

Department of Statistics, Presidency University, Kolkata

Presidency University, Kolkata

Department of Statistics

SYLLABUS

IN

U.G. STATISTICS (MAJOR)

[Semesters 1 – 6]

(With effect from 2016 – 2017 ACADEMIC SESSION)

OUTLINE

SEMESTER - 1				
SL. No.	Paper	Code	Title	Marks
1	Major-1	STAT 0101	Descriptive Statistics-I (18) , Probability Theory-I (17)	35+15
2	Practical / Sessional-1	STAT 0191	Based on Major-1, Numerical Analysis and MS-Excel	50

SEMESTER - 2				
SL. No.	Paper	Code	Title	Marks
1	Major-3	STAT 0201	Descriptive Statistics-II (15), Probability Theory-II (10), Real Analysis-I(10)	35+15
2	Practical / Sessional-2	STAT 0291	Based on Major-3, Numerical Analysis and MINITAB	50

SEMESTER - 3				
SL. No.	Paper	Code	Title	Marks
1	Major-5	STAT 0301	Probability Theory-III (20) Real Analysis-II (15)	35+15
2	Major-6	STAT 0302	Linear Algebra-I (20) Population Statistics (15)	35+15
3	Practical / Sessional-3	STAT 0391	Based on Majors 5 and 6, C- Language	50

SEMESTER - 4				
SL. No.	Paper	Code	Title	Marks
1	Major-8	STAT 0401	Based on Majors 8 and 9 C- Language	35+15
2	Major-9	STAT 0402	SEMESTER - 5	35+15
3	Practical / Sessional-4	STAT 0491		50

SL. No.	Paper	Code	Title	Marks
1	Major-11	STAT 0501	Multivariate Analysis (20) Statistical Quality Control (15)	35+15
2	Major-12	STAT 0502	Statistical Inference-II (35)	35+15
3	Major-13	STAT 0503	ANOVA (20) Large Sample Theory (15)	35+15
4	Practical / Sessional-5	STAT 0591	Based on Major 11	50
5	Practical / Sessional-6	STAT 0592	Based on Majors 12 and 13	50

Department of Statistics, Presidency University, Kolkata

SEMESTER - 6				
SL. No.	Paper	Code	Title	Marks
1	Major-14	STAT 0601	Regression Analysis (15) Stat. Inference-III (20)	35+15
2	Major-15	STAT 0602	Design of Experiments (20) Time Series Analysis (15)	35+15
3	Major-16	STAT 0603	Sample Survey (25) Economic Statistics (10)	35+15
4	Practical / Sessional-7	STAT 0691	Based on Majors 14 and 15	50
5	Practical / Sessional-8	STAT 0692	Based on Major 16 (35) + Grand viva-voce (15)	50

N.B.:- Marks in Theory Paper : End-Semester Examination 35 + Internal Assessment 15 = Total 50
Marks in Practical Paper includes Viva-voce marks (15% to 20%).

DETAILED SYLLABUS OF STATISTICS : SEMESTER-WISE

SEMESTER – 1

MAJOR-1 : Paper Code STAT 0101 : Descriptive Statistics-I, Probability Theory-I
Marks 35+15

Descriptive Statistics-I

Introduction : Nature of Statistics, Uses of Statistics, Statistics in relation to other disciplines, Abuses of Statistics.

Types of Data: Concepts of population and sample, quantitative and qualitative data, cross-sectional and time-series data, discrete and continuous data, different types of scales.

Collection and Scrutiny of Data: Primary data – designing a questionnaire and a schedule, checking its consistency. Secondary data – its major sources. Complete enumeration.

Presentation of data: Construction of Tables with one or more factors of classification, diagrammatic representations, frequency distributions and cumulative frequency distributions and their graphical representations, stem and leaf displays.

Univariate data – different measures of location, dispersion, relative dispersion, skewness and kurtosis, Moments, Sheppard's corrections (without proof), Liapounov's inequality, Quantiles and different measures based on them. Box Plot. Outlier Detection.

References :

1. Goon A.M., Gupta M. K., Dasgupta B.: Fundamentals of Statistics (Vol-1)
2. Yule G.U & Kendall M.G. : An Introduction to the Theory of Statistics
3. Snedecor & Cochran : Statistical Methods
4. Croxton F.E., Cowden D.J. & Klein : Applied General Statistics
5. Wallis F.E. & Roberts H.V. : Statistics – a new approach

6. Tukey J.W. : Exploratory Data Analysis

Probability Theory-I

Random Experiment: Trial, Sample point, Sample space, Different types of events.

Definition of probability: Classical and relative-frequency approach to probability, Kolmogorov's Axiomatic definition (detailed discussion on discrete space only), limitations of Classical definition. Probability of union and intersection of events, Probability of occurrence of exactly m and at least m events out of n events. Conditional probability and Independence of events, Bayes' Theorem and its applications. Examples based on classical approach and repeated trials.

References:

1. Chung K.L.: Elementary Probability Theory with Stochastic Process
2. Feller W.: An Introduction to Probability Theory & its Applications
3. Goon A.M., Gupta M.K. & Dasgupta B.: An Outline of Statistical Theory (Vol-1)
4. Rohatgi V.K. (1984): An Intro. to Probability Theory & Math. Statistics
5. Hoel P.J., Port S.C. & Stone C.J.: Introduction to Probability Theory (Vol-1)
6. Cramer H. : The Elements of Probability Theory
7. Parzen E. : Modern Probability Theory and its Applications
8. Uspensky J.V. : Introduction to Mathematical Probability
9. Cacoullos T. : Exercises in Probability
10. Rahman N.A.: Practical Exercises in Probability and Statistics
11. Pitman J. : Probability
12. Stirzaker D. : Elementary Probability
13. Chandra T.K. & Chatterjee D. : A First Course in Probability
14. Bhat B.R. : Modern Probability Theory

Practical / Sessional-1 : STAT 0191 : Marks 50

Based on Major-1, Numerical Analysis [covering Approximation of numbers and functions, Absolute and Relative errors. (1L) Interpolation: Polynomial approximation, Difference Table, Newton's Forward and Backward interpolation formulae and Lagrange's general interpolation formula, Error terms (5L) Numerical Differentiation and its applications. (2L)] and MS-Excel.

***References* : [for Numerical Analysis]**

1. Scarborough J.B. : Numerical Mathematical Analysis
2. Atkinson K. : Elementary Numerical Analysis
3. Sastry S.S.: Intriductory Methods of Numerical Analysis
4. Hildebrand F.B. : Introduction to Numerical Analysis
5. Mollah, S. A. : Numerical Analysis & Computational Procedures

MAJOR-3 : Paper Code STAT 0201: Descriptive Statistics-II, Probability Theory-II, Real Analysis I : Marks 35+15

Descriptive Statistics II

Bivariate data – Scatter Diagram, Concept of Regression, Principles of Least Squares, Correlation Coefficient and its properties, Correlation Ratio, Correlation Index, Intraclass Correlation, Fitting of polynomial and exponential curves. Rank Correlation – Spearman's and Kendall's measures.

Analysis of Categorical Data: Consistency of data, independence and association of attributes, measures of association – Pearson's and Yule's measures, Goodman-Kruskal's γ . Odds Ratio. Fitting of logit model through least squares.

References :

1. Goon AM, Gupta MK, Dasgupta B: Fundamentals of Statistics (Vol-1)
2. Yule G.U & Kendall M.G: An Introduction to the Theory of Statistics
3. Kendall M.G. & Stuart A. : Advanced Theory of Statistics (Vols.1 & 2)
4. Snedecor & Cochran : Statistical Methods (6th ed)
5. Croxton F.E., Cowden D.J. & Klein : Applied General Statistics
6. Wallis F.E. & Roberts H.V. : Statistics- a new approach
8. Lewis-Beck M.S. (edt.) : Regression Analysis
11. A. Agresti : Analysis of Ordinal Categorical Data

Probability Theory II

Random Variables : Definition of discrete and continuous random variables, cumulative distribution function (c.d.f.) and its properties (with proof), probability mass function (p.m.f.) and probability density function (p.d.f.),

Expectation and Moments, Dispersion, Skewness, Kurtosis, Quantiles.

Generating Functions: Probability generating function and moment generating function in the univariate case.

References:

1. Chung K.L. : Elementary Probability Theory with Stochastic Process
2. Feller W. : An Introduction to Probability Theory & its Applications
3. Goon A.M., Gupta M.K. & Dasgupta B. : An Outline of Statistical Theory(Vol-1)
4. Rohatgi V.K. : An Intro. to Probability Theory & Math. Statistics
5. Hoel P.J., Port S.C. & Stone C.J. : Introduction to Probability Theory (Vol-1)
6. Cramer H. : The Elements of Probability Theory
7. Parzen E. : Modern Probability Theory and its Applications
8. Uspesky J.V. : Introduction to Mathematical Probability
9. Cacoullos T. : Exercises in Probability
10. Rahman N.A. : Practical Exercises in Probability and Statistics
11. Pitman J. : Probability
12. Stirzaker D. : Elementary Probability
13. Chandra T.K. & Chatterjee D. : A First Course in Probability
14. Bhat B.R.: Modern Probability Theory

Real Analysis I

Department of Statistics, Presidency University, Kolkata

Sets of Real Numbers: Field Structure and Order Structure, Completeness, Archimedean Property, Topological properties of real line.

Sequence and Series of Real Numbers: Convergence, Limits, Subsequences, Concept of limsup and liminf, Tests for Convergence.

Limits of Functions: Definition and basic results, Concepts of O and O .

Continuity: Definition, Properties, Sequential Criterion of Continuity, Uniform Continuity

Differentiation: Definition, Sign of the Derivative, Darboux Theorem, Rolle's Theorem, Mean Value Theorem, Concept of Higher order derivatives, Maxima and Minima

References :

1. Goldberg, R.R. : Methods of Real Analysis
2. Apostol, T.M. : Mathematical Analysis
3. R G Bartle, Sherbert D R.: Introduction to Real Analysis
4. Terrance Tao: Real Analysis I
5. Malik, S.C. & Aroora, S. : Mathematical Analysis
6. Mapa, S.K. : Real Analysis

Practical / Sessional-2 : STAT 0291 : Marks 50

Based on Major-3, Numerical Analysis [covering Numerical Integration: Trapezoidal and Simpson's $\frac{1}{3}$ rules. (2L) Numerical solution of equations: method of fixed point iteration and Newton-Raphson method in one unknown, Conditions of convergence, rates of convergence. Extension of the iteration method to two unknowns (without convergence) (4L) Stirling's approximation to factorial n. (1L)] and MINITAB.

References : [for Numerical Analysis]

1. Scarborough J.B. : Numerical Mathematical Analysis
2. Atkinson K. : Elementary Numerical Analysis
3. Sastry S.S.: Intriductory Methods of Numerical Analysis
4. Hildebrand F.B. : Introduction to Numerical Analysis
5. Mollah, S. A. : Numerical Analysis & Computational Procedures

SEMESTER – 3

MAJOR-5 : Paper Code STAT 0301: Probability Theory-III, Real Analysis-II Marks 35+15

Probability Theory III

Univariate Discrete Distributions : Uniform, Bernoulli, Hypergeometric, Binomial, Poisson, Negative Binomial, Geometric distributions and their properties.

Univariate Continuous Distributions : Rectangular, Normal (Normal approximation to the Poisson distribution), Cauchy, Gamma, Beta, Exponential, Laplace, Logistic, Pareto, Log-normal distributions and their properties. Application of Pareto and Lognormal as income distributions.

Truncated distributions.

Department of Statistics, Presidency University, Kolkata

Probability Inequalities (Univariate Cases) : Markov's & Chebyshev's (one- and two- sided) inequalities, Jensen's Inequality, Cauchy-Swartz Inequality, Holder's Inequality, Minkowski's Inequality, C_r Inequality etc.

Scaling methods : Z, Percentile, Thurstone, Equivalent scaling procedures.

References:

1. Chung K.L. : Elementary Probability Theory with Stochastic Process
2. Feller W. : An Introduction to Probability Theory & its Applications (Vol.1)
3. Goon A.M., Gupta M.K. & Dasgupta B. (1994): An Outline of Statistical Theory (Vol-1)
4. Rohatgi V.K. : An Intro. to Probability Theory & Math. Statistics
5. Hoel P.J., Port S.C. & Stone C.J. : Introduction to Probability Theory (Vol-1)
6. Cramer H. : The Elements of Probability Theory
7. Parzen E. : Modern Probability Theory and its Applications
8. Cacoullos T. : Exercises in Probability
10. Rahman N.A. : Practical Exercises in Probability and Statistics
11. Pitman J. : Probability
12. Stirzaker D. : Elementary Probability
13. Chandra T.K. & Chatterjee D. : A First Course in Probability
14. Bhat B.R. : Modern Probability Theory

Real Analysis II

Riemann Integration, Differentiation under Integration, Improper Integrals and their convergence (Gamma and Beta Integrals).

Sequence and Series of Functions, Point-wise and Uniform Convergence, Power Series.

Taylor-series expansion.

Constrained optimization – use of Lagrangian multiplier.

Evaluation of double Integrals – Repeated Integrals and change of variables.

References :

1. Goldberg, R.R. : Methods of Real Analysis
2. Apostol, T.M. : Mathematical Analysis
3. R G Bartle, Sherbert D R.: Introduction to Real Analysis
4. Malik, S.C. & Aroora, S. : Mathematical Analysis
5. Mapa, S.K. : Real Analysis
6. A Basic Course in Real Analysis – S Kumaresan

MAJOR-6 : Paper Code STAT 0302: Linear Algebra-I, Population Statistics Marks 35+15

Linear Algebra-I

Vector Algebra : Vector spaces with real field, Basis and dimension of a vector space, Orthogonal vectors, Gram-Schmidt Orthogonalization.

Matrix Algebra : Linear transformation and Matrices, Matrix operations, Elementary matrices and their uses, Row space and Column space of a matrix, Rank of a matrix and related results.

Inverse of a matrix, Determinants, the Sweep-out and the Pivotal Condensation methods

References:

1. Hadley G. : Linear Algebra
2. Rao A.R. & Bhimasankaran P. : Linear Algebra
3. Searle S.R. : Matrix Algebra – useful for Statistics
4. Rao C.R. : Linear Statistical Inference & its Applications
5. Hoffman K. & Kunze R. : Linear Algebra
6. Goon A.M. : Vectors and Matrices
7. Matrix CookBook-: Peterson and Pederson

Population Statistics

Introduction: Sources of Population Data – Census data, Registration data and the errors in such data. Rates and ratios of vital events.

Measurements of Mortality : Crude Death rate, Specific Death Rate, Standardized death Rate, Case fatality rate and Cause of Death Rate, Infant Mortality Rate, Neonatal and Perinatal Mortality Rates

Life Tables : Descriptions of Complete and Abridged Life Tables and their uses, Cohort vs. Current Life Tables, Stable population and Stationary population, Construction of complete life table from population and death statistics.

Measurements of Fertility : Crude Birth Rate, General Fertility Rate, Age Specific Fertility Rate, Total Fertility Rate.

Measurement of Population Growth: Crude Rate of Natural Increase and Vital Index, Gross and Net Reproduction Rates.

Population Estimation, Projection and Forecasting : Use of A.P. and G.P. methods for population estimates, Fitting of Logistic curve for population forecasting using Rhode's method.

References :

1. Goon A.M., Gupta M.K., Dasgupta B.: Fundamentals of Statistics (Vol-2)
2. Spiegelman M. : Introduction to Demography
3. Cox P.R. : Demography
4. Biswas S. : Stochastic Processes in Demography and Applications
5. Mishra B.D. : An Introduction to the Study of Population
6. Keyfitz. N and Caswell. H : Applied Mathematical Demography (3rd edition)

Practical / Sessional-3 : STAT 0391 : Marks 50

Based on Majors 5 , 6 and C- Language.

References : [for C Programming]

1. Kanitkar : Let Us C
2. Chatterjee, A.K. & Chatterjee, T. : Computer Applications of Mathematics and Statistics

SEMESTER – 4

MAJOR-8 : Paper Code STAT 0401 : Probability Theory IV, Statistical Quality Control Marks 35+15

Probability Theory IV

The c.d.f., p.m.f., p.d.f. and generating functions in bivariate case. Marginal and Conditional distributions, Independence, Conditional Expectation, Correlation and Regression. Theorems on sum and product of expectations of random variables.

Bivariate Normal Distribution and its properties.

Basic concept of a Markov chain and some simple examples.

Weak Law of Large Numbers (WLLN) and Central Limit Theorems – Lindeberg-Levy CLT (Statement only with applications). Stirling's approximation to factorial n .

References :

1. Chung K.L. : Elementary Probability Theory with Stochastic Process
2. Feller W. : An Introduction to Probability Theory & its Applications
3. Goon A.M., Gupta M.K. & Dasgupta B. : An Outline of Statistical Theory (Vol-1)
4. Rohatgi V.K. : An Intro. to Probability Theory & Math. Statistics
5. Hoel P.J., Port S.C. & Stone C.J. : Introduction to Probability Theory (Vol-1)
6. Cramer H. : The Elements of Probability Theory
7. Parzen E. : Modern Probability Theory and its Applications
8. Uspesky J.V. : Introduction to Mathematical Probability
9. Cacoullos T. : Exercises in Probability
10. Rahman N.A. : Practical Exercises in Probability and Statistics
11. Pitman J. : Probability
12. Stirzaker D. : Elementary Probability
13. Chandra T.K. & Chatterjee D. : A First Course in Probability
14. Bhat B.R. : Modern Probability Theory

Linear Algebra-II

Characteristic roots and vectors , Quadratic forms – classification and canonical reduction.

Systems of Linear Equations: Homogeneous and Non-homogeneous systems – conditions for solvability.

References:

1. Hadley G. : Linear Algebra
2. Rao A.R. & Bhimasankaran P. : Linear Algebra
3. Searle S.R. : Matrix Algebra – useful for Statistics
4. Rao C.R. : Linear Statistical Inference & its Applications
5. Hoffman K. & Kunze R. : Linear Algebra
6. Goon A.M. : Vectors and Matrices

**MAJOR-9 : Paper Code STAT 0402: Sampling Distributions-I, Economic Statistics
Marks 35+15**

Sampling Distributions

Introduction: Concepts of Random Sampling, Statistics and Sampling Distributions of Statistics. Transformations and Jacobians — Illustrations using different distributions, reproductive properties of the distributions.

Some Standard Sampling Distributions : χ^2 -distribution, distributions of the mean and variance of a random sample from a normal population, t and F distributions.

Distributions of means, variances and correlation coefficient (null case) of a random sample from a bivariate normal population, distribution of the simple regression coefficient (for both stochastic and non-stochastic independent variable cases).

Distributions of Order Statistics and Sample Range.

References:

1. Goon A.M., Gupta M.K. & Dasgupta B. : An Outline of Statistical Theory (Vol-1)
2. Johnson, N.I. & Kotz S. : Distributions in Statistics

Statistical Inference-I

Idea of Estimation.

Point estimation: Requirements of a good estimator – notions of Mean Square Error, Unbiasedness: Minimum Variance Unbiasedness and Best Linear Unbiasedness

Elements of Hypothesis Testing : Null and Alternative hypotheses, Simple and Composite hypotheses, Critical Region, Type I and Type II Errors, Level of Significance and Size, p-value, Power.

Heuristic test procedures related to a single Binomial proportion and Poisson parameter; two Binomial proportions and Poisson parameters; the mean and variance of a single univariate normal distribution, the means and variances of two independent normal distributions and a single bivariate normal distribution; regression and correlation coefficients of a single bivariate normal distribution, etc.

References:

1. Goon A.M., Gupta M.K. & Dasgupta B. : An Outline of Statistical Theory (Vol-2)
2. Johnson, N.I. & Kotz S. : Distributions in Statistics
3. Ross S.M. : Introduction to Probability Models
4. Mood A.M., Graybill F. & Boes D.C.: An Introduction to the Theory of Statistics (3rd ed)
5. Rao C.R. : Advanced Statistical Methods in Biometric Research
6. Hogg R.V. & Craig A.T.: Introduction to Mathematical Statistics
7. Rohatgi V.K. : An Introduction to Probability Theory & Mathematical Statistics
8. Stuart G & Ord J.K. : Advanced Theory of Statistics (Vol -2)
9. Goon A. M., Gupta M. K. and Dasgupta B. : Fundamentals of Statistics (Vol-1)
11. Bhattacharya GK & Johnson R. A. : Concepts & Methods of Statistics

Practical / Sessional-4 : STAT 0491 : Marks 50

Based on Majors 8 , 9 and C- Language

SEMESTER – 5

**MAJOR-11 : Paper Code STAT 0501 : Multivariate Analysis, Statistical Quality Control
Marks 35+15**

Multivariate Analysis

Multivariate data – multiple regression, multiple correlation and partial correlation – their properties and related results.

Random Vector: Probability mass and density functions, Distribution Function, Mean vector and Dispersion matrix, Marginal and Conditional Distributions, Ellipsoid of Concentration, Multiple Regression, Multiple Correlation, Partial Correlation.

Multivariate Distributions: Multinomial, Multivariate Normal distributions and their properties.

References:

1. Kendall M.G. & Stuart A. : Advanced Theory of Statistics (Vol 30)
2. Anderson T.W. : An Introduction to Multivariate Statistical Analysis, 3rd edition
3. Goon A.M., Gupta M.K. & Dasgupta B.: An Outline of Statistical Theory (Vols 1 & 2)
4. Rohatgi V.K. : An Introduction to Probability Theory & Math. Statistics
5. Johnson, N.L. & Kotz S. : Distributions in Statistics
6. Hogg R.V. & Craig A.T. : Introduction to Mathematical Statistics
7. Rao C.R. : Linear Statistical Inference and its Applications
8. Mukhopadhyay P. : Mathematical Statistics
9. Johnson R. A. and Wichern, W : Applied Multivariate Statistical Analysis, 5th edition

Statistical Quality Control

Introduction: Concepts of Quality and Quality Control, Process Control and Product Control

Process Control: Control Charts and their uses, Choice of Subgroup sizes,

Construction of control charts by attributes (p, c, np) (including unequal subgroup size) and variables (\bar{x} , R). Interpretation of non-random patterns of points.

Product Control: Producer's Risk, Consumer's Risk, Acceptance Sampling Plan, Single and Double sampling plans by attributes, their OC, ASN (and ATI), LTPD and AOQL. Single sampling plan for inspection by variables (one-sided specification, known and unknown σ cases), Use of IS plans and tables.

References :

1. Goon A. M., Gupta M. K., Dasgupta B. : Fundamentals of Statistics (Vol-2)
2. Duncan A.J. : Quality Control and Industrial Statistics
3. Cowden D.J.: Statistical Methods in Quality Control
4. Grant E.L. & Leavenworth : Statistical Quality Control
5. Bowley A.H. & Goode H.P. : Sampling Inspection by Variables
6. Ekambaram S. K.: The Statistical Basis of Quality Cont. Charts
7. Montgomery D.C.: Introduction to Statistical Quality Control
8. IS2500 Part I and Part II
9. Bureau of Indian Standards : Handbook on Statistical quality Control
10. Indian Standards Institution : Manual on Basic Principles of Lot Sampling

MAJOR 12 : Paper Code STAT 0502 : Statistical Inference-II

Marks 35+15

Theory of Estimation

Sufficiency, Factorization Theorem (Discrete case only), Properties of minimum variance unbiased estimators, consistent estimators and asymptotic efficiency, Cramer-Rao lower bound, Rao-Blackwell Theorem, Lehmann-Scheffe Theorem.

Methods of Estimation – Moment, Least-square, Maximum Likelihood & Minimum χ^2 methods and their properties (excluding proofs of large sample properties).

Interval Estimation: Confidence intervals, Concepts of Uniformly Most Accurate (UMA) confidence sets, relationship with tests of hypotheses.

Hypothesis Testing

Theory of Hypothesis Testing: Most Powerful (MP), Uniformly Most Powerful (UMP), Randomized and Nonrandomized tests, Neyman-Pearson Fundamental Lemma (sufficiency part only), and its use in the construction of MP and UMP tests (single parameter with range independent of the parameter), Uniformly Most Powerful Unbiased (UMPU) tests (definition only) with examples [not restricted only to a single Binomial proportion and Poisson parameter; two Binomial proportions and Poisson parameters; the mean(s) and variance(s) of a single univariate normal distribution, two independent normal distributions and a single bivariate normal distribution; regression and correlation coefficients of a single bivariate normal distribution, etc.]

Likelihood Ratio tests and its applications to tests for the equality of means and variances of several normal populations.

References:

1. Goon A.M., Gupta M.K. & Dasgupta B. : An Outline of Statistical Theory (Vol-2)
2. Johnson, N.I. & Kotz S. : Distributions in Statistics
3. Ross S.M. : Introduction to Probability Models
4. Mood A.M., Graybill F. & Boes D.C.: An Introduction to the Theory of Statistics (3rd ed)
5. Rao C.R. : Advanced Statistical Methods in Biometric Research
6. Hogg R.V. & Craig A.T.: Introduction to Mathematical Statistics
7. Rohatgi V.K. : An Introduction to Probability Theory & Mathematical Statistics
8. Stuart G & Ord J.K. : Advanced Theory of Statistics (Vol -2)
9. Goon A. M., Gupta M. K. and Dasgupta B. : Fundamentals of Statistics (Vol-1)
11. Bhattacharya GK & Johnson R. A. : Concepts & Methods of Statistics

MAJOR 13 : Paper Code STAT 0503 : ANOVA & Large Sample Theory

Marks 35+15

ANOVA

Basic idea of linear model (containing definition and different types), Brief conceptual discussion on orthogonal splitting of total variation & statement of Fisher-Cochran theorem (without proof), Theorem of least-square (statement only).

Department of Statistics, Presidency University, Kolkata

Introduction: Heterogeneity and Analysis of Variance, Linear Hypothesis, Orthogonal splitting of total variation, Selection of Valid Error.

Applications of the ANOVA technique (based on both fixed- and random- effects models) to one-way classified data, two-way classified data with equal number of observations per cell.

References :

1. Goon A.M., Gupta M.K. & Dasgupta B. : An Outline of Statistical Theory (Vol-2)
4. Mood A.M., Graybill F. & Boes D.C. : An Introduction to the Theory of Statistics (3rd ed)
5. Rao C.R. : Advanced Statistical Methods in Biometric Research
6. Hogg R.V. & Craig A.T.: Introduction to Mathematical Statistics
7. Rohatgi V.K. : An Introduction to Probability Theory & Mathematical Statistics
8. Stuart G & Ord J.K. : Advanced Theory of Statistics (Vol 2)
9. Goon A. M., Gupta M. K. and Dasgupta B. : Fundamentals of Statistics (Vols.1 and 2)
11. Bhattacharya GK & Johnson R. A. : Concepts & Methods of Statistics
12. Scheffe H. : The Analysis of Variance

Large Sample Theory

Delta method, Derivation of large sample standard error of sample moments, standard deviation, coefficient of variation, b_1 and b_2 measures, and correlation coefficient and their uses in large sample tests under normality assumption, Large sample distribution of sample quantile

Transformations of Statistics to stabilize variance : derivation and use of Sin^{-1} , square-root, logarithmic and z-transformations.

Large sample tests for binomial proportions, Poisson means (single and two independent samples cases) and correlation coefficients..

Large Sample distribution of Pearsonian χ^2 -statistic and its uses. Yates' correction in a 2×2 contingency table.

References:

1. Goon A.M., Gupta M.K. & Dasgupta B.: An Outline of Statistical Theory (Vols.1 and 2)
2. Serfling R.J. : Approximation Theory of Mathematical Statistics
3. Chandra T.K. : A First Course in Asymptotic Theory in Statistics
4. Hogg R.V. & Craig A.T. : Introduction to Mathematical Statistics

Practical / Sessional-5 : STAT 0591 : Marks 50

Based on Major 11

Practical / Sessional-6 : STAT 0592 : Marks 50

Based on Majors 12 and 13

SEMESTER – 6

**MAJOR 14 : Paper Code STAT 0601 : Regression Analysis, Statistical Inference III
Marks 35+15**

Regression Analysis

Testing simple regression coefficients, tests for parallelism and identity, correlation ratio, linearity of simple regression, multiple correlation and partial correlation coefficients.

References :

1. Goon A.M., Gupta M.K. & Dasgupta B. : An Outline of Statistical Theory (Vol-2)
2. Mood A.M., Graybill F. & Boes D.C. : An Introduction to the Theory of Statistics (3rd ed)
3. Rao C.R. : Advanced Statistical Methods in Biometric Research
4. Hogg R.V. & Craig A.T.: Introduction to Mathematical Statistics
5. Rohatgi V.K. : An Introduction to Probability Theory & Mathematical Statistics
6. Stuart G & Ord J.K. : Advanced Theory of Statistics (Vol 2)
7. Goon A. M., Gupta M. K. and Dasgupta B. : Fundamentals of Statistics (Vols.1 and 2)
8. Bhattacharya GK & Johnson R. A. : Concepts & Methods of Statistics
9. Scheffe H. : The Analysis of Variance

Statistical Inference III

Nonparametric Methods

Nonparametric Methods : Sign test, Mann-Whitney test, Run test, Test of randomness, Confidence limits for Quantiles based on Sign test-statistic. Combination of Probabilities in tests of significance.(include Kolmogorov-Smirnov and Goodness of fit test and tolerance limits)

Sequential Analysis:

Sequential probability ratio test (SPRT) for simple versus simple hypotheses. Fundamental relations among α , β , A and B, determination of A and B in practice. Wald's fundamental identity and the derivation of operating characteristics (OC) and average sample number (ASN) functions, examples based on normal, Poisson, binomial and exponential distributions

References:

1. Goon A. M., Gupta M. K. and Dasgupta B. : Fundamentals of Statistics (Vol-1)
2. Goon A. M., Gupta M. K. and Dasgupta B. : An Outline of Statistical Theory (Vol-2)
3. Gibbons J.D and Chakraborty S.C. : Nonparametric Statistical Inference
4. Rohatgi V.K. : An Introduction to Probability Theory & Mathematical Statistics

MAJOR 15 : Paper Code STAT 0602 : Design of Experiments, Time Series Analysis
Marks 35+15

Design of Experiments

Principles of experimental design: Randomization, Replication and Local Control, Uniformity trials, Shapes and Sizes of Plots and Blocks.

Standard Designs and their Analyses: Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD), comparison of efficiencies. Applications of the techniques of ANOVA to the analysis of the above designs.

Split Plot Design and Strip arrangements.

Groups of Experiments using RBD and LSD

Factorial Experiments: 2^n experiments, Advantages, Total and Partial Confounding, Analysis

Missing Plot Technique: Analysis with one missing plot in an RBD and in an LSD.

Analysis of Covariance (ANCOVA) : Application of the ANCOVA technique to one-way classified data and to two-way classified data with equal number of observations per cell

References:

1. Goon A. M. ,Gupta M. K., Dasgupta B.: Fundamentals of Statistics (Vol-2)
2. Kempthorne O. : The Design and Analysis of Experiments
3. Das M.N. & Giri N.C. : Design and Analysis of Experiments. (2nd edition)
4. Montgomery D.C. : Design and Analysis of Experiments
5. Cochran W.G. & Cox G.M. : Experimental Designs
6. Federer W.T. : Experimental Designs – Theory and Application
7. Mukhopadhyay P. : Applied Statistics
8. Scheffe H. : The Analysis of Variance
9. Joshi, D.D. : Linear Estimation and Design of Experiments

Time Series Analysis

Introduction: Examples of time series from various fields, Preliminary adjustments, Components of a times series, Additive and Multiplicative models.

Trend and Seasonal Components: Estimation of trend by linear filtering (simple and weighted moving-averages) and curve fitting (polynomial, exponential and Gompertz), Variate difference method, Detrending. Estimation of seasonal component by ratio to moving-average method, ratio to trend method, Deseasonalization.

Stationary Time Series, Autocovariance and autocorrelation function, Concept of Linear Process, Causality and invertibility, Some Special Processes: Moving-average (MA) process and Autoregressive (AR) processes, Estimation of the parameters of AR(1) and AR(2) – Yule-Walker equations., ARMA process.

Sample mean and autocorrelation function, Correlogram

Prediction in time series by minimizing mean squared error, Exponential smoothing method of forecasting.

References:

1. Kendall M.G. : Time Series
2. Chatfield C. : The Analysis of Time Series –An Introduction
3. P.Brockwell & R.A.Davis : Introduction to time series and forecasting
4. Mukhopadhyay P. : Applied Statistics
5. Johnston J. & Dinardo J. : Econometric Methods

MAJOR 16 : Paper Code STAT 0603 : Sample Survey & Economic Statistics
Marks 35+15

Sample Survey

The Statistical System in India : The Central and State Government organizations, the functions of the Central Statistical Organization (CSO), the National Sample Survey Organization (NSSO).

Introduction: Concepts of Finite Population and Sample, Need for Sampling, Complete Enumeration and Sample Surveys.

General Ideas: Planning and execution of sample surveys, analysis of data and reporting, Biases and Errors. Judgment and probability sampling schemes. Tables of Random Numbers and their uses.

Simple Random Sampling with and without replacement, Determination of sample size in simple random sampling.

Stratified random sampling, Linear and Circular Systematic Sampling, Cluster sampling, Two-stage (with equal-sized first stage units) sampling with equal selection probabilities at each stage. Associated unbiased estimators of population total, mean, and proportion, their variances and unbiased variance estimators. Allocation problem in stratified random sampling and optimum choice of sampling and sub-sampling fractions in two-stage sampling, Interpenetrating sub-sampling technique for unbiased variance estimation in systematic sampling

Ratio and Regression methods of estimation in simple random sampling. Double sampling for ratio and regression estimators.

Randomized Response Techniques: Warner's Model.

References:

1. Goon A. M. ,Gupta M. K., Dasgupta B.: Fundamentals of Statistics (Vol-2)
2. Murthy M.N. : Sampling Theory and Methods
3. Des Raj & Chandhok P.: Sample Survey Theory
4. Cochran W.G. : Sampling Techniques (3rd edition)
5. Mukhopadhyay P.: Theory and Methods of Survey Sampling
6. Sukhatme P.V. & Sukhatme B.V. : Sampling Theory of Surveys
7. Sampathy S. : Sampling Theory and Methods
8. NSSO Publications
9. CSO Publications

Economic Statistics

Index Numbers: Price, Quantity and Value indices.

Price Index Numbers: Construction, Uses, Limitations, Tests for index numbers, Various formulae and their comparisons, Chain-Index Numbers.

Some Important Indices: Consumer Price Index, Wholesale Price Index and Index of Industrial Production – formulae and uses.

Measurement of income inequality: Gini's coefficient, Lorenz curves.

References:

1. Nagar A.L. & Das R.K. : Basic Statistics
2. Goon A. M.,Gupta M. K., and Dasgupta. B. : Fundamentals of Statistics (Vol-2)
3. Yule G.U. & Kendall M.G.: An Introduction to the Theory of Statistics
4. Kendall M.G. & Stuart A.: Advanced Theory of Statistics (Vol -3)
5. Croxton F.E., Cowden D.J. & Klein : Applied General Statistics

Department of Statistics, Presidency University, Kolkata

6. Mudgett B.D. : Index Numbers
7. Allen R.G.D.: Index Numbers in Theory and Practice
8. Mukhopadhyay P. : Applied Statistics
9. Johnston J. & Dinardo J. : Econometric Methods

Practical / Sessional-7 : STAT 0691 : Marks 50

Based on Majors 14 and 15

Practical / Sessional-8 : STAT 0692 : Marks 50

Based on Major 16 and Grand Viva-Voce