UNIVERSITY OF KERALA

FIRST DEGREE PROGRAMME IN STATISTICS

CHOICE BASED CREDIT AND SEMESTER SYSTEM

EFECTIVE FROM 2018 ADMISSIONS
(Revised)
Aims and Objectives of the Programme

Aims:

In this programme, we aim to provide a solid foundation in all aspects of statistics and to show a broad spectrum of modern trends in statistics and to develop experimental, computational and application skills of students. The syllabi are framed in such a way that it bridges the gap between the plus two and post graduate levels of statistics by providing a more complete and logical framework in almost all areas of basic statistics. The programme also aims.

(i) to provide education in statistics of the highest quality at the undergraduate level and produce graduates of the caliber sought by industries and public service as well as academic teachers and researchers of the future.

(ii) to attract outstanding students from all backgrounds.

(iii) to provide an intellectually stimulating environment in which the students have the opportunity to develop their skills and enthusiasms to the best of their potential.

(iv) to maintain the highest academic standards in undergraduate teaching.

(v) to impart the skills required to gather information from resources and use them.

(vi) to equip the students in methodology related to statistics.

Objectives:

By the end of the second semester, the students should have:

(i) attained a common level in elementary and basic principles of statistics and laid a strong foundation in mathematics for their future courses.

(ii) developed their experimental and data analysis skills through a wide range of expertise in handling applications of statistics by their training acquired in the

statistical lab.

By the end of the fourth semester, the students should have:

(i) been introduced to powerful tools for tackling a wide range of topics in statistical methods and distribution theories

(ii) become familiar with additional relevant mathematical techniques.

(iii) further developed their experimental skills through a series of practical training imparted in the statistical lab, which is an integral apart of the proposed new curriculum.

By the end of the sixth semester, the student should have.

(i) covered a range of topics in almost all areas of statistics including a statistical inference, Sample survey, design of experiments, Operation-research, Statistical quality control and other applied areas.

(ii) had expertise and independence in handling real life applications of statistics as demonstrated in their project work.

(iii) developed their understanding of statistics as an important independent branch of scientific statistics having applications in all areas of learning.

Course Structure: Core Courses

Sem	Course title	Instruction hour per week	Credit	Total hours/Semester	Evaluation	
		L P			Internal	External
I	ST:1141 Statistical Methods I	2 2	4	72	20%	80%
II	ST:1241 Statistical Methods II(Foundation course2)	2 2	3	72	20%	80%
III	ST:1341 Probability and Distribution-I	3 2	3	90	20%	80%
IV	ST:1441 Probability and Distribution-II ST:1442 Practical I	3 2	3 3	54 36	20%	80%
V	ST:1541 Limit Theorems and Sampling Distributions ST:1542 Estimation ST:1543 Testing of Hypothesis ST:1544 Sample Survey Methods ST:1551 Open Course 1 Project	5 3 2 3 2 3 2 3 2	4 3 3 4 2	90 90 90 90 54 36	20%	80%
VI	ST:1641Design of Experiments and Vital Statistics ST:1642 Applied Statistics ST:1643 Operation Research and Statistical Quality Control ST:1644 Practical II ST:1645Practical III ST:1646 Project ST:1651 Open Course 2 ST:1661 Elective	4 3 4 2 4 2 3 3	4 4 4 4 3 4 2	126 108 108 54 54	20%	80%

Course Structure for Practical and Project for the Core Course

Sem	Title of the Paper	Duration of Exam	No. of credits	Evaluation weightage		Allotted hours	
				I.A	E.A	Per week	Per year
IV	ST:1442 Practical I	2 hrs	3	1	3	S_3-2 S_4-2	72
VI	ST:1644 Practical II ST:1645Practical III ST:1646 Project	2hrs 2 hrs	4 3 3	1 1 1	3 3 3	S_5-6 S_6-6	216

General Course Structure of the first Degree Programme in Statistics

B.Sc. Statistics Degree Programme
I Semester- Core Course 1

ST 1141: Statistical Methods I

Hours/Week: 4

Module I

Origin and meaning of Statistics: General uses, relation with other disciplines, Limitations and misuses of Statistics, Different scales of measurement, Methods of collection and editing of primary data. Designing of a questionnaire and a schedule. Sources and editing of secondary data. Classification and tabulation of data.

Module II

Diagrammatic presentation- line diagram, bar diagrams and pie diagrams. Diagrammatic representation of data, pictograms, cartograms etc., Graphical representation of frequency distribution by frequency polygon, frequency curve and ogives

Module III

Measures of central tendency-arithmetic mean, weighted arithmetic mean, median, mode, geometric mean, harmonic mean. Properties of these averages. Positional averages – quartiles, deciles and percentiles.

Module IV

Measures of dispersion- range, quartile deviation, mean deviation, standard deviation. Properties of these measures. Relative measures of dispersion – coefficient of variation.

Module V

Moments - raw and central moments and their interrelationships, Sheppard's corrections for moments for grouped data. Definition and measures of skewness and kurtosis.

Books for Study

1. Gupta S.C. and Kapoor, V.K.(1984). *Fundamentals of Mathematical Statistics*. Sultan Chand & Co., 3rd Edn, New Delhi.

2. Saxena, H.C. (1983). *Elementary Statistics*. S. Chand & Co., New Delhi.

References

1. Anderson, T.W. and Sclove, S. L. (1978). *An introduction to statistical analysis of data*. Houghton Miffin/co, USA.
2. Anderson, T.W. and Finn, J.D. (2012). *The new statistical analysis of data*. Springer Science & Business Media, New York.
3. Croxton, F.E. and Cowden, D.J. (1973). *Applied General Statistics.* Prentice Hall of India, New Delhi.
4. Kendall, M.G. (1943). *Advanced Theory Of Statistics Vol-I*. Charles Griffin: London.
5. Snedecor, G.W. and Cochran, W.G. (1967). *Statistical methods*. Iowa State University Press, United States.
6. Yule, G.U. and Kendall, M.G. (1956). *Theory and problems of statistics*. Charles Griffin, London.
7. Spiegel, M. R. (1961). *Theory and problems of statistics*. Schaum's outline series, New York.

II Semester- Core Course 2
ST 1241: Statistical Methods - II

Hours/Week: 5

Module I

Correlation- scatter diagram, Karl Pearson's coefficient of correlation and its properties, correlation ratio. Concept of rank correlation, Spearmen's rank correlation coefficient, repeated ranks, Association of attributes.

Module II

Curve fitting and principle of least squares – fitting of first degree, second degree, power curves and exponential curves. Simple regression analysis- regression equations by method of least squares, linear regression coefficients and its properties. Angle between the regression lines. Standard error, probable error, coefficient of determination, partial and multiple for three variables (without proof).

Module III – Introduction to Data Mining

Introduction. Data mining and data warehousing; Data mining and OLAP; Data
Description for data mining (Summaries and Visualization, clustering, Link Analysis) Predictive data mining: Types of predictions (Classification, Regressions and Time series)

Module IV – Data Mining models and Algorithms

Neural Networks; Decision trees; Logistic regression, Discriminant analysis, Nearest neighbour techniques.

Module V – Introduction to Excel and R (Only general introduction).

Introduction to Excel (important functions for semester 1 and semester 2), important charts, introduction to R commands useful for semester 1 and semester 2, R programs using these functions.

Books for Study

1. Eibe Frank and Mark Hall(2011). *Data mining : Practical machine learning tools and Techniques*. 3rd Edition. Elsevier India.
2. Gerald Keller (2001). *Applied Statistics with Microsoft Excel*. Duxbury press, United States.
3. Gupta S. C. and Kapoor, V. K.(1984). *Fundamentals of Mathematical Statistics*. Sultan Chand & Co., 3rd edition. New Delhi.
4. Manohar, H.L.(2017). *Data Analysis and Business Modeling using Microsoft Excel*. Prentice Hall of India, New Delhi. **ISBN -978-81-203-5288-9.**
5. Saxena. H. C.(1983). *Elementary Statistics*. S. Chand & Co., New Delhi. ISBN- 9788121909259.
6. Purohit, S.G., Deshmukh, S.R., & Gore, S.D. (2008). *Statistics using R*. Alpha Science International, United Kingdom.
7. Purohit, S.G., Deshmukh, S.R., & Gore, S.D. (2015). *Statistics using R*. Alpha Science International, United Kingdom.

References

1. Gupta, G.K. (2011). *Introduction to Data mining with case studies*. PHI. New Delhi.
2. Michael J. Craley (2013).*The R Book*, second edition, Wiley, New York.
3. Sarah E. Hutchinson-Clifford and Glen Coulthard (2001). *Advantage series: Excel 2002-brief*. Richard-D Irwin Inc., New York.
4. David W. hosmer and Stanley Lemeshow (2000). *Applied logistic Regression.* 2nd edition. Wiley series in probability and statistics, New York.
5. William R Klecka (1980). *Discriminant Analysis*. Sage publications, Inc., new York.
6. Andrew S. Tanenbaum (1996). *Computer Networks*. 3rd edition, Bratislava. ISBN-10.
7. William Stallings (2005).*Wireless communications*. Pearson Prentice Hall, UK.

Web Resources:

www.fgcu.edu/support/office2000
www.openoffice.org*Open Office web site*
www.microsoft.com/office*MS Office web site*
www.lgts.org*Office on-line lessons*
www.learnthenet.com*Web Primer*
www.computer.org/history/timeline
www.computerhistory.org
http://computer.howstuffworks.com
www.keralaitmission.org
www.technopark.org
http://ezinearticles.com/?Understanding-The -Operation-Of-Mobile -Phone –Networks & id=68259

III Semester- Core Course 3

ST 1341: Probability & Distribution – I

Hours/Week: 5

Module I

Random Experiment, Sample Space, Events, Types of Events, Mathematical andStatistical definitions of Probability, Axiomatic definition, Probability space, Elementary properties of probability, Addition theorem, Conditional Probability, Multiplication theorem, Concept of geometric probability, Baye's theorem and its applications.

Module II

Random variable, Distribution function of a random variable, Its properties, Discrete and Continuous type random variables, probability mass function and probability density function, their properties, functions of random variables, transformation of random variables.

Module III

Bivariate random variable, joint distribution function and its properties, joint probability mass function and joint probability density function and their properties, marginal and conditional distributions, independence of random variables, jacobian of transformations.

Module IV

Mathematical expectation examples, properties, addition and multiplication theorem on expectation, expectation of function of random variables, moments-univariate and bivariate, Cauchy – Schwartz inequality, correlation coefficient, conditional expectation (regression function), conditional variance, examples of random variables whose expectation do not exist.

Module IV

Generating functions– probability generating function, moment generating function, characteristic function, cumulant generating function, their properties derivation of moments from generating functions, bivariate moment generating function, examples of random variables whose moment generating function do not exist.

References:

1. Bhat, B. R., Sri. Venkata Ramana T and Rao Madhava K. S. (1977). *Statistics: A beginners Text Vol- 2*, New Age International (P) Ltd., New Delhi.
2. F. M. Dekking etal. (2005). *A Modern Introduction to Probability and Statistics*. Springer Verlag, New York.

3. Goon A. M., Gupta N.K., Das Gupta B. (1999). *Fundamentals of Statistics. Vol. 2* World Press, Kolkatta.
4. Gupta, S.C. and Kapoor, V.K. (2002). *Fundamentals of Mathematical Statistics*, Sulthan Chand, New Delhi.
5. Hogg, R.V. and Craig, A.T. (1970). *Introduction to Mathematical Statistics.* Pearson Education Pvt. Ltd, UK.
6. Mukhopadhaya, P. (1996). *Mathematical Statistics.* New Central Book Agency (P) Ltd., Calcutta.
7. Rohatgi, V. K. *An Introduction to Probability Theory and Mathematical Statistics*.Wiley eastern Limited
8. Rohatgi, V. K and Saleh, A.K.MD. (2001). *An Introduction to Probability and Statistics*. 2nd edition. John Wiley & Sons, Inc., New York.
9. Wilks, S.S. (1964). *Mathematical Statistics*, John Wiley, New York.

IV Semester- Core Course 3

ST 1441: Probability & Distribution – II

Hours/Week: 5

Module I

Discrete probability distributions -I: Degenerate distribution-mean, variance and mgf; Uniform distribution on *n* points-mean and variance; Bernoulli distribution – mean, variance and mgf; Binomial distribution, Poisson distribution – Poisson distribution as limiting case of binomial distribution, first four raw moments and central moments, beta and gamma coefficients, mgf and probability generating function, recurrence relations for the moments, mode, additive property, other simple distributional properties and fitting etc. of both binomial and Poisson. Negative binomial distribution – mean and variance, mgf, additive property.

Module II

Geometric distribution – mean and variance, mgf and probability generating function, Lack of memory property; Multinomial distribution mgf, mean, variance and covariances; Hypergeometric distribution – mean and variance.

Module III

Continuous probability distributions I-Uniform distribution-mean, variance and mgf, Integral probability transformation; Triangular distribution-mean, variance and mgf; Gamma distribution-mean and variance, mgf, additive property; Beta distribution-two types, means and variance of both types, Exponential distribution – mean, variance and mgf, Lack of memory property, application in life testing problems, double exponential distribution.

Module IV

Continuous probability distributions II - Normal distribution – raw moments and central moments, beta and gamma coefficients, mgf and characteristic function, mode and median, linear combination of independent normal variates, Standard normal distribution, its chief properties and use of standard normal tables, fitting of normal distribution. Lognormal distribution – mean and variance, skewness and kurtosis properties, application in Economics. Cauchy distribution – standard form, non-existence of mean, characteristic function (without derivation) and simple distributional properties;

Module V

Basic concepts of Multivariate Normal Distribution – Introduction to p – variate random vectors, mean vector and dispersion matrix, Multivariate normal distribution – pdf, joint characteristic function, distributions of the components of multivariate normal random vector through characteristic function, Bivariate normal distribution as a special case of multivariate normal, marginal and conditional distributions of bivariate normal distribution (with derivation)

References:

1. Bhat, B. R., Sri. Venkata Ramana, T. and Rao Madhava, K.S. (1977). *Statistics: A beginners Text Vol- 2*, New Age International (P) Ltd., New Delhi.
2. Dekking, F. M. (2005). *A Modern Introduction to Probability and Statistics: Understanding why and how*. Springer Science & Business Media., New York.
3. Goon, A. M., Gupta, N.K., Das Gupta, B. (1999). *Fundamentals of Statistics- Vol.2.* .World Press, Kolkatta.
4. Gupta, S.C. and Kapoor, V.K. (2002). *Fundamentals of Mathematical Statistics*. Sulthan Chand, New Delhi.
5. Hogg, R.V. and Craig, A.T. (1970). *Introduction to Mathematical Statistics*, Pearson Education. Pvt. Ltd. UK.
6. Mukhopadhaya, P. (1996). *Mathematical Statistics*. New Central Book Agency (P) Ltd., Calcutta.
7. Rohatgi, V.K. and Saleh, A.M.E. (2001). *An Introduction to Probability and Statistics*. 2nd edition. John Wiley & Sons, Inc, New York.
8. Rohatgi, V. K. *An Introduction to Probability Theory and Mathematical Statistics*.Wiley eastern Limited
9. Wilks S.S. (1964). *Mathematical Statistics*, John Wiley, New York.

IV Semester- Core Course 4
ST 1442: Practical I(using R -3 hours Examination)

Numerical problems based on Core Courses ST 1141: Statistical Methods I, ST 1142: Statistical Methods II, ST 1341: Probability & Distribution - I and ST 1441: Probability & Distribution - II

Five Questions are to be worked out in each sheet based on the topics in the syllabus as follows

Sheet	Title
1	Diagrams and Graphs
2	Measures of Central Tendency
3	Measures of Dispersion
4	Moments, Skewness and Kurtosis
5	Fitting of Curves
6	Probability
7	Random Variables and Mathematical Expectations
8	Bivariate Distribution
9	Discrete Probability Distributions
10	Continuous Probability Distributions

V Semester- Core Course 5

ST 1541: Limit Theorems and Sampling Distributions

Hours/Week: 5

Module I

Introduction to measure theoretic probability: Sequence of events, limit of events – limit supremum, limit infimum, monotone and continuity property of probability measure, independence of finite number and sequence of events, Borel- Cantelli lemma.

Module II

Chebychev's inequality, convergence in probability, convergence in law, Bernoulli Law of large numbers, Chebychev's weak law of large numbers, concept of central limit theorem, Lindberg-Levy Central Limit theorem, application of central limit theorem.

Module III

Sampling distributions: Concept of random sample and statistic, definition of sampling distribution, standard error; sampling distribution of the mean and variance of a sample arising from a normal distribution; –distribution-mean and variance, mgf, additive property and use of – tables;

Module IV

Non – central distributions and its basic properties (statement only), Student's - distribution- mean and variance; use of -tables; Non – central t distribution and its basic properties, F-distribution – mean and variance, use of F –tables, Non – central F distribution and its basic properties; inter-relationships between the standard normal, , and distributions.

Module V

Introduction to order statistics: Empirical distribution function, order statistic, probability distribution of r^{th} order statistic, moments of rth order statistic, probability distribution of order statistic from U(0, θ) distribution and exponential distribution, problems for 1^{st} and n^{th} order statistics only.

References:

1. Bhat, B. R. (2007*). Modern Probability Theory - An Introductory Text Book*, New Age International Publishers, New Delhi.
2. Gupta, S.C. and Kapoor, V.K. (2002). *Fundamentals of Mathematical Statistics*, Amerind Publishing Co. Pvt. Ltd., New Delhi.
3. Rohatgi, V.K. and Saleh A.M.E.(2001): *An Introduction to Probability and Statistics*. 2^{nd} edition. John Wiley and Sons, Inc, NewYork.
4. Rohatgi, V. K. *An Introduction to Probability Theory and Mathematical Statistics*.Wiley eastern Limited

V Semester- Core Course 6
ST 1542: Estimation

Hours/Week: 5

Module I

Point estimation: Problem of point estimation; parameter space, estimator andestimate– examples; Unbiasedness– examples; Consistency – examples, sufficient condition for consistency and its use.

Module II

Interval estimation-Interval estimation: basic concepts-confidence interval, confidence coefficient; Constructing confidence intervals for each of the mean, variance and proportion of a population, and for each of the difference of means and the difference of proportion of two populations.

Module III

Sufficiency – examples, Factorization theorem (statement only) and its application;Efficiency – example; Minimum variance unbiased estimator – examples. Cramer –Rao inequality (statement only) and its application; Minimum variance bound estimator – examples.

Module IV

Methods of estimation: Method of moments – examples, properties of momentestimator (statement only); Method of maximum likelihood-examples, properties oflikelihood estimator (statement only), Method of least squares -examples.

Module V

Gauss-Markov set up, Theory of linear estimation, estimability of parametric functions, Gauss-Markov theorem.

References

1. Gupta, S. C and Kapoor, V. K (2002). *Fundamentals of Mathematical Statistics.* Amerind Publishing Co. Pvt. Ltd. 3., New Delhi.
2. Hogg, R. V and Craig, A. T (1970). *Introduction to Mathematical Statistics,* Amerind Publishing Co. Pvt. Ltd., New Delhi.
3. Joshi, D.D.(1987). *Linear Estimation and Design of Experiments*. Wiley-Eastern Ltd., New Delhi.
4. Mukhopadhaya. P. (1996). *Mathematical Statistics.* New Central Book Agency (P) Ltd., Calcutta.
5. Rohatgi, V. K. *An Introduction to Probability Theory and Mathematical Statistics*.Wiley eastern Limited
6. Rohatgi, V. K and Saleh, A.K.MD. (2001). *An Introduction to Probability and Statistics*, 2nd edition. John Wiley & Sons, Inc., New York.

V Semester- Core Course 7
ST 1543: Testing of Hypothesis

Hours/Week: 5

Module – I

Statistical hypothesis – simple and composite, null and alternative hypothesis, test of hypothesis, two types of errors, level of significance, size and power of a test, critical region, power curve and power function.

Module – II

Neyman – Pearson's approach of test of hypothesis, Neyman – Pearson's lemma,most powerful test, uniformly most powerful test, derivation of test using Neyman Pearson's lemma for mean and variance of a normal population, the mean of binomial and Poisson distribution, likelihood ratio test and its properties (statement only).

Module – III

Test of significance – Large sample tests-testing the significance of a proportion,testing the equality of two proportions, testing the significance of a mean, testing the equality of two means, testing the significance of correlation coefficient, testing the significance of difference between two correlation coefficients. Tests based on chi – square distribution – testing the goodness of fit, testing the independence of attributes, testing the significance of standard deviation of a normal population.

Module – IV

Small sample tests: test based on student 't' distribution – test of significance of mean from a normal population, testing the equality of means of two normal population, testing the significance of correlation coefficient, paired 't' test. Test based on F distribution – testing the equality of variances of two normal populations.

Module – V

Non-parametric estimation-estimable parameter-degree of an estimable parameter-Kernal-U-statistic -empirical distribution function-kolmogrov-Sminorv statistic, Kolmogorov Smirnov one sample and two sample tests -sign test for one sample and two samples-run test -Wilcoxon signed rank test. Two sample problems -median test-Mann-Whitney-Wilcoxon test.

Text books

1. Goon, A. M, Gupta, M. K. and Das Gupta, B. (1986). *Fundamentals of Statistics Vol I*, 6th edition, World Press, Calcutta.
2. Rohatgi, V. K. (1984). *An Introduction to Probability Theory and Mathematical Statistics*, Wiley Eastern, New York.
3. Rohatgi, V. K and Saleh, A.K.MD. (2001). *An Introduction to Probability and Statistics*, 2nd edition. John Wiley & Sons, Inc., New York.

Reference Books

1. Goon, A. M, Gupta, M. K and Das Gupta (1994). *An outline of statistical theory Vol I*, World Press Calcutta.
2. Gupta, S. C and Kapoor, V. K(2002). *Fundamentals of Mathematical Statistics*, Sultan Chands.
3. Hogg, R.V., Craig, A.J. (2011). *Introduction to Mathematical Statistics*, 4th edition, Collier Mc Millan.
4. Mood, A.M, Graybill, F.A. and Boes, D.P. (1972). *Introduction to theory of statistics*, 3rd edition – Macgraw Hill.
5. Wilks, S. S (1962). *Mathematical Statistics*, John Wiley, New York.

V Semester- Core Course 8
ST 1544: Sample Survey Methods

Hours/Week: 5

Module I

Concepts of population and sample, sampling frame, sampling design, need forsampling, principle steps in sample survey, advantages of sample survey over census survey, probability sampling and non probability sampling, basic concepts in sampling, organisational aspects of survey sampling, sampling and non – sampling errors, sample selection and sample size.

Module II

Simple random sampling with and without replacement, estimation of populationmean and variance, expectation and variance of estimators, unbiased estimators of variances of these estimators confidence interval for population mean and variance, estimation of sample size based on desired accuracy for variables and attributes.

Module III

Stratified sampling: Concepts of stratified population, and stratified sample estimation of population mean and total, mean and variance of estimator of population mean assuming SRSWOR with in strata, proportional allocation, Optimum allocation with and without varying costs, comparison of simple random sampling with proportional and optimum allocation.

Module IV

Systematic sampling: Concepts of systematic population, systematic sample, estimation of population mean and total, expectation and variance of estimators, circular systematic sampling, comparison with stratified sampling, population with linear trend.

Module V

Ratio and regression estimators under SRSWR, ratio estimators for population mean and variance, expectation– bias – approximate variance, estimator for variance, Regression estimates of population mean and total.

Text Books

1. Cochran, W.G. (1977). *Sampling Techniques*. Wiley Eastern Ltd., New Delhi.
2. Gupta, S.C. and Kapoor V.K. (2002). *Fundamentals of applied Statistics*, Sultan Chand & Co. New Delhi.

References

1. Murthy, M.N. (1967). *Sampling theory and Methods*. Statistical Publishing Society, Calcutta.

2. Sukhatme, P.V. and Sukhatme, B.V. (1970). *Sampling Theory of Surveys with Applications*. Indian Society of Agricultural Statistics.

VI Semester: Core Course 9

ST 1641: Design of Experiments and Vital Statistics

Hours/Week: 7

Module-I

Analysis of variance for one way and two way classification layout and analysis, principles of experimentation-randomisation, replication and local control.

Module II

Basic designs: CRD, RBD(one observation per cell), LSD layout and analysis, missing plot technique for one or two missing observations, efficiency of RBD over CRD, LSD over RBD and LSD over CRD.

Module III

Factorial Experiments: Basic concepts of 2^n factorial experiments, main effects and interaction, confounding, Yates method of analysis.

Module IV

Demography, functions of vital statistics-census, registration, adhoc surveys, hospital records, life tables, measurement of mortality, crude death rate, age specific death rate, infant mortality rate, standardized death rate, complete life table, its main features, mortality rate and probability of dying.

Module V

Measurement of fertility, crude birth rate, general fertility rate, age specific birth rate, total fertility rate, gross reproduction rate and net reproduction rate.

Text Books

1. Benjamin, B(1960). *Elements of Vital Statistics*. G. Allen & Unwin, UK.
2. Gupta, S.C. and Kapoor, V.K. (2002). *Fundamentals of Applied Statistics*. Sultan Chand & Co. New Delhi.

References

1. Das, M. N. and Giri, N.C. (1979). *Design and Analysis of Experiments*. Wiley-Eastern Ltd., New Delhi.
2. Joshi, D.D. (1987). *Linear Estimation and Design of Experiment*. Wiley-Eastern Ltd., New Delhi.
3. Kemthorne, O. (2005). *Design and Analysis of Experiments*. Wiley, New York.
4. Srivastva, O.S. (1983). *A Text Book of Demography*. Stosius Inc/Advent Books Division

VI Semester: Core Course 10

ST 1642: Applied Statistics

Hours/Week:6

Module-I

Index Numbers: meaning-classification-construction of index numbers-unweighted index numbers-weighted index numbers-Laspeyre's, Paasche's, Dorbish-Bowley's, Fisher's, Marshall-Edgeworth's and Kelly's methods-Quantity index numbers.

Module-II

Test on index numbers-factor reversal test, time reversal test, circular test, chain index numbers-base shifting, splicing and deflating of index numbers. Consumer price index number.

Module-III

Time Series: concepts of time series, components of time series-additive and multiplicative models, estimation of components-measurement of trend using graphical, semi-average and moving average methods, method of least squares.

Module-IV

Measurement of seasonal variation using method of simple averages- ratio to trend method, ratio to moving average method, method of link relatives.

Module-V

Indian official statistics: Central statistical organisation-National sample survey organisation-population census-De Facto and De Jure method-economic census-agricultural statistics-world agricultural census-livestock and poultry statistics, forest statistics, fisheries

statistics, mining and quarrying statistics, labour statistics, national income statistics, methods of national income estimation, financial statistics.

Text Books:

1. Gupta, S. P(2011). *Statistical Methods* .Sultan Chand & Sons, New Delhi.
2. Kapur, J.N and Saxena, H.C. (1970). *Mathematical Statistics.* Sultan Chand & Sons, New Delhi.

References:

1. Agarwal, B.L. (1988). *Basic Statistics*. Wiley Eastern Ltd. New Delhi.
2. Gupta, S.C. and Kapoor, V.K. (2002). *Fundamentals of Mathematical Statistics.* Sultan Chand & Sons, New Delhi.

VI Semester: Core Course 11

ST 1643: Operation Research & Statistical Quality Control

Hours/Week:6

Module-I

Introduction to Operation Research (OR**)-**Linear programming problem (LPP)-formulation-solving the LPP by graphical method, basic solution, optimum solution, solving the LPP by simplex method-various cases-unbounded solution-unrestricted variables, alternative optimum.

Module-II

Need for artificial variables, two phase method, Big-M method, primal, dual-relationship, dual simplex method, transportation problem, assignment problem.

Module-III

Statistical quality control (SQC), definition of quality, quality control and statistical quality control, need for SQC techniques in industry-causes of quality variation. Control chart-uses of control chart, specification and tolerance limits- 3sigma limits, warning limits. Control charts for variables- X chart and R chart-purpose of the charts-basis of subgrouping-plotting X and R results,determining the trial control limits, interpretation of control charts.

Module-IV

Control chart for attributes, purpose of the chart-pchart-d and chart-np, construction of p and np chart-choice between chart for p and chart for np-construction of c-chart and u-chart.

Module-V

Acceptance sampling plans for attributes, producer's risk and consumer's risk. Concepts of AQL, LTPD, AOQ, AOQL, ATI and ASN- single, double and multiples sampling plans-OC curves for single and double sampling plans.

Text Books:

1. Gupta, R. C. (1974). *Statistical Quality Control*. Khanna Publishers, Delhi.
2. Kanti Swarup, Gupta, P. K and Manmohan. (1993). *Operation Research*. Sultan Chand Publishers, New Delhi.
3. Kapoor, V. K and Gupta, S. P. (1978). *Fundamentals of Applied Statistics*. Sultan Chand & Sons, New Delhi.
4. Schaum's outline series(1997): *Operation Research.*
5. Bronson, R. and Naadimuthu, G. (1997). *Schaum's Outline of Operations Research*. McGraw Hill Professional, US.

References:

1. Ekambaram, S. K. (1963). *Statistical basis of Acceptance Sampling*. Asia Publishing House.
2. Frederick, S. Hiller and Gerald, J. Lieberman. (1987). *Operations Research*. CBS Publishers &Distributors, Delhi.
3. Goel and Mittal (1982). *Operations Research*. Pragathi Prakashan, Meerut.
4. Grant, E.L. and Laven Worth, R.S. (1996). *Statistical Quality Control*. McGraw Hill.
5. Gupta, R.K. (1985). *Operations Research*. Krishna Prakashan, Mandir Meerut.
6. Hamdy, A. Taha. (1996). *Operation Research*, 6th Ed. Prentice Hall of India, New Delhi.
7. Montgomery, D.C. (1983). *Introduction to Statistical Quality Control*. John Wiley & Sons.
8. Sharma, J.K. (2001). *Operations Research-Theory and Applications*. Macmillan India Ltd.

VI Semester: Core Course 12
ST 1644: Practical II (using R -3 hours Examination)

Numerical problems based on core courses ST 1542: Estimation, ST 1543: Testing of hypothesis and ST 1544: Sample survey methods.

Five Questions are to be worked out in each sheet based on the topics in the syllabus as follows

Sheet	Title
1	Theory of Point Estimation
2	Theory of Interval Estimation
3	Testing of Hypothesis
4	Large Sample Tests
5	Small Sample Tests
6	Non Parametric Tests
7	Simple Random Sampling
8	Stratified Sampling
9	Systematic Sampling
10	Ratio and Regression Estimators

VI Semester: Core Course 13
ST 1645: Practical III (using R -3 hours Examination)

Numerical problems based on core courses ST 1641: Design of experiments and vital statistics, ST 1642: Applied statistics and ST 1643: Operation research and statistical quality control.

Five Questions are to be worked out in each sheet based on the topics in the syllabus as follows

Sheet	Title
1	Linear Estimation and Analysis of Variance
2	Design of Experiments
3	Analysis of Missing Plots
4	Vital Statistics
5	Index Numbers
6	Test on Index Numbers
7	Time Series
8	Simplex Method
9	Principle of Duality
10	Statistical Quality Control

VI Semester
ST 1646: Project

VI Semester: Open Course 2
ST 1661: Elective Course

One elective to be selected by the department from the following elective courses.

ST 1661.1 Medical statistics
ST1661.2 Stochastic processes
ST 1661.3 Inventory control and Queuing theory.

ST 1661.1 Medical Statistics

Hours/Week: 3

Module-1

Basic concepts and designs: controlled and uncontrolled clinical trials, historical controls, protocol; placebo, randomization, blind and double blind trials, ethical issues and protocol deviations.

Size of trials,multiplicity and meta- analysis, interim analysis, multi-centre trials, combining trials, crossover trials, binary response data, logistic regression modelling , McNemar's test.

Module-II

Basic concepts, survival function, hazard function, censoring. Single sample methods.Life tables. Kaplan-Meier survival curve.

Parametric models.Two sample methods, log-rank test, parametric comparisons. Regression models, Inclusion of covariates, Cox's proportional hazard model, competing risks, crossover trials and further aspects.

Module-III Epidemiology-elementary concepts

Recommended Books.

1. Altman, D. G. (1999). *Practical Statistics for Medical Research*. Chapman &Hall.
2. Atkinson, A. C and Donev, A. N. (1992). *Optimum Experimental Designs*. Oxford University Press.
3. Barnett, V. (1991). *Sample Survey-Principles and Methods*. 2nd Ed., Edward Arnold.
4. Box, G. E. P and Draper, N. R. (1987). *Empirical Model Building and Response Surface.* Wiley, New York.

5. Campbell, M. J. (2001). *Statistics at Square Two*, BMJ.
6. Collectt, D. (2003). *Modelling Survival data in Medical Research*, 2nd Ed., Chapman and Hall.
7. Cornell, J. A. (1990). *Experiments with Mixtures*,3rd Ed., Wiley New York.
8. Cox, D. R and Reid, N. (2000). *The Theory of the Design of Experiments*. Chapman and Hall, CRC London.
9. Everitt, B. S and Rabe-Heskith, S. (2001). *Analysing Medical Data Using S-Plus*. Springer.
10. Gupta, S. C and Kapoor, V. K. (1983). *Fundamentals of Statistics*. Sultan Chand and Sons, New Delhi.
11. Mathews, J. N. S. (2000). *An Introduction to Randomized Controlled Clinical Trials*. Hodder Arnold.
12. Pocock, S. J. (1983). *Clinical trials. A Practical Approach*. Wiley, New York.
13. Rohatgi, V. K. (1984). *An Introduction to Probability Theory and Mathematical Statistics*.Wiley Eastern, New Delhi.
14. Rohatgi, V. K and Saleh, A.K.MD. (2001). *An Introduction to Probability and Statistics*, 2nd edition. John Wiley & Sons, Inc., New York.
15 .Senn, S. (2003). *Dicing with Death:Chance, Risk and Health*. CUP.

ST 1661.2 Stochastic Processes

Hours/Week:3

Module-I

Collection of random variables, joint probability distributions, consistency theorem (statement only), generating function, distribution of sum of independent random variables, conditional distribution, definition of stochastic processes-examples, state space, classification of stochastic processes with examples.

Module-II

Markov process, Markov chain, transition probability, stationary transition probability, Chapman-Kolmogorov equation (proof not required), stochastic matrix, classification of states-recurrent, transient and periodic, properties, closed set of states, stationary distribution and ergodic theorem (statement only).

Poisson process-postulates, definition, examples, inter arrival times-its distributions, relation of poisson process with binomial and uniform distribution, compound poisson process-definition, examples and applications.

Module-III

Stochastic process with stationary and independent increments, stationary process-wide sense and strict sense, gaussian process. Time series, components of time series, first order auto regressive process, auto correlation.

Branching process-definition, discrete time and discrete state branching process-examples, probability generating function, probability of extinction.

Text Books and References

1. Bailey, N. T. J. (1964). *Elements of Stochastic Process with Applications to the Natural Sciences*. Wiley, New York.
2. Bartlett, M. S. (1955). *An Introduction to Stochastic Processes*. Cambridge University Press.
3. Box, G. E. P and Jenkins, G. M. (1976). *Time Series Analysis: Forecasting and Control*. Holden-Day, San Francisco.
4. Medhi, J. (1984). *Stochastic Processes*. Wiley Eastern Ltd, New Delhi.
5. Samuel Karlin (1972). *A First Course in Stochastic Process*. Academic Press, NewYork.

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ST 1661.3 Inventory Control and Queuing Theory

Hours/Week: 3

Module-I

Introduction, terminologies connected with Inventory control, costs associated with inventories, factors affecting inventory control, Economic order quantity (EOQ).Deterministic inventory problem with no shortages, deterministic inventory problem with shortages, EOQ problem with price breaks, Inventory problem with uncertain demand, probabilistic inventory control. News paper boy problem.

Module-II

Queuing system, elements of a queuing system, operating characteristics, pure birth and death models, classification of queuing models, transient and steady state, Kolmogorov differential equations.

Module-III

Poisson queues M|M|1 with infinite channel capacity and limited channel capacity, Non-Poisson queuing system, examples, cost models in queuing.

References

1. Hamdy A Taha,(1996). *Operation Research An Introduction*. Prentice Hall of India, New Delhi.
2. Kanthi Swarup, P.K, Gupta, Manmohan, (1993). *Operations Research*. Sultan Chand & Sons, New Delhi.
3. Mustafi, C.K.(1996). *Operations Research Methods and Practices*. New Age International Publishers, New Delhi.
4. Rao, S.S. (1984). *Optimization theory and Applications*. New Age International Publishers, New Delhi.

Open Courses for other Degree Programmes

ST 1551.1: Statistics and Research Methodology

Hours/Week: 3

Module-I

Concept and objectives of research, types of research, research methods v/s research methodology, steps involved in scientific research, flow chart of research process, formulation of research problems, literature survey, formulation of hypothesis, preparation of research design/research plan.

Variables, data, types of variables-nominal and ordinal, qualitative and quantitative, discrete and continuous, cross sectional and time series, univariate and multivariate attributes.

Measurement and scaling-motivation of scaling, different types of scaling-nominal, ordinal, ratio and interval, scaling of rates and ranks, scaling of judgements.

Module-II

Definition of statistics, role of statistics in research methodology, primary and secondary data, population and sample, sampling frame, census and sampling surveys, methods of collecting primary data, observational method, interview method, questionnaire and schedule method, local correspondents methods. Designing a questionnaire and schedule, collection of secondary data, selection of appropriate method for data collection. Sampling design, various types of sampling designs, sampling and non sampling errors, selection of sample size, steps in sampling design, collection of data, scrutiny of data.

Module-III

Representation of data, classification and tabulation, bar chart, pie chart, histogram, box plot, stem and leaf diagram, frequency curve, scatter plots. Descriptive measures-mean , standard deviation, Testing of hypothesis, hypothesis, types of errors, p-value, one tailed and two tailed test, Interpretation of results and report writing-meaning of interpretation, need of interpretation types of report, different steps in report writing, lay out of research report, precautions for writing research reports.

References

1. Bhattacharya and Sreenivas (1972). *Psychometrics and Behavioural Research*. Sterling Publishers, P. Ltd.
2. Gopal, M. H. (1964). *An Introduction to Research Procedure in Social Sciences*. Asia Publishing House, Mumbai.

3. Kothari, C. R. (2001). *Research Methodology-Methods and Techniques*, 2nd Ed. Viswa Prakashan, New Delhi.
4. Torgerson, W. (1958). *Theory and methods of Scaling*. John Wiley and Sons, New York.

ST 1551.2: Stochastic Processes

Hours/Week:3

Module-I

Definition of stochastic processes, examples, state space, time space, classification of stochastic processes with examples. Markov process, Markov chain, transition probability, stationary transition probability, Chapman-Kolmogorov equation (proof not required). Stochastic matrix, classification of states-recurrent, transient and periodic, properties, closed set states, stationary distribution, ergodic theorem (statement only).

Module-II

Stochastic process with stationary and independent increments, stationary process-wide sense and strict sense, examples, Gaussian processes. Time series, components of time series, auto regressive process, moving average process, auto correlation, spectral density. Applications.

Module-III

Poisson process-postulates, definition, examples, inter arrival time-its distributions, relation of Poisson process with binomial and uniform distribution, compound Poisson process-definition, examples and applications.

References

1. Bailey, N. T. J. (1964). *Elements of Stochastic Process with Applications to the Natural Sciences*. Wiley, New York.
2. Bartlett, M. S. (1955). *An Introduction to Stochastic Processes*. Cambridge University Press.
3. Box, G. E. P and Jenkins, G. M. (1976). *Time Series Analysis: Forecasting and Control*. Holden-Day, San Francisco.
4. Medhi, J. (1984). *Stochastic Processes*. Wiley Eastern Ltd, New Delhi.
5. Samuel Karlin (1972). *A First Course in Stochastic Process*. Academic Press, New York.

ST 1551.3: Design of Experiments

Hours/Week: 3

Module-I

Concepts of design of experiments, linear estimation, estimability of parametric function, Gauss-Markov setup, Gauss-Markov theorem, need for design of experiments, principles of experimentation-randomisation, replication and local control.

Module-II

Analysis of variance (ANOVA)-one way and two way classification models, ANOVA tables.

Module-III

Basic designs: C.R.D and R.B.D lay out, missing plot techniques for one missing observation. L.S.D layout, missing plot technique for one missing observations.

References

1. Das and Giri. (1979). *Design and Analysis of Experiments*. New Age, International (P) Ltd.
2. S. C. Gupta and V.K. Kapoor(2002). *Fundamentals of Applied Statistics*. Sultan Chand & Co. New Delhi.
3. D. D. Joshi. (1987). *Linear Estimation and Design of Experiments*
4. Federer: *Design of Experiments.*

ST 1551.4: Official Statistics

Hours/Week: 3

Module-I Statistical Organisation and Vital Statistics

Introduction to Indian statistical systems role, function and activities of Central and State statistical organisations. Organisation of large scale sample surveys. Role of National Sample Survey Organisation. General and special data dissemination systems.

Rates and ratios of vital events. Mortality and fertility, measurement of mortality and fertility.Mortality table, stationary and stable population.

Module-II Index Numbers

Index numbers-its definition, application of index numbers, price relatives and quantity or volume relatives, link and chain relatives. Problems involvedin computation of index numbers. Use

of averages, simple aggregative and weighted average methods. Laspeyre's, Paasche's and Fisher's index numbers. Time and factor reversal test of index numbers. Consumer price index.

Module-III Time Series Analysis

Time series-definition, its different components, illustrations, additive and multiplicative models, determination of trend, growth curves, analysis of seasonal fluctuations, construction of seasonal indices.

References

1. Chat filed, C. (1980). *The Analysis of Time Series-An Introduction*. 2nd Ed., Chapman and Hall.
2. Cox, P. R. (1957). *Demography*. Cambridge University Press.
3. Goon, A. M., Gupta, M. K and Desgupta, B. (1986). *Fundamentals of Statistics*; Vol.II. World Press, Calcutta.
4. Mukhopadhay, P. (1999). *Applied Statistics*. New Central Book Agency Pvt. Ltd. Calcutta.
5. Ramakumar, R. (1986). *Technical Demography*. Wiley Eastern.
6. *Basic Statistics Relating to the Indian Economy* (CSO) 1990.
7. *Guide to Official Statistics* (CSO) 1995.
8. *Statistical System in India* (CSO) 1995.

ST 1551.5: Time Series & Forecasting

Hours/Week: 3

Module-I

Time series analysis, utility of time series data-four components, adjustments for various changes, models of time series.Estimation of trend-methods-freehand drawing, semi-averages, moving averages, least squares (linear, quadratic and exponential)-Detrending a time series.

Module II

Estimation of seasonal variation-methods of construction of seasonal index-average method, ratio to trend method, link relative method, Deseasonalisation. Estimation of cyclical variation-residual method, direct method, reference cycle analysis method, harmonic analysis method. Estimation of irregular variations.

Module III

Business forecasting and its importance, Methods of forecasting, linear trend, regression (single & double), ARIMA models (Box-Jenkins method-not to be examined). Computer based forecasting (understanding of the use of software in analysis). Interpretation of of outputs expected.

References

1. D. N. Elhance, Veena Elhance & B. M. Agarwal, Kitab(1995).*Fundamentals of Statistics*, Mahal Publications.
2. S. C. Gupta & V. K. Kapoor(2002), *Fundamentals of Applied Statistics*, Sultan Chand & Sons.
3. Parimal Mukhophadyay(1998).*Applied Statistics*.
4. G. V. Shenoy & Madan Paul.,*Statistical Methods in Business and Social Sciences*.

ST 1551.6: Statistics for Psychology and Education

Hours/Week: 3

Module-I

Introduction-scope and limitations of statistics, elements of sample survey, preparation of questionnaire, variables and constants-scales of measurements-derived scores-translating raw scores to standard scores-score transformation, percentile scores, comparability of scores, normalized standard scores, methods of estimating reliability, factors affecting reliability.

Module-II

Correlation techniques applied in evaluation of test materials, Karl Pearson's coefficient of correlation, Spearman's rank correlation, biserial correlation, point biserial correlation, tetrachoric correlation, partial correlation, phi coefficient.

Module-III

Tests of association-chisquare-contigency coefficient, Fisher's exact test, Yule's Q-tests of hypothesis, basic concepts (an overview of parameteric and non-parametric tests). Non- parametric test-sign tests-run test-median test-Mann-Whitney U test-Wilcoxon signed rank test (Interpretation of results expected).

References

1). Y. P. Agarwal(1986).*Statistical Methods, Concepts, Application and Computation*, Sterling Publications.

2) Edward. W. Minium, Bruce. M. King, Gorden Bear(2002).*Statistical Reasoning in Psychology and Education.* John wiley and Sons.

3). H. E. Garrett(2006). *Statistics in Psychology & Education.*

ST 1551.7: Econometric Methods

Hours/Week: 3

Module I

Basic concepts, definition and scope of econometric methods, economic models, examples, types of variables.

Normal distribution-definition and properties, correlation and regression-simple and multiple, least square method of estimation.

Module II

Simple linear model, estimation of parameters, ordinary least square method, maximum likelihood method, properties of estimators, confidence interval and hypothesis testing.

Module III

General linear model-assumptions, least square estimators, confidence interval and hypothesis testing, multicollinearity-meaning and consequences. Generalized least square estimators, auto correlation, tests for autocorrelation, hetroscedasticity, dummy variables and lagged variables (concepts only).

References

1. Gujarathi, D. (1979). *Basic Econometrics*. McGraw Hill.
2. Johnston, J. (1984). *Econometric Models*, 3rd edition. McGraw Hill.
3. Koutsoyiannis, A. (1979). *Theory of Econometrics*. Mac million Press.
4. Madanani, G. M. K. (2005). *Introduction to Econometrics Principles and Applications*, 7th edition. Oxford and IBH Publishing Co. Pvt. Ltd.

ST 1551.8: Essential Statistics for Social Sciences

Hours/Week: 3

Module I

Basic statistics, Definition and functions of statistics. Importance of statistics to social research, elements of sample survey, preparation of questionnaire, opinion polls, Gallop polls etc. Classification and tabulation-frequency tables and its diagrammatic & graphical representations. Ratio proportion and percentage.

ModuleII

Measures of central tendency- mean, median, mode, percentiles and percentile score. Measures of variability, absolute and relative measures. Correlation and regression.

Module III

Simple concepts of probability. Binomial, Poisson and Normal distributions. (simple problems and basic concepts without derivations), **C**ontingency tables & tests of association, interpretation of results, Basic concepts of Testing of hypothesis, Concepts of parametric-non parametric tests, non parametric tests-Sign test (one sample and two samples), Run, Median, Wilcoxon sign test, K-S test(one sample and two samples), Kruskal-Wallis test, Fried man two way analysis of variance, (name and applications only without any problem and derivation)

References

1. Blalock, H. M and Blalck(1971)., *Methodology in Social Research*-: Mc Graw-Hill.
2. Gillespie, D. F & Gilisson, C. (1992), *Quantitative Methods in Social Work*, Binglamton.
3. Kirk Elifson, Richard. P. Runyon, Andrey Haber(1998)., *Fundamentals of Social Statistics*, 3rd Ed. Mc Graw Hill- International Edition.
4. Weinbach, R. W & Grinnel, R. M. (1997). *Statistics for Social Work*-New York.

ST 1551.9: Statistics for Humanities

Hours/Week: 3

Module I

Statistics-introduction-origin & growth of statistics, function of statistics, scope of statistics, statistical methods, statistics & computers-organizing a statistical survey, introduction, planning the survey, executing the survey. Collection of data-introduction, primary & secondary data, methods of collecting primary data, preparation of questionnaire, source of secondary data, editing primary and secondary data.

Module II

Classification and tabulation of data-meaning and objective of classification-types of classification-tabulation of data-types of tables. Formation of descrete and continuous frequency distribution. Diagramatic and graphic representation of data. Significance of diagrams and graphs. General rules for constructing diagrams.

Module III

Descriptive Statistics: Measures of central tendency, measures of variation (absolute and relative measures). Lorenz curve. Correlation and tests of association, multivariate statistical tests for establishing disputed authorship and such problems.

References

1) Blalock, H. M and Blalock,(1971). *Methodology in Social Research*., Mc Graw-Hill.
2) D. N Elhance, Veena Elhance and B. M Agarwall. Kitab(1995). *Fundamentals of Statistics*. Mahal Publications.
3) G. V. Shenay, Madan Pant.*Statistical Methods in Business and Social sciences*. Macmillan India Ltd.

ST 1551.10: Geostatistics

Hours/Week: 3

Module I

Elementary statistics-population, sample, variable, parameter, basic steps in statistical study. Processing a categorical data set and a quantitative data set. Measures of central tendency-mean, median and mode. Measures of dispersion-range, quartile deviation, standard deviation. Relative measures. Illustration using ecological and geographical data. Analysis of sequence of data, geological measures in sequences. Least square methods and regression analysis. Auto correlation and cross correlation (basic concepts only). Illustration using geological and geographical data.

Module II

Elements of probability theory-random experiments, sample space, events, definition of probability-classical and relative frequency definition. Addition and multiplication theorem (statement s only). Baye's theorem (statement only) and applications. Random variables, expectation, basic distributions-binomial, Poisson and normal (basic concepts only). Illustration using geological data.

Module III

Tests of significance-basic concepts of statistical inference, standard error, large sample tests and small sample tests for population mean, variance (one or two sample). Analysis of variance-one way and two way classification. Illustration using geographic data. Analysis of multivariate data-discriminant analysis, cluster analysis, factor analysis (basic concepts and examples). Illustration using R/Minitab/etc.

References

1. Cheeney, R. F(1983). Statistical Methods in Geology.
2. Davis, J. C. (2002). *Statistics and Data Analysis in Geology*. 3rd Ed. John Wiley (Chapters 2, 4 & 6).
3. Miller, R. L. and Khan, T. S. (1962). *Statistical Analysis in the Geological Analysis*. Wiley
4. Nebendu Pal and Sahadeb Saikar (2008).*Statistics Concepts and Applications*. Prentice Hall of India. Chapters (1, 2, 3, 4, 5).

ST 1551.11: Data Analysis

Hours/Week: 3

Module I

Classification, tabulation, charts, graphical representation, use of statistical packages (SPSS) to describe the above, stages of processing interpretations, computation of statistical constants, measures of central tendency, measures of dispersion, skewness, kurtosis, correlation, interpretations.

Module 2

Partial and multiple correlation, simple and multiple regression, testing the significance of partial and multiple correlation. Use of statistical packages interpretations.

Module 3

Parametric tests-Normal test, chi-square test, t-test, F-test, ANOVA (one way and two way). Non-parametric tests-chi square test, Mann-Whitney test, Wilcoxon test, Kruskal-Wallis test, Friedman test. Use of statistical packages (SPSS) interpretations.

References

1. Agarwall, B. L(2009). *Basic Statistics*. Wiley Eastern, Ltd. New Delhi.
2. Gupta, S. C and Kapoor, V. K. (2002). *Fundamentals of Mathematical Statistics*, 11th Ed. Sultan Chand & Sons, New Delhi.
3. Gupta, S. P(2011). *Statistical Methods*. Sultan Chand & Sons, New Delhi.