Proposed Statistics Syllabus

for

B.Sc. Program
Physical Sciences/ Mathematical Sciences

submitted to

Faculty of Mathematical Sciences
University of Delhi,
Delhi-110007

under the

Choice Based Credit System

Department of Statistics
University of Delhi
Delhi-110007

Proposed Scheme for Choice Based Credit System
in

B.Sc. Program Physical Sciences/ Mathematical Sciences

Semester	Core Course (12)	Ability Enhancement Compulsory Course (AECC) (2)	Skill Enhancement Course (SEC) (2)	Discipline Specific Elective (DSE) (6)
1	DSC – 1 A	**AECC1**		
	DSC – 2 A			
	DSC – 3 A			
2	DSC – 1 B	**AECC2**		
	DSC – 2 B			
	DSC – 3 B			
3	DSC – 1 C		**SEC-S1**	
	DSC – 2 C			
	DSC – 3 C			
4	DSC – 1 D		**SEC-S2**	
	DSC – 2 D			
	DSC – 3 D			
5			**SEC-S3**	**DSE 1A**
				DSE 2A
				DSE 3A
6			**SEC-S4**	**DSE 1B**
				DSE 2B
				DSE 3B

Core Courses (DSC)

Core 1: Descriptive Statistics and Probability Theory

Core 2: Statistical Methods

Core 3: Statistical Inference

Core 4: Sample Surveys and Design of Experiments

Skill Enhancement Courses (SEC)

SE 1: Data Analysis using Software

SE 2: Statistical Computing using C

SE 3: Statistical Simulation

SE 4: Statistical Techniques for Research Methods

Discipline Specific Electives (DSE)

DSE 1 (choose one)

DSE 1- (i) Vital Statistics

DSE 1 – (ii) Quality Control

DSE 2 (choose one)

DSE 2 – (i) Index Number and Time Series Analysis

DSE 2 – (ii) Econometric Theory

Details of Courses under B.Sc. Program Physical Sciences/ Mathematical Sciences

Course		***Credits**
Theory + Practical	Theory + Tutorials	
I. Core Course	12×4 = 48	12×5 = 60 (12 Papers)
04 Courses from each of the		
03 disciplines of choice		
Core Course Practical / Tutorial*	12×2 = 24	12×1 = 12
(12 Practical/ Tutorials*)		
04 Courses from each of the		
03 Disciplines of choice		
II. Elective Course	6×4 = 24	6×5 = 30
(6 Papers)		
Two papers from each discipline of choice including paper of interdisciplinary nature.		
Elective Course Practical / Tutorials*	6×2 = 12	6×1 = 6
(6 Practical / Tutorials*)		
Two Papers from each discipline of choice including paper of interdisciplinary nature		

• Optional Dissertation or project work in place of one Discipline elective paper (6 credits) in 6th Semester

III. Ability Enhancement Courses

1.**Ability Enhancement Compulsory**	2×2 = 4	2×2 = 4 (2 Papers of 2 credits each)
Environmental Science		
English/MIL Communication		

2. **Skill Enhancement Course**	4×2 = 8	4×2 = 8
(Skill Based) (4 Papers of 2 credits each)		
	Total credit = 120	**Total credit = 120**

Institute should evolve a system/policy about ECA/ General Interest/ Hobby/ Sports/ NCC/ NSS/ related courses on its own.

***wherever there is practical there will be no tutorials and vice-versa.**

Structures of Core Courses, Skill Enhancement Courses and Discipline Specific Elective Courses in B.Sc. Program Statistics

CORE COURSES STRUCTURE

Semester	Papers	Page No.
1	Core 1: Descriptive Statistics and Probability Theory	1-2
2	Core 2: Statistical Methods	3-4
3	Core 3: Statistical Inference	5-6
4	Core 4: Sample Surveys and Design of Experiments	7-8

SKILL ENHANCEMENT COURSES STRUCTURE

Semester	Papers	Page No.
3	SE 1: Data Analysis using Software	9-9
4	SE 2: Statistical Computing using C	10-11
5	SE 3: Statistical Simulation	12-12
6	SE 4: Statistical Techniques for Research Methods	13-13

DISCIPLINE SPECIFIC ELECTIVE COURSES STRUCTURE

Semester	Papers	Page No.
5	DSE 1-(i): Vital Statistics DSE 1-(ii): Statistical Techniques for Quality Control	14-14 15-15
6	DSE 2-(i): Index Number and Time Series Analysis DSE 2-(ii): Econometrics	16-17 18-18

Core 1: Descriptive Statistics and Probability Theory

Concepts of a statistical population and sample from a population, quantitative and qualitative data, nominal, ordinal and time-series data, discrete and continuous data. Presentation of data by tables and by diagrams, frequency distributions for discrete and continuous data, graphical representation of a frequency distribution by histogram and frequency polygon, cumulative frequency distributions (inclusive and exclusive methods).

Measures of location (or central tendency) and dispersion, moments, measures of skewness and kurtosis, cumulants. Bivariate data: Scatter diagram, principle of least-square and fitting of polynomials and exponential curves. Correlation and regression. Karl Pearson coefficient of correlation, Lines of regression, Spearman's rank correlation coefficient, multiple and partial correlations (for 3 variates only).

Random experiment, sample point and sample space, event, algebra of events, Definition of Probability - classical, relative frequency and axiomatic approaches to probability, merits and demerits of these approaches (only general ideas to be given). Theorem on probability, conditional probability, independent events. Baye's theorem and its applications.

REFERENCES:

1. J.E. Freund (2009): *Mathematical Statistics with Applications*, 7th Ed., Pearson Education.
2. A.M. Goon, M.K. Gupta and B. Dasgupta (2005): *Fundamentals of Statistics*, Vol. I, 8th Ed., World Press, Kolkatta.
3. S.C. Gupta and V.K. Kapoor (2007): *Fundamentals of Mathematical Statistics*, 11th Ed., Sultan Chand and Sons.
4. R.V. Hogg, A.T. Craig and J.W. Mckean (2005): *Introduction to Mathematical Statistics*, 6th Ed., Pearson Education.
5. A.M. Mood, F.A. Graybill and D.C. Boes (2007): *Introduction to the Theory of Statistics*, 3rd Ed., Tata McGraw Hill Publication.

LIST OF PRACTICALS:

1. Problems based on graphical representation of data: Histograms (equal class intervals and unequal class intervals), Frequency polygon, Ogive curve.
2. Problems based on measures of central tendency using raw data, grouped data and for change of origin and scale.
3. Problems based on measures of dispersion using raw data, grouped data and for change of origin and scale.
4. Problems based on combined mean and variance and coefficient of variation
5. Problems based on Moments using raw data, grouped data and for change of origin and scale.
6. Relationships between moments about origin and central moments
7. Problems based on Skewness and kurtosis

8. Karl Pearson correlation coefficient (with/ without change of scale and origin).
9. Lines of regression, angle between lines and estimated values of variables
10. Lines of regression and regression coefficients
11. Spearman rank correlation with /without ties
12. Fitting of polynomials and exponential curves

Core 2: Statistical Methods

Random variables: Discrete and continuous random variables, p.m.f., p.d.f. and c.d.f., illustrations of random variables and its properties, expectation of random variable and its properties. Moments and cumulants, moment generating function, cumulants generating function and characteristic function. Bivariate probability distributions, marginal and conditional distributions; independence of variates (only general idea to be given). Transformation in univariate and bivariate distributions.

Point (or degenerate), Binomial, Poisson, Geometric, Negative Binomial, Hypergeometric, Normal, Uniform, Exponential, Beta and Gamma distributions.

Markov inequality, Chebychev's inequality, WLLN and SLLN: Statements and applications, Central limit theorem (CLT) for i.i.d. variates, and its applications.

REFERENCES:

1. A.M. Goon, M.K. Gupta and B. Dasgupta (2003): *An outline of Statistical Theory* (Vol. I), 4th Ed., World Press, Kolkata.
2. S.C. Gupta and V.K. Kapoor (2007): *Fundamentals of Mathematical Statistics*, 11th Ed., Sultan Chand and Sons.
3. R.V. Hogg, A.T. Craig, and J.W. Mckean (2005): *Introduction to Mathematical Statistics*, 6th Ed. Pearson Education.
4. A.M. Mood, F.A. Graybill and D.C. Boes (2007): *Introduction to the Theory of Statistics*, 3rd Ed., Tata McGraw Hill Publication.
5. V.K. Rohtagi and A.K. Md. E. Saleh (2009): *An Introduction to Probablity and Statistics*, 2nd Edition, John Wiley and Sons.
6. S.A. Ross (2007): *Introduction to Probability Models*, 9th Ed., Academic Press.

LIST OF PRACTICALS:

1. Fitting of binomial distributions for n and p = q = ½ and for n and p given.
2. Fitting of binomial distributions computing mean and variance
3. Fitting of Poisson distributions for give n and λ and after estimating mean.
4. Fitting of negative binomial
5. Fitting of Suitable distribution
6. Application Problems based on Binomial distribution
7. Application problems based on Poisson distribution
8. Application problems based on negative binomial distribution
9. Problems based on Area property of normal distribution
10. Application based problems based on normal distribution
11. Fitting of normal distribution when parameters are given/ not given.

Core 3: Statistical Inference

Definitions of random sample, parameter and statistic, null and alternative hypotheses, simple and composite hypotheses, level of significance and probabilities of Type I and Type II errors, power of a test and critical region. Sampling distribution of a statistic, sampling distribution of sample mean, standard error of sample mean.

Large sample tests for single mean, difference of means**,** standard deviation and difference of standard deviations. Sampling distributions of chi-sq, t and F: definitions, properties and relationships between them. Tests of Significance based on Chi-square (goodness of fit and independence of attributes), t distribution and F- distribution using classical and p-value approach.

Estimation: Parameter space, sample space, point estimation, requirement of a good estimator, consistency, unbiasedness, efficiency, sufficiency, Minimum variance unbiased estimators. Cramer-Rao inequality: statement and application, Methods of estimation: maximum likelihood, least squares and minimum variance, statement of Rao-Blackwell theorem and Lehmann-Scheffe theorem. Properties of maximum likelihood estimators (illustration). Interval Estimation: confidence intervals for the parameters of normal distribution, confidence intervals for difference of mean and for ratio of variances.

Neyman-Pearson lemma and MP test: statements and applications.

REFERENCES:

1. G. Casella and R.L. Berger (2002): *Statistical Inference,* 2nd Ed., Thomson Duxbury.
2. E.J. Dudewicz and S.N. Mishra (1988):*Modern Mathematical Statistics*, John Wiley and Sons.
3. A.M. Goon, M.K. Gupta and B. Dasgupta (2003): *An Outline of Statistical Theory* (Vol. I), 4th Ed., World Press, Kolkata.
4. S.C. Gupta and V.K. Kapoor (2007): *Fundamentals of Mathematical Statistics*, 11th Ed., Sultan Chand and Sons.
5. R.V. Hogg, A.T. Craig and J.W. Mckean (2005): *Introduction to Mathematical Statistics*, 6th Ed. Pearson Education.
6. V.K. Rohtagi and A.K. Md. E. Saleh (2009): *An Introduction to Probablity and Statistics*, 2nd Ed., John Wiley and Sons.

LIST OF PRACTICALS:

1. Large Sample Tests (Based on normal distribution)
2. Testing of goodness of fit
3. Testing of independence of attributes based on 2 X 2 contingency table
4. Testing of equality of two populations variances
5. Applying the paired t-test for difference of means
6. Maximum Likelihood Estimation

7. Confidence interval for Binomial proportion
8. Confidence interval for the difference of proportions
9. Confidence interval for difference of population means
10. Confidence interval for ratio of variances
11. Type I and Type II errors
12. Most powerful critical region (NP Lemma)

Core 4: Sample Surveys and Design of Experiments

Sample Surveys: Basic concepts of sample survey: concept of sampling, need for sampling, complete enumeration v/s. sampling, principles of sampling theory, principal steps in a sample surveys, planning and organization of a sample survey, sampling and non-sampling errors. Simple random sampling (srswr and srswor): definition and procedures of selecting a sample, properties of simple random sample, estimation of mean and sampling variance of sample mean.

Stratified random sampling: introduction, estimation of population mean and its variance, choice of sample sizes in different strata, comparison of stratified sampling under proportional and Neyman allocation with SRSWOR in terms of precision. Systematic sampling: introduction to linear systematic sampling, estimation of sample mean and its variance (N=nk), comparison of systematic sampling with srswor in terms of mean squares.

Analysis of variance: one-way and two-way classified data with one observation per cell only.

Design of experiments: Principles of Design of experiments, uniformity trails, completely randomized, Randomized block and Latin square designs. Missing plot technique, 2^2 and 2^3 Factorial experiments: construction and analysis.

Indian Official Statistics: Present Official Statistical System in India relating to census of population, agriculture, industrial production, and prices; methods of collection of official statistics, major publications, their reliability and limitations. Agencies responsible for the data collection- C.S.O., N.S.S.O., Office of Registrar General: historical development, main functions and important publications.

REFERENCES:

1. A.M. Goon, M.K. Gupta, and B. Dasgupta (2005): *Fundamentals of Statistics* (Vol. II), 8th Ed., World Press, Kolkata.
2. A.M. Goon, M.K. Gupta and B. Dasgupta (2005): *An Outline of Statistical Theory* (Vol. II), 3rd Ed., World Press, Kolkata.
3. S.C. Gupta and V.K. Kapoor, *Fundamentals of Applied Statistics*, 4th Ed., Sultan Chand and Sons, 2008.
4. D.C. Montgomery (2001): *Designs and Analysis of Experiments*, John Wiley and Sons, New York.
5. P. Mukhopadhyay (1998): *Theory and Methods of Surveys Sampling*, Prentice Hall of India.
6. P.V. Sukhatme, B.V. Sukhatme, S. Sukhatme and C. Ashok (1984): *Sampling Theory of Surveys with Applications*, Lowa State University Press, Lowa, USA.
7. Guide to current Indian Official Statistics, Central Statistical Office, GOI,New Delhi.
8. http://mospi.nic.in/

LIST OF PRACTICALS:

1. To select a SRS with and without replacement
2. For a population of size 5, estimate population mean, population mean square and population variance. Enumerate all possible samples of size 2 by wr and wor and establish all properties relative to SRS
3. For srswor, estimate mean, standard error, the sample size
4. Stratified Sampling: allocation of sample to strata by proportional and Neyman's methods Compare the efficiencies of above two methods relative to SRS
5. Estimation of gain in precision in stratified sampling
6. Comparison of systematic sampling with stratified sampling and SRS in the presence of a linear trend
7. Analysis of an one way/ two way ANOVA
8. Analysis of a CRD, RBD.
9. Analysis of a LSD.
10. Analysis of an RBD with one missing observation
11. Analysis of an LSD with one missing observation
12. Analysis of 2^2 and2^3 factorial in CRD and RBD

SE 1: Data Analysis using Software

This course will review topics in probability and statistics studied in core for data analysis. Introduction to SPSS/R for statistical computing, analysis and graphical interpretation would be done using software skills. The following problems can be done on any one of the statistical software to enhance data analysis skills using software.

Graphical representation of data by histograms, frequency polygon, Pie chart, ogives, boxplot and stem-leaf. Measures of central tendency, dispersion.

Fitting of polynomials, exponential curves and plotting of probability distributions. Correlation and regression. Testing of hypothesis.

REFERENCES:

1. Gardener, M (2012) Beginning R: The Statistical Programming Language, Wiley Publications.
2. Cunningham, B.J (2012): Using SPSS: An Interactive Hands-on approach

SE 2: Statistical Computing using C

C language: Structure of C program. Data type: Basic data types, Enumerated data types, Derived data types. Variable Declaration, Assignment of variables. Numeric, Character, real and string constants. Different type of operators and expressions, Basic input/output. Standard header files, Library functions. String functions.

Conditional statements, if...else, Nesting of if....else, elseif ladder, switch statements, Loops in C: for, while, do... while loops. break, continue, exit( ), goto and label declarations.

Arrays, Functions, classification of functions, functions definition and declaration, assessing a function, return statement. Parameter Passing in functions, recursion in Functions.

Programs in C should be based on computational techniques in Statistics.

REFERENCES:

1. Balagurusamy, E. (2011): Programming in ANSI C, 6th Edition, Tata McGraw Hill.
2. Forouzan, B.A. and Gilberg, R.F. (2007): Computer Science – A Structured Programming Approach Using C. (3rd Edition). Thompson Course Technology
3. Gottfried, B.S. (1996): Schaum's Outline of Programming with C, 2nd Edition, McGraw Hill.
4. Kanetakar, Y. (2008): Let us C, BPB Publications.

LIST OF PRACTICALS:

1. Plot of a Graph of $y = f(x)$; $f(x) = x$, $f(x) = \exp(-x^2/2)$
2. Roots of a quadratic equation (with imaginary roots also)
3. Sorting of an array
4. Mean, Median and Mode of a Grouped Frequency Data
5. Variance and coefficient of variation of a Grouped Frequency Data
6. Preparing a frequency table
7. Value of n! using recursion
8. Random number generation from Uniform, Exponential, Normal, Beta and Gamma distribution
9. Matrix Addition, Subtraction, Transpose, Trace and Multiplication.
10. fitting of binomial and Poisson distribution, goodness of fit
11. Chi-square test goodness of fit
12. chi-square contingency table
13. t-test for two means
14. Paired t-test
15. F-ratio test

16. Multiple ad Partial correlation.
17. Rank Correlation (find Ranks also) without ties
18. Fitting line of regression

SE 3: Statistical Simulation

This course demonstrates to the student how computers may be used to simulate the behavior of real world systems by utilizing mathematical models with an emphasis on discrete system simulation. The simulation projects will be done using simulation software packages and structured programming languages.

Introduction: Need for simulation, general principles, advantages and disadvantages of simulation, Monte Carlo simulation technique.

Random numbers, random-variate generation, input modeling, verification and validation of simulation models, output analysis.

REFERENCES:

1. T.A. Payer, Introduction to Simulation, McGraw Hill.
2. J. Reitman (1971): Computer Simulation Application, Wiley.

SE 4: Statistical Techniques for Research Methods

Statistics is the science and practice of developing human knowledge through the use of empirical data expressed in quantitative form. There are basic steps depending on the subject matter and researcher. Research is structural and to conduct researchers use pre-collected data, called secondary data analysis. This course would help the student to understand the use of both primary as well as secondary data and various techniques to collect the data, analyze the data and interpret the results thereafter.

Introduction: meaning, objection and motivation in research, types of research, research approach, significance of research. Research problems: Definition, selection and necessity of research problems, techniques in defining a research problem.

Survey methodology and data collection: introduction, inference and error in surveys, the target populations, sampling frames and coverage error, methods of data collection, nonresponse, questions and answers in surveys.

Data analysis and interpretation: review of various techniques for data analysis covered in core statistics papers, techniques of interpretation, precaution in interpretation.

Report writing: layout of a research report, characteristics of a good research report.

REFERENCES:

1. Kothari, C.R. (2004): Research Methodology: Methods and Techniques, 2nd Revised Edition, New Age International Publishers.
2. Kumar, R (2011): Research Methodology: A Step - by - Step Guide for Beginners, SAGE publications.

DSE 1-(i): Vital Statistics

Population Theories: Coverage and content errors in demographic data, use of balancing equations and Chandrasekharan-Deming formula to check completeness of registration data. Adjustment of age data, use of Myer and UN indices, Population composition, dependency ratio.

Introduction and sources of collecting data on vital statistics, errors in census and registration data. Measurement of population, rate and ratio of vital events. Measurements of Mortality: Crude Death Rate (CDR), Specific Death Rate (SDR), Infant Mortality, Rate (IMR) and Standardized Death Rates.

Stationary and Stable population, Central Mortality Rates and Force of Mortality. Life (Mortality) Tables: Assumption, description, construction of Life Tables and Uses of Life Tables.

Measurements of Fertility: Crude Birth Rate (CBR), General Fertility Rate (GFR), Specific Fertility Rate (SFR) and Total Fertility Rate (TFR). Measurement of Population Growth: Crude rates of natural increase, Pearl's Vital Index, Gross Reproduction Rate (GRR) and Net Reproduction Rate (NRR).

REFERENCES:

1. P. Mukhopadhyay (1999): Applied Statistics, Books and Allied (P) Ltd.
2. A.M. Goon, M.K. Gupta and B. Dasgupta (2008): Fundamentals of Statistics, Vol. II, 9th Edition, World Press.
3. S. Biswas (1988): Stochastic Processes in Demography & Application, Wiley Eastern Ltd.
4. Fredrick E. Croxton, Dudley J.Cowden, and S. Klein (1973): Applied General Statistics, 3rd Edition. Prentice Hall of India Pvt. Ltd.
5. N. Keyfitz and John A. Beckman ( ): Demogrphy through Problems S-Verlag New york.

LIST OF PRACTICALS:

1. To calculate CDR and Age Specific death rate for a given set of data
2. To find Standardized death rate by:- (i) Direct method (ii) Indirect method
3. To construct a complete life table
4. To fill in the missing entries in a life table
5. To calculate CBR, GFR, SFR, TFR for a given set of data
6. To calculate Crude rate of Natural Increase and Pearle's Vital Index for a given set of data
7. Calculate GRR and NRR for a given set of data and compare them

DSE 1-(ii): Statistical Techniques for Quality Control

Quality: Definition, dimensions of quality, historical perspective of quality control and improvements starting from World War II, historical perspective of Quality Gurus and Quality Hall of Fame. Quality system and standards: Introduction to ISO quality standards, Quality registration. Statistical Process Control - Seven tools of SPC, chance and assignable causes of quality variation.

Statistical Control Charts- Construction and Statistical basis of 3-σ Control charts, analysis of patterns on control chart, Control charts for variables: X-bar & R-chart, X-bar & s-chart. Control charts for attributes: np-chart, p-chart, c-chart and u-chart. Comparison between control charts for variables and control charts for attributes.

Acceptance sampling plan: Principle of acceptance sampling plans. Single sampling plan their OC, AQL, LTPD, AOQL, ASN, ATI functions with graphical interpretation, use and interpretation of Dodge and Romig's sampling inspection plan tables.

REFERENCES:

1. Montogomery, D. C. (2009): Introduction to Statistical Quality Control, 6th Edition, Wiley India Pvt. Ltd.
2. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
3. Mukhopadhyay, P (2011):Applied Statistics, 2nd edition revised reprint, Books and Allied(P) Ltd.
4. Montogomery, D. C. and Runger, G.C. (2008): Applied Statistics and Probability for Engineers, 3rd Edition reprint, Wiley India Pvt. Ltd.

LIST OF PRACTICALS:

1. Construction of X-bar and R chart (without trial control limits)
2. Construction of X-bar and s chart (without trial control limits)
3. Construction of p-chart (fixed sample size)
4. Construction of p-chart (variable sample size)
5. Construction of d-chart
6. Construction of c- chart
7. Construction of u-chart
8. Single sampling inspection plan
9. OC functions and OC curves
10. Determination of the best plan on the ASN

DSE 2-(i): Index Number and Time Series Analysis

Index Numbers: Definition, construction of index numbers and problems thereof for weighted and unweighted index numbers including Laspeyre's, Paasche's, Edgeworth-Marshall and Fisher. Factor reversal and time reversal tests. Chain index numbers, conversion of fixed based to chain based index numbers and vice-versa. Consumer price index numbers.

Introduction to times series data, application of time series from various fields. Components of a times series, Decomposition of time series.

Trend: Estimation of trend by free hand curve method, method of semi averages, fitting a various mathematical curve, and growth curves. Method of moving averages. Detrending. Effect of elimination of trend on other components of the time series.

Seasonal Component: Estimation of seasonal component by Method of simple averages, Ratio to Trend. Ratio to Moving Averages and Link Relative method, Deseasonalization. Random Component: Variate component method.

REFERENCES:

1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
2. Gupta, S.C. and Kapoor, V. K. (2008): Fundamentals of Applied Statistics, 4th Ed. (reprint), Sultan Chand and Sons.
3. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
4. Kendall M.G. (1976): Time Series, Charles Griffin.
5. Chatfield C. (1980): The Analysis of Time Series –An Introduction, Chapman & Hall.
6. Mukhopadhyay P. (2011): Applied Statistics, 2nd ed. Revised reprint, Books and Allied.

LIST OF PRACTICALS:

1. Calculate price and quantity index numbers using Laspeyre's, Paasche's, Marshall-Edgeworth and Fisher's formulae
2. To calculate the Chain Base index numbers for a given series of Fixed Base index numbers and show that the two are same
3. To compute Chain Base index numbers for a given set of data
4. To convert the Chain Base index numbers to Fixed Base index numbers
5. Fitting and plotting of modified exponential curve by method of three selected points
6. Fitting and plotting of Gompertz curve by method of partial sums
7. Fitting and plotting of logistic curve by method of three selected points
8. Fitting of trend by Moving Average Method (for n even and n odd)
9. Measurement of Seasonal indices Ratio-to-Trend method

10. Measurement of Seasonal indices Ratio-to-Moving Average method
11. Measurement of seasonal indices Link Relative method
12. Calculation of variance of random component by variate difference method

DSE 2-(ii): Econometrics

Nature and Scope of Econometrics.

Simple Linear Regression Model: Two Variable Case Estimation of model by method of ordinary least squares, properties of estimators, goodness of fit, tests of hypotheses, scaling and units of measurement, confidence intervals, Gauss-Markov theorem and forecasting.

Multiple Linear Regression: OLS Estimation of parameters; properties of OLS estimators, goodness of fit - R^2, partial regression coefficients and testing of hypotheses on parameters (individual and joint).

Violations of Classical Assumptions: Multicollinearity- Concept, Consequences, Detection and Remedies. Heteroscedasticity and serial correlation– Concept and Consequences.

REFERENCES:

1. Gujarati, D. and Sangeetha, S. (2007): *Basic Econometrics*, 4th Edition, McGraw Hill Companies.
2. Johnston, J. (1972): *Econometric Methods*, 2nd Edition, McGraw Hill International.
3. Koutsoyiannis, A. (2004): *Theory of Econometrics*, 2nd Edition, Palgrave Macmillan Limited.
4. Maddala, G.S. and Lahiri, K. (2009)*: Introduction to Econometrics*, 4th Edition, John Wiley & Sons.

LIST OF PRACTICALS:

1. Problems based on estimation of simple linear model
2. Testing of parameters of simple linear model
3. Multiple Regression
4. Problems concerning specification errors
5. Problems related to consequences of Multicollinearity
6. Diagnostics of Multicollinearity
7. Problems related to consequences Heteroscedasticity
8. Diagnostics of Heteroscedasticity
9. Estimation of problems of General linear model under Heteroscedastic distance terms
10. Problems related to selection of best regression model