran test. Contingency tables. Test of independence in contingency tables. Fisher's exact test for 2x2 contingency tables, Test for Homogenty.
3. Non-parametric methods. Chebyshev's inequality. The sign test. Wilcoxon's signed rank test. Mann-Whitney U test. Median test. Run test. Kolmogrorov-Smirnov test. Kruskal-Wallis test. Median test for k-samples. Friedman's test.
4. Sequential test. Test for proportion. Operating characteristic (OC) function. Average sample number (ASN) function. Test for standard deviation.

Books Recommended

1. Dixon, W.J., and Massey, F.J. "Introduction to Statistical Analysis" McGraw-Hill Company, New York, Fourth Edition, 1979.
2. Steel, R.G.D. and Torrie, J.H. "Introduction to Statistical Analysis" McGrow-Hill Book Company, New York, Second Edition, 1980.

Reference Books

1. Larson, H.J. "Introduction to Probability Theory and Statistical Inference" John Wiley and Sons, New York, Third Edition, 1982.
2. Wilcox, Rand R. "Fundamentals of modern Statistical methods", Springer N.Y. 2001.
3. Vaidyanathan, M. "Latest Statistical Methods", S. Chand and Company, New Delhi, 2001.
4. Aggarwal, Y.P. "Statistical Methods" Sterling publisher, New Delhi, 1998.

Code	Subject Title	Cr. Hrs	Semester
STAT-303	Design and Analysis of Experiments (Theory)	3	V
Year	Discipline		
3	Statistics-I,II,III		

Code	Subject Title	Cr. Hrs	Semester
STAT-304	Design and Analysis of Experiments (Lab)	1	V
Year	Discipline		
3	Statistics-I,II,III		

Course Outline

1. Concept of experiment. Planning of experiment. Design of experiment and its terminology. Principles of experimental designs. Analysis of Variance (ANOVA). Inference about means after ANOVA. Multiple comparison tests: LSD test, Duncan's test, Tukey's test, Orthogonal contrast test, Scheffe's Test, Transformations.
2. Layout and analysis of Completely Randomized, Randomized Complete Block, Latin Square and Graeco-Latin Square designs. Estimation of missing observations. Relative efficiency of these designs. Fixed, Random and Mixed effect models. Expected mean squares deviations. Partitioning of treatment and error SS. Orthogonal Polynomials.
3. Covariance analysis for Completely Randomized, Randomized Complete Block and Latin Square designs; single and double covariates.

Books Recommended

1. Cochran, W.C. and Cox, G.M. "Experimental Design" John Wiley and Sons, New York, Second Edition, 1957.
2. Montgomery, D.C. "The Design and Analysis of Experiments". John Wiley and Sons, New York, Fourth Edition, 1997.
3. John, J.A. and Quenoville, M.H. "Experiments and Analysis of Experiments", Charles Griffin & Co. London, Second Edition, 1977.

Reference Books

1. Kempthorone, O. & Hin Kelmann, K. "Design and Analysis of Experiments, Vol.1", John Wiley and Sons, New York, 1994.
2. Barker, T.B. "Quality by Exp. Design", Second Edition, 1994, Marcel Dekker, Inc. New York.
3. Boniface, D.R., "Experiment Design and Statistical Methods for Behavioural and Social Research", Champman & Hall, London, First Edition, 1995.
4. Ostle, B. and Mensing, R.W. "Statistics in Research" The lowa State University Press, New York, Second Edition, 1971.
5. Winer, B.J. "Statistical principles in Experimental Design", McGraw-Hill Book Company, New York, Second Edition, 1971.
6. Federer, W.T. "Experimental Design". Macmillan Company, New York, 1955.

7. Graybill, F.A. “An Introduction to Linear Statistical Models Vol.1”, McGraw Hill Book Company, New York, 1961.
8. Heath, D. “An Introduction to Experimental Design and Statistics for Biology”, UCI Press, London, Second Edition, 1996.
9. Clewer, Alan, G. “Practical Statistics and Experimental Design for Plant and Crop Science”, Wiley, N.Y., 2001.
10. Quinn Gerry, P. “Exp. Design and Data Analysis for Biologists”, Camb. Press, Cambridge, 2002.
11. JeffWu, C.F. “Experimental: Planning Analysis”, Wiley N.Y., 2002.
12. Kuehl, R.O., “Design of Experiments: Statistical principles of research design and analysis” Duxbury, Boston, 2000.

Code	Subject Title	Cr. Hrs	Semester
STAT-305	Sampling Techniques (Theory)	3	V
Year	Discipline		
3	Statistics-I,II,III		

Code	Subject Title	Cr. Hrs	Semester
STAT-306	Sampling Techniques (Lab)	1	V
Year	Discipline		
3	Statistics-I,II,III		

Sampling Techniques

Course Outline:

1. Sampling and non-sampling errors and their sources. Non-response and their sources. Bias and sources of bias. Probability and Non-probability samples.
2. Simple random sampling. Estimation of mean, total, proportion and variance Confidence limits, Determination of sample size. Inverse Sampling.
3. Stratified random sampling. Estimation of mean, total, proportion and variance. Arbitrary, proportional and optimum allocations and their comparisons. Determination of sample size. Effect of deviation from optimum allocation. Controlled and two way selection. Gain in precision in stratified sampling as compared with simple random sampling. Construction of strata.
4. Systematic sampling. Estimation of mean, total and variance. Systematic sampling under stratification. Comparison of systematic, stratified and random sampling for population with linear trend. Population in random order. Periodic variations.

Books Recommended

1. Cochran, W.G. “Sampling Techniques” John Wiley and Sons, New York, Third Edition, 1977.
2. Raj. D., “Sampling Theory” Mc-Graw-Hill Book Company, New York, 1971.
3. Singh, D. Chaudhry F.S. “Theory and Analysis of Sample Survey Designs”, Wiley Eastern Limited, New Dehli, India, 1986.

Reference Books

1. Fuller, Wayne A. “Sampling Statistics” John Wiley and Sons, New Jersey, 2009.
2. Brewer, K. “Combined Survey Sampling Inference” Oxford University Press, New York, 2002.
3. Raj, D. “Design of Sample Survey” Mc-Graw-Hill Book Company, New York, 1971.
4. Kish, L. “Survey Sampling” John Wiley and Sons, New York, 1965.
5. Som, R.K. “A Manual of Sampling Techniques” Heinemaan Educational Books Limited, London, 1973.
6. Sukhatme, P.V. and Sukhatme, B.V., Sukhatme, S. and Asok, C. “Sampling Theory of Surveys with Applications” Iowa State University Press, Ames, IOWA. Third Edition, 1984.

Code	Subject Title	Cr. Hrs	Semester
STAT-307	Probability Theory (Theory)	3	V
Year	Discipline		
3	Statistics-I,II,III		

Code	Subject Title	Cr. Hrs	Semester
STAT-308	Probability Theory (Lab)	1	V
Year	Discipline		
3	Statistics-I,II,III		

Probability Theory

Course Outline

Probability. Kinds of probability. Conditional probability and independence. Total probability and Bayes theorem. Random variables. Distribution function, probability function and probability density function. Moments, factorial moments and cumulants. Probability generating function. Moments generating function. Cumulant generating function. Chebyshev inequality, Univariate distributions: Discrete uniform, binomial, hyper-geometric, multinomial, Poisson, geometric, negative binomial distributions.

Books Recommended

1. Hogg. R.V. and Craig, A.T., "Introduction to Mathematical Statistics" Prentice-Hall International, Inc. Engle Wood Cliffs, N.T., Fifth Edition, 1995.
2. Mood, A.M., Graybill, F.A. and Bloes, D.C. "Introduction to the Theory of Statistics "McGraw-Hill Book Company, New York, Third Edition, 1974.

Reference Books

1. J. Susan Milton and Jesse C. Arnold, "Introduction to probability and statistics", McGraw Hill, 2003.
2. Sheldon, M. Ross, "Introduction to probability modes", Academic press, 2003.
3. Dudewicz, E.J. and Misra, S.N. "Modern Mathematical Statistics" John Wiley and Sons, New York, 1988.
4. Hogg. R.V. and Tanis, E.A. "Probability and Statistical Inference" McMillan Publishing Company, New York, Forth Edition, 1993.
5. Stuart, A. and Ord, J.K. "Kendall's Advanced Theory of Statistics Vol.-I" Edward Arnold, London, Sixth Edition, 1994.

Code	Subject Title	Cr. Hrs	Semester
STAT-309	Statistical Computer Packages	2	V
Year	Discipline		
3	Statistics-I,II,III		

Statistical Computer Packages

Course Outline

Introduction to Computer and Windows, Introduction to SPSS, Starting SPSS, How to exit from SPSS, Different windows in SPSS, Data Entry in SPSS: Defining a variable, Entering data, Saving data file, Defining Value Labels, Computing frequencies, Computing the new variables, Selection of cases, Defining Date Variable, Defining weights variable, Recoding and categorizing the existing variables, Categorizing the variables, Ranking the cases, Defining the missing values, Replacing the missing values, Creating a time series, Exploring the variable.

Finding descriptive statistics, Editing Output., Cross tabulation and measures of association, Entering a Cross-tabulated data, Graphs for variables and cross-tabulated variables, Merging and Splitting files, Bar Chart, Pie Chart, Histogram, and Historigram.

Box plot, P-P plot, Q-Q plot, One sample t-test, Independent Samples t-test, Paired samples t-test, Parametric statistical inference (one sample, Two sample, More than two sample).

Scatter Diagram, Correlation, Partial Correlation, and Regression Analysis: Simple and Multiple regressions, Non-Parametric Tests, Test of inference about proportions (one & several), Computing probability distribution and distribution functions.

Recommended Books:

1. Discovering Statistics by using SPSS. 3rd ed. Any Field.
2. Ho, Robert (2006), Handbook of Univariate and Multivariate Data Analysis and Interpretation with SPSS, Chapman and Hall/CRC.
3. Kirkpatrick, L.A. and Feeney, B.C. (2001), A Simple Guide to SPSS for Windows, Wadsworth: Thompson Learning.
4. George, D. and Mallery, P. (1999), SPSS for Windows: Step by Step, Allyn and Bacon.
5. Brace, N., Kemp, R. and Snelgar, R. (2003), SPSS for Psychologists: 2nd Edition, Palgrave and Macmillan.
6. Statistics for researchers.

Code	Subject Title	Cr. Hrs	Semester
STAT-310	Advanced Experimental Design (Theory)	3	VI
Year	Discipline		
3	Statistics-I,II,III		

Code	Subject Title	Cr. Hrs	Semester
STAT-311	Advanced Experimental Design (Lab)	1	VI
Year	Discipline		
3	Statistics-I,II,III		

Course Outline

1. Factorial experiments and its advantages. pxq Factorial in Randomized Complete Block designs. 2nd series Factorial experiments. Linear and quadratic components of main effects and interactions. 3rd series Factorial experiments.
2. Confounding, its types and its advantages. Complete and partial confounding in 2nd series.
3. Fractional replication. Quasi-Latin squares.
4. Split-plot designs and Split-split plot designs.
5. Balanced incomplete and Partially Balanced incomplete block designs. Comparison of Incomplete Block design with Randomized Complete Block design. Youden Squares.

Books Recommended

1. Cochran, W.C. and Cox, G.M. “Experimental Design”, John Wiley and Sons, New York, Second Edition, 1957.
2. Montgomery, D.C. “The Design and Analysis of Experiments”, John Wiley and Sons, New York, Fourth Edition, 1997.
3. John, J.A. and Quenoville, M.H. “Experiments Design and Analysis”, Second Edition, Charles Griffin & Co. London, 1977.

Reference Books

1. Kempthorone, O. & Hin Kelmann, K. “Design and Analysis of Experiments, Vol.1”, John Wiley and Sons, New York, 1994.
2. Barker, T.B. “Quality by Exp. Design”, Marcel Dekker, Inc. New York, Second Edition, 1994.
3. Boniface, D.R., “Experiment Design and Statistical Methods for Behavioural and Social Research”, Chapman & Hall, London. First Edition, 1995.
4. Ostle, B. and Mensing, R.W. “Statistics in Research”, The lowa State University Press, Third Edition, 1975.
5. Winer, B.J. “Statistical Principles in Experimental Design”. McGraw-Hill Book Company, New York, Second Edition, 1971.
6. Federer, W.T. “Experimental Design”, Macmillan Company, New York, 1955.
7. Graybill, F.A. “An Introduction to Linear Statistical Models, Vol.1” McGraw Hill Book Company, New York, 1961.
8. Heath, D. “An Introduction to Experimental Design and Statistics for Biology”, UCI Press, London, second edition, 1996.

9. Clewer, AlanG, “Practical Statistics and Experimental Design for Plant and Crop Science”, Wiley N.Y., 2001.
10. Quinn Gerry P, “Exp. Design and Data Analysis for Biologists” Camb. Press, Cambridge, 2002.
11. JeffWu, C.F. “Experimental: Planning Analysis”, Wiley, New York, 2002.
12. Kuehl, R.O. “Design of experiments: Statistical principles of research design and analysis” Duxbury, Boston, 2000.

Code	Subject Title	Cr. Hrs	Semester
STAT-312	Advanced Sampling Techniques (Theory)	3	VI
Year	Discipline		
3	Statistics-I,II,III		

Code	Subject Title	Cr. Hrs	Semester
STAT-313	Advanced Sampling Techniques (Lab)	1	VI
Year	Discipline		
3	Statistics-I,II,III		

Advanced Sampling Techniques

Course Outline

1. Ratio and Regression estimation. Estimation of total, mean square error and bias using design based approach and model based approach in estimate in simple random sampling. Unbiased ratio-type estimators. Ratio estimation in stratified sampling. Estimation of mean and variance in linear regression estimates. Best linear unbiased estimator (BLUE). Bias of the linear regression estimates. Regression estimation in stratified sampling. The Linear regression estimator under the general linear model.
2. Cluster sampling. Estimation of mean, total and variance for single-stage cluster sampling. Cost function. Variance function, cluster sampling for proportions, Sampling with unequal probability with replacement.
3. Two-stage sampling. Estimation of mean, total, proportion and variance. Both stages with equal probability. Two-stage sampling with units of unequal sizes, First stage PPS (with replacement) and second stage with equal probability. Both stages with probability proportional to size and with replacement. Sampling methods when a single primary unit is selected for the sample. Basic concept of double sampling.

Books Recommended

1. Cochran, W.G. “Sampling Techniques” John Wiley & Sons, New York, Third Edition, 1977.
2. Raj. D., “Sampling Theory” Mc-Graw-Hill Book Company, New York, 1971.
3. Singh, D. Chaudhry F.S. “Theory and Analysis of Sample Survey Designs”, Wiley Eastern Limited, New Dehli, India, 1986.

Reference Books

1. Fuller, Wayne A. “Sampling Statistics” John Wiley and Sons, New Jersey, 2009.
2. Brewer, K. “Combined Survey Sampling Inference” Oxford University Press, New York, 2002.
3. Raj, D. “Design of Sample Survey” Mc-Graw-Hill Book Company, New York, 1971.
4. Kish, L. “Survey Sampling” John Wiley and Sons, New York, 1965.
5. Som, R.K. “A Manual of Sampling Techniques” Heinemaan Educational Books Limited, London, 1973.
6. Sukhatme, P.V. and Sukhatme, B.V., Sukhatme, S. and Asok, C. “Sampling Theory of Surveys with Applications” Iowa State University Press, Ames, IOWA. Third Edition, 1984.

Code	Subject Title	Cr. Hrs	Semester
STAT-314	Multivariate Techniques (Theory)	3	VI
Year	Discipline		
3	Statistics-I,II,III		

Code	Subject Title	Cr. Hrs	Semester
STAT-315	Multivariate Techniques (Lab)	1	VI
Year	Discipline		
3	Statistics-I,II,III		

Multivariate Techniques

Course Outline:

Review of matrix algebra, Notions of multivariate distributions. The multivariate normal distribution and its properties. Linear compound and linear combinations. Estimation of the mean vector and the covariance matrix. The Wishart distribution and its properties. The joint distribution of the sample mean vector and the sample covariance matrix.

Books Recommended

1. Johnson, R.A., & Wichern, D.W. (2008). Applied multivariate statistical analysis, Pearson Education: Singapore.
2. Anderson, T.W. (2003). An introduction to multivariate statistical analysis (3rd ed.). John Wiley & Sons: New York.
3. Chatfield, C. & Collins, A.J. (1980). Introduction to multivariate analysis. Chapman and Hall: London.
4. Morrison, D.F. (1990). Multivariate statistical methods (3rd ed.). McGraw Hill Publishing Co.: New York.

Reference Books

1. Kandall, M.G., & Stuart, A. (1983). The advanced theory of statistics (4th ed.). Charles Griffin and Company: London.
2. Rao, C.R. (1973). Linear statistical inference and its applications (2nd ed.). John Wiley and Sons: New York.

Code	Subject Title	Cr. Hrs	Semester
STAT-316	Probability Distributions (Theory)	3	VI
Year	Discipline		
3	Statistics-I,II,III		

Code	Subject Title	Cr. Hrs	Semester
STAT-317	Probability Distributions (Lab)	1	VI
Year	Discipline		
3	Statistics-I,II,III		

Probability Distributions

Course Outline

Continuous distributions: continuous uniform, normal, exponential, gamma, beta, lognormal, Weibull, Pareto and Cauchy distributions and their properties.

Bivariate distributions. Marginal distribution. Conditional distribution and independence. Conditional expectation and conditional variance. Bivariate normal distribution and its properties.

Transformation of random variables. Sum, product and quotient of random variables. Moment generating function techniques. Derivations of chi-square, t and F distributions and their properties. Order statistics, Distribution of the rth order statistics. Distribution of sample range, sample median and sample mid-range.

Books Recommended

1. Hogg. R.V. and Craig, A.T., "Introduction to Mathematical Statistics" Prentice-Hall International, Inc. Engle Wood Cliffs, N.T., Fifth Edition, 1995.
2. Mood, A.M., Graybill, F.A. and Bloes, D.C. "Introduction to the Theory of Statistics "McGraw-Hill Book Company, New York, Third Edition, 1974.

Reference Books

1. J. Susan Milton and Jesse C. Arnold, "Introduction to probability and statistics", McGraw Hill, 2003.
2. Sheldon, M. Ross, "Introduction to probability modes", Academic press, 2003.
3. Dudewicz, E.J. and Misra, S.N. "Modern Mathematical Statistics" John Wiley and Sons, New York, 1988.
4. Hogg. R.V. and Tanis, E.A. "Probability and Statistical Inference" McMillan Publishing Company, New York, Forth Edition, 1993.
5. Stuart, A. and Ord, J.K. "Kendall's Advanced Theory of Statistics Vol.-I" Edward Arnold, London, Sixth Edition, 1994.

Code	Subject Title	Cr. Hrs	Semester
STAT-318	FORTRAN Computer Language	2	VI
Year	Discipline		
3	Statistics-I,II,III		

FORTRAN Computer Language

Course Outline

Introduction to the Computers: History, Main Computers, Various Input and Output devices and Tips for the computer maintenance.

Introduction to Operating Systems, Introduction to DOS: DATE, TIME, COPY, XCOPY, FORMAT, DEL, RENAME etc. Commands.

FORTRAN, FORTRAN fundamentals, Constants, Variables and Arithmetic. Input, Output and Format Statements. Decision making in FORTRAN language. Branching and looping Arrays, Functions, sub-programs and sub-routines filing.

Books Recommended

1. Lipschutz, M.M. Lipschuts S. “Theory and Problems of Data Processing”. Schaum’s outline series. McGraw Hill Book Company, New York.
2. Lipschutz., AS. And Poc., A. “Theory and Problems of Programming with FORTRAN”. Schaum’s out line series, McGraw Hill Book Company, New York.
3. Salaria R.S. “Programming in Microsoft FORTRAN 77”, BPB Publications, New Delhi, India, 1994.

Reference Books

1. Fouri, W.M. Gaughran, S.L and Fouri, M. “IBM FORTRAN 77: Elements of Programming Style” 1986, Hayden Book Company.
2. Zwoss, V. “Introduction to Computer Science” 1981, Braves and Noble Books, New York.

Code	Subject Title	Cr. Hrs	Semester
STAT-321	Applied Statistics	3	V
Year	Discipline		
3	Applied Psychology		

Course Objectives

This course is designed to train the students in theoretical as well as applied statistics with particular reference to psychology. The statistical analysis is a very essential part of psychological research and students need to grasp the concepts, theoretical rational of use of certain statistical analysis and also to learn to carry out these analyses.

At the completion of course the students should be able to:

1. Understand basic concepts in statistical research.
2. Carry out statistical techniques of data analyses manually
3. Carry out statistical analyses using SPSS.
4. Interpret and discuss statistical results and present them in tables

Course Contents

Introduction

Defining Statistics
Descriptive and Inferential Statistics.
Scales of Measurement
Importance of Statistics in Psychology

Descriptive Statistics and Graphic Representation of Data

Data, Types of Data. frequency Distribution.
Cumulative frequency Distribution
Histogram, Polygon,
Pictograph, Bar Diagram, Pie Chart

Measures of Central Tendency and variability

Mean, Mode, Median
Range, Mean Deviation, Quartile Deviation, Variance, Standard Deviation, Shepherd 'S Correction. Coefficient of Variation, Z. Scores.

Probability

Defining Probability,
Subjective Empirical And Classical Probability.
Laws of Probability.
Permutation and Combination.

Normal & Binomial Distribution

Normal distribution: its properties and application.
Binomial distribution: its properties and application.

Recommended Books

- Alder, H.L. & Accsstes, E.B. Introduction to Probability and Statistics. San Francisco: Froeman
- and Company. New York.
- Howell, D. 1999. Fundamental Statistics for Behavioral Sciences. 4th Edition
- Howell, D. 2002. Statistical Methods for Psychology. 5th Edition. Luxury Press.
- Downic, N.M. & Heath, R.W. Basic statistical Methods. New York: Harcourt Brace &
- Jakanovich
- Fergusan, G. A. & Takane, Y. 1969. Statistical Analysis in Psychology and Education (6th ed.).
- McGraw Hill.
- Freund , J.E. Modern Elementary Statistics. New Jersey, Prentice Hall.
- Garrett H.T.& Woodworth, R.S. Statistics in Psychology and Education ,
- Guilford, J.P. & Fruchter, B. Fundamental Statistics in Psychology and Education.
- Kinnear & Gray 1994. SPSS for Windows Made Simple. 3rd Edition Psychology Press.
- McClane J. T. 2000. A First Course in Statistics 7th Edition. Prentice Hall
- Moore, D. S. & McCabe, G. P. 1998 Introduction to the Practice of Statistics. 3rd
- New York: Longmans.
- Siegel , S. Non-Parametric Statistics. New York: McGraw Hill.
- Sinha, B. J. 2000. Encyclopedia of Statistics, Psychology and Education. Anmol
- Terry Sircich Upper Saddle River, New Jersey.
- Winer,S.B. Statistical Principles in Experimental Design. McGraw Hill Book Company. N.Y.

Code	Subject Title	Cr. Hrs	Semester
STAT-322	Statistical Package for Social Sciences (SPSS) in Psychology	3	VI

Year	Discipline
3	Applied Psychology

Course Objectives

Students would have already completed basic computer skills course. This course is designed to enhance their competence in using computers for data analysis and literature search. At the end of course the students will be able to analyze data using SPSS and use psychological search engines.

Course Contents

Introduction to Statistical Package for Social Sciences (SPSS)

Basic features of SPSS
Entering Statistical data
Assigning variable names and values labels
Computing and Recording Techniques
Calculating descriptive statistics. (Including Mean, Median, Mode and Standard deviation)
Computing differences between Two Means by t-Test. (Independent and matched samples)
Computing differences between Multiple Group by t-Test. (One-Way ANOVA)
Computing Relationship between Variables (Correlation).
Regression Analysis.
Non parametric statistics.

Doing Online Literature Search Using search Engines: Yahoo, Google, Alta Vista

a. Using Data bases: Science Direct, Ebscohost, Black Synergy, Psychinfo, Medical Index etc.
b. How to make on line search effective.

Recommended Books

- Kinear, P.R., & Gray, C.D. (1994). SPSS for windows made simple. Hove, East Sussex: Erlbaum Publishers.
- Maran, R. (1995). Windows 95 simplified. Foster City, C.A: IDG Books Worldwide, Inc.
- Maran, R., & Wing, K. (1997). Teach yourself word 97. Foster City, C.A: IDG Books worldwide, Inc.
- Nelson, K.Y. (1996). Windows 95 is driving me crazy. Berkeley, CA: Peach pit Press.
- Person, R. (1993). Using Excel Version 5 for windows. Indianapolis: Que Corporation.

Pedagogy

This is a training course, which will be conducted in computer lab with guided instructions and practical work during each class.

Code	Subject Title	Cr. Hrs	Semester
STAT-323	Advanced Statistics	3	VI
Year	Discipline		
3	Applied Psychology		

Course Objectives

This course is designed to train the students in theoretical as well as applied statistics with particular reference to psychology. The statistical analysis is a very essential part of psychological research and students need to grasp the concepts, theoretical rational of use of certain statistical analysis and also to learn to carry out these analyses.
At the completion of course the students should be able to:
Carry out statistical techniques of data analyses according to the hypotheses been formulated.
Interpret and discuss statistical results and present them in graphic and table form as well as able to report results in text form.

Course Contents

Testing Hypotheses.
Null and Alternative Hypotheses
Acceptance And Rejection Regions
One Tailed & Two Tailed Tests
Type One and Type Two (I & II) Errors
Level of Significance
Testing The Hypotheses About Mean and Difference Between Means both Small And Large Samples. (T & Z Tests)
Analysis of Variance, One Way and two way analysis of variance

Correlation, Regression and Prediction
Correlation & Causation
Pearson Product moment Correlation,
Spearman's Rank Order Correlation.
Regression analysis. Linear Regression. Scatter Diagram.
Standard Error of Estimation.

Introduction to Non Parametric Statistics
Introduction to Non-Parametric tests
Chi Square Test (Contingency Table and Proportions)
Yates Correction. Non Parametric tests. Wilcoxan test, Mann Whitney test, Sign test, Kruskal Wallis

Recommended Books

- Alder, H.L. & Accsstes, E.B. Introduction to Probability and Statistics. San Francisco: Froeman and Company. New York.
- Howell, D. 1999. Fundamental Statistics for Behavioral Sciences. 4th Edition
- Howell, D. 2002. Statistical Methods for Psychology. 5th Edition. Luxury Press.
- Downic, N.M. & Heath, R.W. Basic statistical Methods. Harcourt Brace & Jakanovich.

- New York
- Fergusan, G. A. & Takane, Y. 1969. Statistical Analysis in Psychology and Education 6th Edition .McGraw Hill.
- Freund , J.E. Modern Elementary Statistics. New Jersey, Prentice Hall.
- Garrett H.T.& Woodworth, R.S. Statistics in Psychology and Education ,
- Guilford, J.P. & Fruchter, B. Fundamental Statistics in Psychology and Education.
- Kinnear & Gray 1994. SPSS for Windows Made Simple. 3rd Edition Psychology Press.
- McClane J. T. 2000. A First Course in Statistics 7th Edition. Prentice Hall
- Moore, D. S. & McCabe, G. P. 1998 Introduction to the Practice of Statistics. 3rd
- New York: Longmans.
- Siegel , S. Non-Parametric Statistics. New York: McGraw Hill.
- Sinha, B. J. 2000. Encyclopedia of Statistics, Psychology and Education. Anmol
- Terry Sircich Upper Saddle River, New Jersey.
- Winer, S.B. Statistical Principles in Experimental Design. McGraw Hill Book Company. N.Y.

Pedagogy

Lectures, Tutorials, student presentations, class discussions, invited lectures

Code	Subject Title	Cr. Hrs	Semester
STAT-401	**Statistical Inference-I (Theory)**	**3**	**VII**
Year	Discipline		
4	**Statistics**		

Code	Subject Title	Cr. Hrs	Semester
STAT-402	**Statistical Inference-I (Practical)**	**1**	**VII**
Year	Discipline		
4	**Statistics**		

Course Outline

Point estimation, problem of estimation. Properties of a good estimator: Unbiasedness, Consistency, Efficiency and Sufficiency. Mean-squared error. Consistency and Best asymptotically normal estimator. Minimal sufficient statistics. Joint sufficiency. Exponential family. Sufficiency and Completeness. Cramer-Rao inequality. Minimum Variance Bound estimators. Rao-Blackwell and Lehmann-Sheffe theorems. Uniformly Minimum Variance Unbiased estimators. Joint completeness. Location invariant and scale-invariant estimators. Pitman estimators for location and scale.

Bayes estimators. Prior and Posterior distributions. Posterior Bayes estimators. Loss function and Risk function. Bayes estimator, Minimax Methods of estimation.

Recommended Books:

- Hogg, R.V. and Craig, A.T. “Introduction to Mathematical Statistics”, Prentice-Hall International, Inc. Engle Wod Cliff, N.J., Sixth Edition, 2004.
- Hogg, R.V. and Tanis E.A., “Probability and Statistical Inference” Macmillan Publishing Company, New York, Seventh Edition, 2009.
- Mood, A.M. Graybill, F.A. and Boes, D.C., “Introduction to the Theory of Statistics”, McGraw-Hill Book Company, New York, Third Edition, 1974.
- Levy, P.S. and Lemeshow, S, “Sampling of Populations: Methods and Applications”, John Wiley, New York, Third Edition, 1999.
- Lehman, E.L. “Theory of Point Estimation”, John Wiley, New York, 1983.
- Rao, C.R., “Linear Statistical Inference and its Applications”, John Wiley, New York, 1973.
- Hoel, P.G. “Introductions to Mathematical Statistics” Fifth Edition, John Wiley, 1984.

Reference Books:

- Lindgrind, B.W. “Statistical Theory” Macmillan Publishing Company, New York, Third Edition, 1976.
- Stuart, A. and Ord, J.K. “Kendalls Advanced Theory of Statistics, Vol-2, Edward Arnold, London, Fifth Edition, 1991.
- Spanos. A “Probability theory and Statistical Inference” Cambridge University Press, 1999.
- Welsh, A.H. “Aspects of Statistical Inference” John Wiley, 1996.
- Freund, J.E. “Mathematical Statistics” Sixth Edition, 1999.
- Kale, B.K. “a first course on parametric inference” Narosa, India, 1999.
- Hagan, A. “Kendall’s Advanced theory of Statistics Vol.2B; Baysian inference” Arnold, U.K. 1994.

Code	Subject Title	Cr. Hrs	Semester
STAT- 403	**Basic Econometrics (Theory)**	**3**	**VII**
Year	Discipline		
4	**Statistics**		

Code	Subject Title	Cr. Hrs	Semester
STAT-404	**Basic Econometrics (Practical)**	**1**	**VII**
Year	Discipline		
4	**Statistics**		

Course Outline

1. **Econometrics**

Its nature, methodology and functions.

2. **Simple Linear regression**

Ordinary least squares method; assumptions and estimation. Maximum likelihood method; assumptions and estimation, Properties of OLS and ML estimators. Partition of total sum of squares. Sampling distribution of sum of squares, Testing of hypotheses confidence intervals for the parameters and Linear combinations of parameter. Comparison of simple linear regressions, Chow test.

3. **General Linear regression**

Ordinary least squares method; assumptions and estimation. Maximum likelihood method; assumptions and estimation properties of OLS and ML estimators. Partition of total sum of squares. Sampling distribution of sum of squares, Testing of hypotheses for the single, all some any parameters, Linear combinations of parameters. Comparison of general linear regressions, Chow test. Gauss Markov's theorem.

4. **Other topics**

Stepwise regression, Ridge regression, GLR partitioned form: Estimator & testing of hypothesis, Use of extraneous information in linear regression. Restricted least squares estimator.

Recommended Books:

- Gujrati, D. “Basic Econometrics”, McGraw Hill Book Company, Third Edition, 1995.
- Johnston, J. “Econometric Methods”, McGraw-Hill Book Company, Third Edition, 1985.
- Koutsoyiannis, A. “Theory of Econometrics”, Macmillan Press Ltd., Hong Kong, 1979.
- Maddala, G.S. “Introduction to Econometrics”, John Wiley, India, Third Edition, 2005.
- Ramanathan, R. “Introductory Econometrics with Applications”, South-Western Thomson Learning, USA, Fifth Edition, 2002.

Reference Books

- Dutta, M. “Econometric Methods, “South-Western Publishing Company, England, 1975.
- Goldberger, A.S. “Econometric Theory”, John Wiley and Sons, New York, 1964.
- Wonnacott, T.H. and Wonnacott, R.J. “Econometrics”, John Wiley and Sons, New York, 1979.
- Draper, N.R. and Smith, I.I. “Applied Regression Analysis”, John Wiley & Sons, New York, 1998.

Code	Subject Title	Cr. Hrs	Semester
STAT-405	**C++ Computer Programming Language (Paper: Theory & Practical equal marks)**	**3**	**VII**
Year	Discipline		
4	**Statistics**		

Course Outline

Introduction to C-Language, Basic Data types, Input, Output and Format. Decision making in C-Language, Branching and Looping. Arrays, Strings, Pointers, Structure and Union. Functions and Concepts of Filing. Introduction to Macros, building of projects and libraries.

Recommended Books:

- Herold H. and Unger W. “C Complete Manual”, Second revised edition, 1992, Galgotia Publications Pvt., New Delhi, India.
- Kernighan B.W. Ritchic D.M. “The C++ Programming Language”, Second Edition, Prentice Hall of India Pvt. Lt., New Delhi, India.
- Tizzard, K. “C for Professional Programmers”, Second Edition, 1992, Ellis Horwood, London
- Hancock L. Krieger M. “C The Primer” Second Edition 1985, McGraw Hill Book Company,
- Schildt H. “C++ Made Easy”, 1990, McGraw Hill Book Co.
- Kochan S.G. “Programming in C” Revised Edition, 1990, Hayden Books, USA.

Code	Subject Title	Cr. Hrs	Semester
STAT-406	**Research Methodology**	**2**	**VII**
Year	Discipline		
4	**Statistics**		

Course Outline

1. Introduction: Definition of Research, Types and Methods of Conducting Research, Census and Survey, Sampling frame, Types of errors in surveys (coverage, non-response, measurement, errors etc.) and methods of control of such errors, Steps for successful surveys.
2. Types of Surveys: Qualitative and Quantitative survey, Assessments survey, Marketing survey, Evaluation of a survey.
3. Methods for conducting a Survey: Mail surveys, telephone surveys, face to face surveys, and drop off surveys.
4. Sample size: Various methods of sample selection, sample size and its practical difficulties.
5. Constructing a questionnaire for different types of surveys.
6. Scaling Techniques.
7. The analysis of Data.
8. Style and Format of report writing.
9. Preparing the report.

Recommended Books:

- Salant, P. and Dillaman, D.A. “How to conduct your own survey”, John Wiley and Sons, Inc. 1994.
- Goode, W. J. and Hatt, P. K. “Methods in Social Research”, McGraw-Hill Book Company, Inc.
- Gupta, S. “Research Methodology and Statistical Techniques”, Deep & Deep Publication, New Delhi, 1997.
- Dalemius T. “Elements of Survey Sampling” SAREC, Stockholm, 1985.

Reference Books

- Grosh, Margaret, “Designing Household Survey Questionnaires for Developing Countries”, World Bank, New Age Int. 1999.
- Kish, Leslie, “Survey sampling”, Wiley 1995.
- Barnett Vic, “Sample Survey”, Arnold London, 2002.
- Gupta S. “Research Methodology and Statistical techniques” Deep & Deep Pub. New Delhi 2003.

Code	Subject Title	Cr. Hrs	Semester
STAT- 407	**Statistical Inference-II (Theory)**	**3**	**VIII**
Year	Discipline		
4	**Statistics**		

Code	Subject Title	Cr. Hrs	Semester
STAT-408	**Statistical Inference-II (Practical)**	**1**	**VIII**
Year	Discipline		
4	**Statistics**		

Course Outline

Method of moments. Maximum likelihood method and its properties. Method of least squares and its properties. Ordered least squares estimation of location and scale parameters. Minimum chi-square method.

Interval estimation. Confidence interval and its interpretation. One-sided confidence intervals. Methods of finding confidence intervals. Pivotal quantity method. Confidence intervals for the mean and variance. Confidence region for the mean and variance. Large-sample confidence intervals. Bayesian interval estimates. Shortest sets of confidence intervals.

Tests of Hypotheses. Simple and composite hypotheses. Power function. Size and power of a test. Randomized and Non-randomized tests. Most powerful tests. Neyman-Pearson lemma. Loss function and Risk function. Bayes test. Generalized likelihood-ratio tests. Uniformly most powerful unbiased test. Monotone likelihood ratio tests of hypotheses. Sequential probability ratio test. Approximate sequential probability ratio test. Average sample number.

Recommended Books:

- Hogg, R.V., & Craig, A.T. (1995). Introduction to mathematical statistics (5th ed.). MacMillan: New York.
- Mood, A.M., Graybill, F.A., & Boes, D.C. (1974). Introduction to the theory of statistics (3rd ed.). McGraw-Hill: New York.
- Levy, P.S., & Lemeshow, S. (2008). Sampling of populations: Methods and applications (4th ed.). John Wiley: New York.

- Lehmann, E.L., & Casella, G. (1998). Theory of point estimation (2nd ed.). Springer: New York.
- Rao, C.R. (2001). Linear statistical inference and its applications (2nd ed.). John Wiley: New York.
- Hoel, P.G. (1984). Introduction to mathematical statistics (5th ed.). John Wiley: New York.

Reference Books

- Hogg, R.V., & Tanis, E.A. (2005). Probability and statistical inference (7th ed.). Prentice Hall: New Jersey.
- Lindgren, B.W. (1993). Statistical theory (4th ed.). Chapman and Hall: New York.
- Kendall, M., Stuart, A., & Ord, J.K. (1991). Kendall's advanced theory of statistics, Vol. 2: Classical Inference and relationship (5th ed.). Oxford University Press: New York.
- Spanos, A. (1999). Probability theory and statistical inference. Cambridge University Press: UK.
- Welsh, A.H. (1996). Aspects of statistical inference (1st ed.). John Wiley: New York.
- Miller, I., & Miller, M. (1998). John E. Freund's mathematical statistics (6th ed.). Prentice Hall: New Jersey.
- Kale, B.K. (2005). A first course on parametric inference (2nd ed.). Narosa: New Dehli.

Code	Subject Title	Cr. Hrs	Semester
STAT-409	**Applied Econometrics (Theory)**	**3**	**VIII**
Year	Discipline		
4	**Statistics**		

Code	Subject Title	Cr. Hrs	Semester
STAT-410	**Applied Econometrics (Practical)**	**1**	**VIII**
Year	Discipline		
4	**Statistics**		

Course Outline

1. Non-spherical disturbances, Consequences of using OLS estimators, ML method assumption and estimation, Generalized least squares; assumption, estimation, properties of GLS estimators. Aitken theorem, Stochastic regressors.
2. Multicollinearity: types, reasons, consequences, remedial measures, Farrar and Glauler test.
3. Heteroskedasticity: Reasons, tests, remedial measures.
4. Autocorrelation: Reasons, tests, remedial measures, consequences.
5. Specification Errors: Over and under specified models and their consequences. Error in variables.
6. Other variables: Instrumental variables, Lagged variables, Dummy variables.
7. Other regression: Polynomial regression, Orthogonal polynomials and their use.
8. Systems of simultaneous linear equations: Reduced form equations, Simultaneous equations Bias. Identification (order and rank conditions), Methods of estimation for identified equations.
9. Income and Wealth distribution: Techniques for income distribution analysis (Lovernz curve, Gini coefficients, Pareto curve).

Recommended Books:

- Gujrati, D. “Basic Econometrics”, McGraw Hill Book Company, Third Edition, 1995.
- Johnston, J. “Econometric Methods”, McGraw-Hill Book Company, Third Edition, 1985.
- Koutsoyiannis, A. “Theory of Econometrics”, Macmillan Press Ltd., Hong Kong, 1979.
- Maddala, G.S. “Introduction to Econometrics”, John Wiley, India, Third Edition, 2005.
- Ramanathan, R. “Introductory Econometrics with Applications”, South-Western Thomson Learning, USA, Fifth Edition, 2002.

Reference Books:

- Dutta, M. “Econometric Methods, “South-Western Publishing Company, England, 1975.
- Goldberger, A.S. “Econometric Theory”, John Wiley and Sons, New York, 1964.
- Wonnacott, T.H. and Wonnacott, R.J. “Econometrics”, John Wiley and Sons, New York, 1979.
- Draper, N.R. and Smith, I.I. “Applied Regression Analysis”, John Wiley & Sons, New York, 1998.

Code	Subject Title	Cr. Hrs	Semester
STAT-411	**Time Series Analysis-I**	**3**	**VII**
Year	Discipline		
4	**Statistics**		

Course Outline

1. Introduction to time series, time series analysis, Objectives of time series analysis, Components of time series, time series plots, time series and stochastic processes, special features of time series data, means, variance, auto-covariance, auto-correlation and partial auto-correlation for sample time series data.

2. Simple Descriptive Techniques: Stationary time series, transformations, Analyzing the secular trend, Filtering, Differencing, Analyzing Seasonal Variations, Analyzing Cyclical Variations, Analyzing Irregular Variations, Auto-correlation (correlogram) and other tests of randomness.

3. Probability Models for Time Series: Stochastic processes and stationary processes, useful stochastic processes, purely random process, random walk, moving average process, Stationarity and Invertibility of moving average models, auto-regressive process, Stationarity and invertibility of auto-regressive models, Duality between moving average and auto-regressive models, Principle of parsimony, Recursion rule for ACVF and ACF of auto-regressive process, Yule-Walker equations for auto-regressive process, Mixed ARMA models, moving average and auto-regressive representations of mixed ARMA models, Models for Non-stationary Time series, Box-Jenkins Integrated ARIMA models,: Stationarity through differencing, other transformations. General linear processes and continuous processes.

Recommended Books:

- Chatfield, C. (2003). The analysis of time series: An introduction (6th ed.). Chapman & Hall: London.
- Wei, W. (1990). Time series analysis: Univariate and multivariate methods. Addison-Wesley publishing company, Inc.
- Box, G.E.P., Jenkins, G.M. & Reinsel, G.C. (2004). Time series analysis: Forecasting and control (3rded.). Holden-dayk: San Francisco.
- Brockwell, P.J., & Davis, R.A. (2002). Introduction to time series and forecasting. (2nded.). Springer: New York.

Reference Books

- Gottman, J.M. (1981). Time series analysis, University Press: Cambridge.
- Gyer, J.D. (1990). Time series analysis. Duxbury Press: Boston.
- Montgomery, D.C. (1990). Forecasting and time series analysis (2nd ed.). McGraw Hill Book Company: New York.
- Anderson, T.W. (1994). Statistical analysis of time series. Wiley: New York.
- Janacek & Gareth. (2001). Practical time series. Arnold Co.: UK.
- Akaike, H. & Kitagawa, G. (1999). The practice of time series analysis .Springer: New York.
- Hamilton, & James, D. (1994). Time series analysis. Princeton University Press: New Jersey.
- Chatfield, C. (2000). Time series forecasting .Chapman & Hill/CRC: New York.

Code	Subject Title	Cr. Hrs	Semester
STAT-412	**Operation Research**	**3**	**VII**
Year	Discipline		
4	**Statistics**		

Course Outlines

Definition and nature of Operations Research (OR). Phases of an OR study. Modeling, constraints, objective and criterion. Problem formulation. Decision Variables, Objective function, Constraints Model building approach to problem solving. Types of models available for OR. Deterministic models, Stochastic Models. Examples of Models. Example of OR applications.

Introduction to linear programming. Graphical solution technique. Simplex Method, Application of Simplex Network.

Recommended Books

- Taha, H.A. “Operations Research. An Introduction”. Macmillan Publishing Company, New York, Fith Edition, 1994.

Code	Subject Title	Cr. Hrs	Semester
STAT-413	**Time Series Analysis-II**	**3**	**VIII**
Year	Discipline		
4	**Statistics**		

Course Outline

1. Model Building, various stages of model building, Identification of model from sample time series, steps for model identification, estimating the auto-covariance, auto-correlation function and partial auto-correlation function, pattern of theoretical ACF and PACF as a tool of model identification.

2. Estimating the parameters of an auto-regressive model, estimating the parameters of moving average, Back casting, dual estimation, mixed ARMA model and integrated model. The Box-Jenkins seasonal model. Model diagnostics; Residual analysis, over fitting and parameter redundancy, portmanteau tests. Model selection criteria, AIC, BIC.

3. Forecasting: Univariate procedures, Minimum mean square estimate of forecast, forecast weights, mean, variance and forecast limits for forecast, forecast error, minimum mean square forecast error, structure of minimum mean square forecast error. Multivariate procedures, comparison of forecasting procedures. Prediction theory.

Books Recommended

- Chatfield, C. (2003).The analysis of time series: An introduction (6th ed.).Chapman & Hall: London.
- Wei, W. (1990).Time series analysis: Univariate and multivariate methods. Addison-Wesley publishing company, Inc.
- Box, G.E.P., Jenkins, G.M. & Reinsel, G.C. (2004).Time series analysis: Forecasting and control (3rded.). Holden-dayk: San Francisco.
- Brockwell, P.J., & Davis, R.A. (2002).Introduction to time series and forecasting. (2nded.). Springer: New York.

Reference Books

- Gottman, J.M. (1981).Time series analysis, University Press: Cambridge.
- Gyer, J.D. (1990). Time series analysis. Duxbury Press: Boston.
- Montgomery, D.C. (1990). Forecasting and time series analysis (2nd ed.). McGraw Hill Book Company: New York.
- Anderson, T.W. (1994). Statistical analysis of time series. Wiley: New York.
- Janacek & Gareth. (2001). Practical time series. Arnold Co.: UK.
- Akaike, H. & Kitagawa, G. (1999). The practice of time series analysis .Springer: New York.

- Hamilton, & James, D. (1994). Time series analysis. Princeton University Press: New Jersey.
- Chatfield, C. (2000). Time series forecasting .Chapman & Hill/CRC: New York.

Code	Subject Title	Cr. Hrs	Semester
STAT-414	**Multivariate Analysis**	**3**	**VIII**
Year	Discipline		
4	**Statistics**		

Course Outline

The Hotelling's T^2 distribution. The linear discriminant function, Mahalanobis distances. Tests of hypotheses and confidence intervals for mean vectors: One sample and two-sample procedures. Multivariate statistical procedures: Discriminant analysis, Principal component analysis, Factor analysis, and Canonical correlation analysis.

Recommended Books:

- Johnson, R.A., & Wichern, D.W. (2008). Applied multivariate statistical analysis. Pearson Education: Singapore.
- Anderson, T.W. (2003). An introduction to multivariate statistical analysis (3rd ed.). John Wiley & Sons: New York.
- Rencher, A.C. (2002). Methods of multivariate analysis (2nd ed). John Wiley & Sons: New York.
- Tabachnick, B.G., & Fidell, L.S. (2006). Using multivariate statistics (5th ed.). Allyn & Bacon: Boston.
- Bhuyan, K.C. (2008). Multivariate analysis and its applications. New Central Book Agency: Kolkata.
- Chatfield, C., & Collins, A.J. (1980). Introduction to multivariate analysis. Chapman and Hall: London.

Reference Books

- Morrison, D.F. (1990). Multivariate statistical methods (3rd ed.). McGraw Hill Publishing Co.: New York.
- Kandall, M.G., & Stuart, A. (1983). The advanced theory of statistics (4th ed.). Charles Griffin and Company: London.
- Rao, C.R. (1973). Linear statistical inference and its applications (2nd ed.). John Wiley and Sons: New York.

Code	Subject Title	Cr. Hrs	Semester
STAT-415	**Total Quality Management**	**3**	**VIII**
Year	Discipline		
4	**Statistics**		

Course Outlines

The basics of Management. Defining Quality. Different views of Quality. Dimensions of Quality. Quality Management. Principles of Quality Management. Eras of Quality Management, their foci and major developments. Introduction to Total Quality Management, Basic concepts, Purpose, benefits and framework of TQM, Implementation of TQM. Barriers to TQM implementation, Guru's of TQM, their Philosophies and Pioneering Works. Customer satisfaction. Internal and External Customer, Customer perception of quality. Employee involvement, Quality Control Circles & Teams.

Continuous Process Improvement: The PDSA Cycle, Kaizen, Six Sigma, Japanese 5-S practice. DRIVE framework. Costs of Quality. Quality Function Deployment. Benchmarking: Reasons to Benchmark, Types of Benchmarking, Benchmarking process, Benefits of Benchmarking, Obstacles to successful Benchmarking. New and old tools of Quality Management.

Statistical Process Control: Statistical Control Charts, Statistical basis of the Control Chart, Steps in the development of control charts, Types of control charts, Process Capability. Acceptance Sampling: Lot by lot Acceptance Sampling for attributes. Types of Sampling Plans. Single Sampling Plans: Construction of OC-curve, Rectifying Inspection. Double and Multiple Sampling Plans.

Quality Management Systems: ISO 9000 Series of Standards: Requirements, Implementation & Benefits. Environmental Management System: ISO 14000 series of Standards: Requirements, Implementation and Benefits.

Books Recommended

- Besterfield, D.H., Michna, C.B., Besterfield, G.H. & Sacre, M.B. (2003). Total Quality Management (3rd ed.). Pearson Education.
- James, P. (1996).Total quality management. Prentice Hall.
- Montgomery, D.C. (2009). Statistical Quality Control (6th ed.). John Wiley & Sons, New York.

Reference Books

- Evans, J.R. & Lindsay, W.M. (2005). The Management and Control of Quality (6th ed.). Thomson South-Western.
- Oakland, J.S. (2003). Total Quality Management (3rd ed.). Butterworth-Heinemann.
- Grant, E.L. & Leaven-worth, R.S. (1996). Statistical Quality Control Handbook (7th ed.). McGraw-Hill Book Company, New York.