UNIVERSITY OF CALCUTTA

SYLLABI

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THREE-YEAR B.Sc. HONOURS & GENERAL
COURSES OF STUDIES

STATISTICS

2010

UNIVERSITY OF CALCUTTA

SYLLABI OF THE THREE-YEAR B.Sc HONS. & GENERAL COURSES OF STUDIES IN STATISTICS

Course Structure (Statistics Honours) for Annual System

Part	Paper	Marks	Topic (as mentioned in Year system)	Topics from the modules
Part 1	IA	50	Descriptive Statistics	Descriptive Statistics I (101)
Total 200				Descriptive Statistics II (201)
	IB	50	Probability Theory I	Probability Theory I (102)
				Probability Theory II (202)
	IIA	50	Linear Algebra and Population Statistics	Linear Algebra (103)
				Population Statistics (203)
	IIB	50	Practical comprising of Papers IA,IB & IIA and use of spreadsheet (EXCEL)	Practical including use of spreadsheet (EXCEL) (104 + 204)
Part 2	IIIA	50	Mathematical Methods and Probability Theory II	Mathematical Methods (301)
Total 200				Probability Theory III (302)
	IIIB	50	Sampling Distributions and Statistical Inference I	Sampling Distributions (401)
				Statistical Inference I (402)
	IVA	50	Official & Economic Statistics and Statistical Quality Control	Official and Economic Statistics (303)
				Statistical Quality Control (403)
	IVB	50	Practical comprising of Papers IIA,IIB &IIIA and use of MINITAB and C	Practical including use of Statistical software : MINITAB and Programming Language: C (304 + 404)
Part 3	VA	50	Multivariate Analysis and Large Sample Theory	Multivariate Analysis (501)
Total 400				Large Sample Theory (601)
	VB	50	Statistical Inference II	Statistical Inference II (502)
				Statistical Inference III (602)
	VIA	50	Design of Experiments and Sample Survey Methods I	Introduction to Designs of Sample Survey and Experiment (503)
				Design of Experiments (603)
	VIB	50	Time Series Analysis and Sample Survey Methods II	Time Series Analysis (504)
				Sample Survey Methods (604)
	VIIA	50	Practical comprising of Papers VA & VB	505 + 506
	VIIB	50	Practical comprising of Papers VIA & VIB	605 + 606
	VIIIA	50	Programming language C (selected features)	Programming language C (selected features) I (507)
				Programming language C (selected features) II (508)
	VIIIB	50	Computation and Data Analysis	Computation and Data Analysis I (607)
				Computation and Data Analysis II (608)

HONOURS

101 Descriptive Statistics I

Introduction : Nature of Statistics, Uses of Statistics, Statistics in relation to other disciplines, Abuses of Statistics. (2L)

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. (3L)

Collection of Scrutiny of Data: Primary data – designing a questionnaire and a schedule, checking its consistency. Secondary data – its major sources. Complete enumeration. Controlled experiments, Observational studies and Sample Surveys. Scrutiny of data for internal consistency and detection of errors in recording. Ideas of cross-validation. (3L)

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. (4L)

Univariate data – different measures of location, dispersion, relative dispersion, skewness and kurtosis, Moments, Liaponouv's inequality, Quantiles and measures based on them – comparison with moment measures. Box Plot. Outlier Detection. (13L)

References :

1. Goon A.M.,Gupta M. K., Dasgupta B.(1998): Fundamentals of Statistics (V-1),World Press
2. Yule G.U & Kendall M.G. (1950): An Introduction to the Theory of Statistics, C.Griffin
3. Snedecor & Cochran (1967): Statistical Methods (6^{th} ed), Iowa State Univ. Press
4. Croxton F.E., Cowden D.J. & Klein (1969): Applied General Statistics, Prentice Hall
5. Wallis F.E. & Roberts H.V. (1957): Statistics- a new approach, Methuen
6. Tukey J.W. (1977): Exploratory Data Analysis, Addison-Wesley Publishing Co.

102 Probability Theory I

Random Experiment: Trial, Sample point, Sample space, Different types of events. (5L)

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 atleast 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 (20L)

References:

1. Chung K.L. (1983): Elementary Probability Theory with Stochastic Process, Springer / Narosa
2. Feller W. (1968): An Introduction to Probability Theory & its Applications, John Wiley
3. Goon A.M., Gupta M.K. & Dasgupta B. (1994): An Outline of Statistical Theory (Vol-1), World Press
4. Rohatgi V.K. (1984): An Intro. to Probability Theory & Math. Statistics, John Wiley

5. Hoel P.J., Port S.C. & Stone C.J. ( ): Introduction to Probability Theory (Vol-1), Mifflin & UBS
6. Cramer H. (1954): The Elements of Probability Theory, John Wiley
7. Parzen E. (1972): Modern Probability Theory and its Applications, John Wiley
8. Uspensky J.V. (1937): Introduction to Mathematical Probability,McGraw Hill
9. Cacoullos T. (1973): Exercises in Probability. Narosa
10. Rahman N.A. (1983): Practical Exercises in Probability and Statistics, Griffen
11. Pitman J. (1993): Probability, Narosa
12. Stirzaker D. (1994): Elementary Probability, Cambridge University Press
13. Chandra T.K. & Chatterjee D. (2001): A First Course in Probability, Narosa
14. Bhat B.R. (1999): Modern Probability Theory, New Age International

103 Linear Algebra

Vector Algebra: Vector spaces with real field, Basis and dimension of a vector space, Orthogonal vectors, Gram-Schmidt Orthogonalization. (7L)

Matrix Algebra : Linear transformation and Matrices, Matrix operations, Elementary matrices and their uses, Rank of a matrix and related results, Inverse of a matrix, Determinants, the Sweep-out and the Pivotal Condensation methods, Characteristic roots and vectors , Quadratic forms – classification and canonical reduction. (16L)

Systems of Linear Equations: Homogeneous and Non-homogeneous systems– conditions for solvability. (2L)

References:

1. Hadley G. (1995): Linear Algebra, Addison Wesley/ Narosa
2. Rao A.R. & Bhimasankaran P. (1996): Linear Algebra
3. Searle S.R. (1982): Matrix Algebra – useful for Statistics, John Wiley
4. Rao C.R. (1974): Linear Statistical Inference & its Applications, Wiley Eastern
5. Hoffman K. & Kunze R. (2001): Linear Algebra
6. Goon A.M. (1988): Vectors and Matrices

201 Descriptive Statistics II

Bivariate data – scatter diagram, correlation coefficient and its properties, Correlation ratio, Correlation Index, Intraclass correlation, Concept of Regression, Principles of least squares, Fitting of polynomial and exponential curves. Rank correlation – Spearman's and Kendall's measures. (17L)

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. (8L)

References :

1. Goon AM,Gupta MK,Dasgupta B.(1998):Fundamentals of Statistics (V-1),World Press
2. Yule G.U & Kendall M.G(1950): An Introduction to the Theory of Statistics, C.Griffin
3. Kendall M.G. & Stuart A. (1966): Advanced Theory of Statistics (Vols 1 & 2)
4. Snedecor & Cochran (1967): Statistical Methods (6^{th} ed), Iowa State Univ. Press
5. Croxton F.E., Cowden D.J. & Klein (1969): Applied General Statistics, Prentice Hall

6. Wallis F.E. & Roberts H.V. (1957): Statistics- a new approach, Methuen
7. Lewis-Beck M.S. (edt.) (1993) : Regression Analysis, Sage Publications
8. A.Agresti (1984): Analysis of Ordinal Categorical Data

202 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 (7L)

The c.d.f., p.m.f. and p.d.f. in bivariate case. Marginal and Conditional distributions, Independence, Conditional Expectation, Correlation and Regression. Theorems on sum and product of expectations of random variables, (15L)

Probability Inequalities: Markov's & Chebyshev's inequalities. (3L)

References:

1. Chung K.L. (1983): Elementary Probability Theory with Stochastic Process, Springer / Narosa
2. Feller W. (1968): An Introduction to Probability Theory & its Applications, John Wiley
3. Goon A.M., Gupta M.K. & Dasgupta B. (1994): An Outline of Statistical Theory(Vol-1), World Press
4. Rohatgi V.K. (1984): An Intro. to Probability Theory & Math. Statistics, John Wiley
5. Hoel P.J., Port S.C. & Stone C.J. ( ): Introduction to Probability Theory (Vol-1), Mifflin & UBS
6. Cramer H. (1954): The Elements of Probability Theory, John Wiley
7. Parzen E. (1972): Modern Probability Theory and its Applications, John Wiley
8. Uspesky J.V. (1937): Introduction to Mathematical Probability,McGraw Hill
9. Cacoullos T. (1973): Exercises in Probability. Narosa
10. Rahman N.A. (1983): Practical Exercises in Probability and Statistics, Griffen
11. Pitman J. (1993): Probability, Narosa
12. Stirzaker D. (1994): Elementary Probability, Cambridge University Press
13. Chandra T.K. & Chatterjee D. (2001): A First Course in Probability, Narosa
14. Bhat B.R. (1999): Modern Probability Theory, New Age International

203 Population Statistics

Introduction: Sources of Population Data – Census data, Registration data and the errors in such data. Rates and ratios of vital events. (2L)

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 (6L)

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. (5L)

Measurements of Fertility: Crude Birth Rate, General Fertility Rate, Age Specific Fertility Rate, Total Fertility Rate. (4L)

Measurement of Population Growth: Crude Rate of Natural Increase and Vital Index, Gross and Net Reproduction Rates. (3L)

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. (5L)

References :

1. Goon AM,Gupta MK,Dasgupta B(2001): Fundamentals of Statistics (V-2),World Press
2. Spiegelman M. (1980): Introduction to Demography, Harvard University Press
3. Cox P.R. (1976): Demography
4. Biswas S. (1988): Stochastic Processes in Demography and Applications
5. Mishra B.D. (1980): An Introduction to the Study of Population, South Asian Pub.
6. Keyfitz. N and Caswell. H (2005): Applied Mathematical Demography (3rd edition), Springer

301 Mathematical Methods

Numerical Methods (15 marks):

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)

Numerical Integration: Trapezoidal and Simpson's ⅓ 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)

Calculus of several variables (10 marks):

Maxima and minima for functions of several variables, Constrained maximization and minimization – use of Lagrange multiplier, Multiple integrals, Transformation of Variables and Jacobian, Polar and Orthogonal transformations (10L)

References :

1. Scarborough J.B. (1958): Numerical Mathematical Analysis, Oxford Univ. Press
2. Atkinson K. (1985): Elementary Numerical Analysis
3. Sastry S.S. (1998): Intriductory Methods of Numerical Analysis
4. Hildebrand F.B. (1974): Introduction to Numerical Analysis, Tata McGraw-Hill
5. Apostol T.M. (1985): Mathematical Analysis, Narosa
6. Apostol T.M. (1968): Calculus (Vols 1 & 2)
7. Goldberg R.R. (1953): Methods of Real Analysis, Oxford & IBH Pub. Co.
8. Widder D.V. (1994): Advanced Calculus
9. Piskunov N. (1977): Calculus (Vols 1 & 2)
10. Malik S.C. & Arora S. (1991): Mathematical Analysis

302 Probability Theory III

Generating Functions: Probability generating function and moment generating function in the univariate and bivariate cases. (3L)

Univariate Discrete Distributions: Uniform, Bernoulli, Hypergeometric, Binomial, Poisson, Negative Binomial, Geometric distributions and their properties. (7L)

Univariate Continuous Distributions: Rectangular, Normal (Normal approximation to the Poisson distribution), Cauchy, Gamma, Beta, Exponential, Laplace, Logistic, Pareto, Log-normal distributions and their properties. Truncated distributions. (9L)

Scaling methods: Z, Percentile, Thurstone, Equivalent scaling procedures (3L)

Bivariate Normal Distribution and its properties. (3L)

References:

1. Chung K.L. (1983): Elementary Probability Theory with Stochastic Process, Springer / Narosa
2. Feller W. (1968): An Introduction to Probability Theory & its Applications, John Wiley
3. Goon A.M., Gupta M.K. & Dasgupta B. (1994): An Outline of Statistical Theory (Vol-1), World Press
4. Rohatgi V.K. (1984): An Intro. to Probability Theory & Math. Statistics, John Wiley
5. Hoel P.J., Port S.C. & Stone C.J. ( ): Introduction to Probability Theory (Vol-1), Mifflin & UBS
6. Cramer H. (1954): The Elements of Probability Theory, John Wiley
7. Parzen E. (1972): Modern Probability Theory and its Applications, John Wiley
8. Uspesky J.V. (1937): Introduction to Mathematical Probability,McGraw Hill
9. Cacoullos T. (1973): Exercises in Probability. Narosa
10. Rahman N.A. (1983): Practical Exercises in Probability and Statistics, Griffen
11. Pitman J. (1993): Probability, Narosa
12. Stirzaker D. (1994): Elementary Probability, Cambridge University Press
13. Chandra T.K. & Chatterjee D. (2001): A First Course in Probability, Narosa
14. Bhat B.R. (1999): Modern Probability Theory, New Age International

303 Official and Economic Statistics

Official Statistics (Marks 10)

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) (4L)

National Income statistics: Income, expenditure and production approaches. Their applications in various sectors in India (6L)

Economic Statistics (Marks 15)

Index Numbers: Price, Quantity and Value indices. (1L)

Price Index Numbers: Construction, Uses, Limitations, Tests for index numbers,Various formulae and their comparisons, Chain Index Number. (7L)

Some Important Indices: Consumer Price Index, Wholesale Price Index and Index of Industrial Production – methods of construction and uses. (3L)

Measurement of income inequality: Gini's coefficient, Lorenz curves, Application of Pareto and Lognormal as income distributions (4L)

References:

1. C.S.O. (1984) : Statistical System in India
2. Goon A. M.,Gupta M. K,, and Dasgupta. B. (2001): Fundamentals of Statistics (V-2),World Press
3. Yule G.U. & Kendall M.G. (1953): An Introduction to the Theory of Statistics, C.Griffin
4. Kendall M.G. & Stuart A. (1966): Advanced Theory of Statistics (Vol 3), C.Griffin
5. Croxton F.E., Cowden D.J. & Klein (1969): Applied General Statistics, Prentice Hall
6. Mudgett B.D. (1951): Index Numbers, John Wiley
7. Allen R.G.D. (1975): Index Numbers in Theory and Practice, Macmillan
8. Mukhopadhyay P. (1999): Applied Statistics
9. Johnston J. & Dinardo J. (1997): Econometric Methods, McGraw Hill
10. Nagar A.L. & Das R.K. (1976): Basic Statistics

401 Sampling Distributions

Introduction: Concepts of Random Sampling, Statistics and Sampling Distributions of Statistics. Illustrations using different distributions, reproductive properties of the distributions. (7L)

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). (13L)

Distributions of Order Statistics and Sample Range. (5L)

References:

1. Goon A.M., Gupta M.K. & Dasgupta B. (1994): An Outline of Statistical Theory (Vol-1), World Press
2. Johnson, N.I. & Kotz S. (1970): Distributions in Statistics, John Wiley
3. Ross S.M. (1972): Introduction to Probability Models, Academic Press
4. Mood A.M., Graybill F. & Boes D.C. (1974): An Introduction to the Theory of Statistics (3rd ed), McGraw Hill
5. Rao C.R. (1952): Advanced Statistical Methods in Biometric Research, John Wiley
6. Hogg R.V. & Craig A.T. (1978): Introduction to Mathematical Statistics
7. Rohatgi V.K. (1984): An Introduction to Probability Theory & Mathematical Statistics, John Wiley
8. Stuart G & Ord J.K. (1991): Advanced Theory of Statistics (Vol 2), Charles Griffin
9. Goon A. M., Gupta M. K.and Dasgupta B. (1997): Fundamentals of Statistics (V-1), World Press
10. Bhattacharya GK & Johnson R. A. (1977): Concepts & Methods of Statistics, John Wiley

402 Statistical Inference I

Idea of Inference - Point & Interval Estimations and Testing of Hypothesis (2L)

Point estimation: Requirements of a good estimator – notions of Mean Square Error, Unbiasedness: Minimum Variance Uunbiasedness and Best Linear Unbisedness, Sufficiency, Factorization Theorem (Discrete case only), Properties of minimum variance unbiased estimators, consistent estimators and asymptotic efficiency, Cramer-Rao lower bound, Rao-Blackwell Theorem. (17L)

Methods of Estimation – Moment, Least-square, Maximum Likelihood & Minimum χ^2 methods and their properties (excluding proofs of large sample properties). (6L)

References:

1. Goon A.M., Gupta M.K. & Dasgupta B. (1994): An Outline of Statistical Theory (Vol-1), World Press
2. Johnson, N.I. & Kotz S. (1970): Distributions in Statistics, John Wiley
3. Ross S.M. (1972): Introduction to Probability Models, Academic Press
4. Mood A.M., Graybill F. & Boes D.C. (1974): An Introduction to the Theory of Statistics (3rd ed), McGraw Hill
5. Rao C.R. (1952): Advanced Statistical Methods in Biometric Research, John Wiley
6. Hogg R.V. & Craig A.T. (1978): Introduction to Mathematical Statistics
7. Rohatgi V.K. (1984): An Introduction to Probability Theory & Mathematical Statistics, John Wiley
8. Stuart G & Ord J.K. (1991): Advanced Theory of Statistics (Vol 2), Charles Griffin
9. Goon A. M., Gupta M. K. and Dasgupta B. (1997): Fundamentals of Statistics (V-1), World Press
10. Bhattacharya GK & Johnson R. A. (1977): Concepts & Methods of Statistics, John Wiley

403 **Statistical Quality Control**

Introduction: Concepts of Quality and Quality Control, Process Control and Product Control (5L)

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. (10L)

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 . (10L)

References :

1. Goon A. M., Gupta M. K., Dasgupta B. (2001): Fundamentals of Statistics (V-2), World Press
2. Duncan A.J. (1953): Quality Control and Industrial Statistics, Richard D Irwin
3. Cowden D.J. (1957): Statistical Methods in Quality Control, Prentice Hall
4. Grant E.L. & Leavenworth (1964): Statistical Quality Control, McGraw Hill
5. Bowley A.H. & Goode H.P. (1952): Sampling Inspection by Variables, McGraw Hill
6. Ekambaram S. K. (1960): The Statistical Basis of Quality Cont. Charts, Asia Publishing House
7. Montgomery D.C. (1985): Introduction to Statistical Quality control, John Wiley
8. IS2500 Part I and Part II
9. Bureau of Indian Standards (1994): Handbook on Statistical quality Control
10. Indian Standards Institution (1982): Manual on Basic Principles of Lot Sampling

501 Multivariate Analysis

Multivariate data – multiple regression, multiple correlation and partial correlation – their properties and related results. (8L)

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. (9L)

Multivariate Distributions: Multinomial, Multivariate Normal distributions and their properties. (8L)

References:

1. Kendall M.G. & Stuart A. (1966): Advanced Theory of Statistics (Vol 3), C.Griffin
2. Anderson T.W. (1958): An Introduction to Multivariate Statistical Analysis, 3rd edition, Wiley interscience
3. Goon A.M., Gupta M.K. & Dasgupta B. (1994): An Outline of Statistical Theory (Volumes 1 & 2), World Press
4. Rohatgi V.K. (1984): An Introduction to Probability Theory & Math. Statistics, John Wiley
5. Johnson, N.L. & Kotz S. (1970): Distributions in Statistics, John Wiley
6. Hogg R.V. & Craig A.T. (1978): Introduction to Mathematical Statistics
7. Rao C.R. (1974): Linear Statistical Inference and its Applications, John Wiley
8. Mukhopadhyay P. (1996): Mathematical Statistics
9. Johnson R. A. and Wichern, W (2001): Applied Multivariate Statistical Analysis, 5th edition, Prentice Hall

502 Statistical Inference II

Test of significance (Marks 15)

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 (4L)

Tests of Significance related 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, Combination of Probabilities in tests of significance (11L)

Analysis of Variance (ANOVA) (Marks 10)

Introduction: Heterogeneity and Analysis of Variance and Covariance, Linear Hypothesis, Orthogonal splitting of total variation, Selection of Valid Error. (3L)

Applications of the ANOVA technique to: one-way classified data, two-way classified data with equal number of observations per cell, testing simple regression coefficients, tests for parallelism and identity, correlation ratio, linearity of simple regression, multiple correlation and partial correlation coefficients. (7L)

References :

1. Goon A.M., Gupta M.K. & Dasgupta B. (1994): An Outline of Statistical Theory (Vol-2), World Press
2. Mood A.M., Graybill F. & Boes D.C. (1974): An Introduction to the Theory of Statistics (3rd ed), McGraw Hill
3. Rao C.R. (1952): Advanced Statistical Methods in Biometric Research, John Wiley
4. Hogg R.V. & Craig A.T. (1978): Introduction to Mathematical Statistics
5. Rohatgi V.K. (1984): An Introduction to Probability Theory & Mathematical Statistics, John Wiley
6. Stuart G & Ord J.K. (1991): Advanced Theory of Statistics (Vol 2), Charles Griffin
7. Goon A. M., Gupta M. K. and Dasgupta B. (1997): Fundamentals of Statistics (V-1 and 2), World Press
8. Bhattacharya GK & Johnson R. A. (1977): Concepts & Methods of Statistics, John Wiley
9. Scheffe H. (1959): The Analysis of Variance, John Wiley

503 Introduction to Designs of Sample Survey and Experiments

Introduction to Sample Survey (Marks 10)

Introduction: Concepts of Finite Population and Sample, Need for Sampling, Complete Enumeration and Sample Surveys. (2L)

General Ideas: Planning and execution of sample surveys, analysis of data and reporting, Biases and Errors. Judgement and probability sampling schemes. Tables of Random Numbers and their uses (3L)

Simple Random Sampling with and without replacement, Determination of sample size in simple random sampling. (5L)

Introduction to Design of Experiments (Marks 15)

Principles of experimental design: Randomization, Replication and Local Control, Uniformity trials, Shapes and Sizes of Plots and Blocks. (4L)

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. (11L)

References:

1. Goon A. M. ,Gupta M. K., Dasgupta B.(2001): Fundamentals of Statistics (V-2),World Press
2. Murthy M.N. (1977): Sampling Theory and Methods, Statistical Pub. Soc., Calcutta
3. Des Raj & Chandhok P.(1998): Sample Survey Theory, Narosa Publishing House
4. Cochran W.G. (1984): Sampling Techniques (3rd edition), Wiley Eastern
5. Mukhopadhyay P. (1998): Theory and Methods of Survey Sampling, Prentice Hall
6. Sukhatme P.V. & Sukhatme B.V. (1970): Sampling Theory of Surveys with, Asia Publishing House
7. Sampathy S. (2001): Sampling Theory and Methods, Narosa
8. NSSO Publications
9. Kempthorne O. (1965): The Design and Analysis of Experiments, Wiley Eastern
10. Das M.N. & Giri N.C. (1986) : Design and Analysis of Experiments. (2nd edition), Wiley Eastern
11. Montgomery D.C. (1976): Design and Analysis of Experiments, John Wiley
12. Cochran W.G. & Cox G.M. (1957): Experimental Designs, John Wiley
13. Federer W.T. (1975): Experimental Designs – Theory and Application, Oxford & IBH
14. Mukhopadhyay P. (1999): Applied Statistics

504 Time Series Analysis

Introduction: Examples of time series from various fields, Components of a times series, Additive and Multiplicative models. (2L)

Trend and Seasonal Components: Estimation of trend by linear filtering (simple and weighted moving-averages) and curve fitting (polynomial, exponential and Gompertz), Detrending. Estimation of seasonal component by ratio to moving-average method, ratio to trend method, Deseasonalization. (10L)

Stationary Time series: Weak stationarity, Autocorrelation Function and Correlogram (4L)

Some Special Processes: Moving-average (MA) process and Autoregressive (AR) process of orders one and two, Estimation of the parameters of AR(1) and AR(2) – Yule-Walker equations (7L)
Exponential smoothing method of forecasting (2L)

References:

1. Kendall M.G. (1976): Time Series, Charles Griffin
2. Chatfield C. (1980): The Analysis of Time Series –An Introduction, Chapman & Hall
3. Mukhopadhyay P. (1999): Applied Statistics
4. Johnston J. & Dinardo J. (1997): Econometric Methods, McGraw Hill

601 Large Sample Theory

Convergence in Probability, Weak Law of Large Numbers and its applications, Convergence in Distribution, DeMoivre Laplace limit theorem, Statement of Central Limit Theorem (i.i.d. case) & its applications. (8L)

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 (8L)

Transformations of Statistics to stabilize variance: derivation and use of Sin^{-1}, square root, logarithmic and z-transformations. (3L)

Large sample tests for binomial proportions, Poisson means (single and two independent samples cases) and correlation coefficients.. (3L)

Large Sample distribution of Pearsonian χ^2 –statistic and its uses. Yate's correction in a 2 x 2 contingency table. (3L)

References:

1. Goon A.M., Gupta M.K. & Dasgupta B. (1994): An Outline of Statistical Theory (Vol-1 and 2), World Press
2. Serfling R.J. (1980): Approximation Theory of Mathematical Statistics, John Wiley
3. Chandra T.K. (1999): A First Course in Asymptotic Theory in Statistics, Narosa
4. Hogg R.V. & Craig A.T. (1978): Introduction to Mathematical Statistics

602 Statistical Inference III

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), Uniformly Most Powerful Unbiased (UMPU) tests (definition only). (9L)

Likelihood Ratio tests and its applications to tests for the equality of means and variances of several normal populations. (5L)

Interval Estimation: Confidence intervals, Concepts of Uniformly Most Accurate (UMA) confidence sets, relationship with tests of hypotheses. (3L)

Nonparametric Methods: Sign test, Mann-Whitney test, Run test, Test of randomness, Confidence limits for Quantiles based on Sign test statistic. (8L)

References :

1. Goon A.M., Gupta M.K. & Dasgupta B. (1994): An Outline of Statistical Theory (Vol-2), World Press
2. Mood A.M., Graybill F. & Boes D.C. (1974): An Introduction to the Theory of Statistics (3rd ed), McGraw Hill
3. Rao C.R. (1952): Advanced Statistical Methods in Biometric Research, John Wiley
4. Hogg R.V. & Craig A.T. (1978): Introduction to Mathematical Statistics
5. Rohatgi V.K. (1984): An Introduction to Probability Theory & Mathematical Statistics, John Wiley
6. Stuart G & Ord J.K. (1991): Advanced Theory of Statistics (Vol 2), Charles Griffin
7. Goon A. M., Gupta M. K. and Dasgupta B. (1997): Fundamentals of Statistics (V-1 and 2), World Press
8. Bhattacharya GK & Johnson R. A. (1977): Concepts & Methods of Statistics, John Wiley

603 Design of Experiments

Split Plot Design and Strip arrangements. (3L)

Groups of Experiments using RBD and LSD (3L)

Factorial Experiments: 2^n experiments, Advantages, Total and Partial Confounding, Analysis (10L)

Missing Plot Technique: Analysis with one missing plot in a RBD and in a LSD. (4L)

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, use in the control of error in CRD, RBD and LSD. (5L)

References:

1. Kempthorne O. (1965): The Design and Analysis of Experiments, Wiley Eastern
2. Das M.N. & Giri N.C. (1986) : Design and Analysis of Experiments. (2nd edition), Wiley Eastern
3. Montgomery D.C. (1976): Design and Analysis of Experiments, John Wiley
4. Cochran W.G. & Cox G.M. (1957): Experimental Designs, John Wiley
5. Federer W.T. (1975): Experimental Designs – Theory and Application, Oxford & IBH
6. Mukhopadhyay P. (1999): Applied Statistics

604 Sample Survey Methods

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 (18L)

Ratio and Regression methods of estimation in simple random sampling. Double sampling for ratio and regression estimators. (5L)

Randomized Response Techniques: Warner's Model. (2L)

References:

1. Goon A. M. ,Gupta M. K., Dasgupta B.(2001): Fundamentals of Statistics (V-2),World Press
2. Murthy M.N. (1977): Sampling Theory and Methods, Statistical Pub. Soc., Calcutta
3. Des Raj & Chandhok P.(1998): Sample Survey Theory, Narosa Publishing House
4. Cochran W.G. (1984): Sampling Techniques (3rd edition), Wiley Eastern
5. Mukhopadhyay P. (1998): Theory and Methods of Survey Sampling, Prentice Hall
6. Sukhatme P.V. & Sukhatme B.V. (1970): Sampling Theory of Surveys with, Asia Publishing House
7. Sampathy S. (2001): Sampling Theory and Methods, Narosa

Practical (Honours) Course Structure

Paper	Course structure
1; 104 (Paper IIB in annual system)	1. Respective practical problems (without using computer) covering papers - Descriptive Statistics I (101) and Linear Algebra (103) – 20 marks 2. Computer course – 5 marks (a) Number system – Binary, Octal, Hexadecimal; Binary arithmetic (b) Use of EXCEL: (i)Workbook and worksheets; working with worksheets to calculate different order moments etc. (ii) Use of functions- Some Statistical and mathematical functions, (iii) Creating easy to understand charts
2; 204 (Paper IIB in annual system)	1. Respective practical problems (without using computer) covering papers - Descriptive Statistics II (201) and Population Statistics (203) – 20 marks 2. Computer course – 5 marks (a) Use of EXCEL: (b) (i) Worksheet (ii) Use of functions
3; 304 (Paper IVB in annual system)	1. Respective practical problems (without using computer) covering papers – Mathematical Methods (301) and Official & Economic Statistics (303) – 20 marks 2. Computer course – 5 marks (a) MINITAB syllabus Use of different menus- manipulation, calculation, statistics, graph, editor Practical Exercises using data: (i) Drawing of different charts and graphs (Histogram, Stem and leaf, box, Scatter, matrix plot) (ii) Computation and interpretation of mean, median, mode, SD, Mean deviation and quartiles. (iii) Computation and interpretation of correlation coefficient , regression line (iv) Matrix addition, multiplication, Diagonalisation, Inversion.
4; 404 (Paper IVB in annual system)	1. Respective practical problems (without using computer) covering papers – Statistical Inference I (402) and Statistical Quality Control (403)– 20 marks 2. Computer course – 5 marks (a) Computer software- operating system, computer languages- machine language, high level language, statistical packages. (b) Algorithm and flow charts (c) Introduction to C programming- (i) Basic structure of a C program (explanation with a simple program) (ii) Constants, variables and declarations (iii) Selected library functions (iv) Simple input-output statements (v) Operators – arithmetic, increment and decrement (vi) Looping structure: “for” loop (vii) Some selected C programs: addition, multiplication, calculation of mean, computation of different order moments, correlation, and fitting straight line to a given

	data set.
5; 505 (Paper VIIA in annual system)	Respective practical problems (without using computer) covering papers – Multivariate Analysis (501), Statistical Inference II (502)
5; 506 (Paper VIIA in annual system)	Respective practical problems (without using computer) covering papers – Introduction to Designs of Sample Survey and Experiments (503), Time Series Analysis (504)
5; 507 (Paper VIIIA in annual system)	Computer Programming: 1. More on input-output statements 2. Operator - relational and logical, conditional operator 3. More on library functions 4. Data type 5. Decision making and branching- If, If-else, Nesting of if statement, go to statement 6. Arrays 7. Some selected C programs: (i) Selection and Bubble sort, Computation of quantiles, Computation of Spearman's rank correlation coefficient (no tie case) (ii) Fitting of Binomial and Poisson distributions (iii) Interpolation by Lagrange's formula.
5; 508 (Paper VIIIA in annual system)	Computer Programming: 1. More on looping structure (control statement) – while, do while 2. Use of Functions 3. File structure 4. Some suggested C programs: (i) Numerical integration (Trapezoidal and Simpson's 1/3 rule) with convergence; (ii) Solution of numerical equations by Newton Raphson and iterative method (single variable); (iii) Addition, multiplication, transpose of matrices (iv) Trace, determinant and inverse of square matrices (v) Generation of random samples from Normal, Chi-square, t and F distributions.
6; 605 (Paper VIIB in annual system)	Respective practical problems (without using computer) covering papers – Large Sample Theory (601), Statistical Inference III (602)
6; 606 (Paper VIIB in annual system)	Respective practical problems (without using computer) covering papers –Design of Experiments (603) , Sample Survey Methods (604)
6; 607 (Paper VIIIB in annual system)	Computation and Data Analysis encompassing all topics taught in the six semesters. Use may be made of all computational methods taught in all the semesters along with analysis tool pack of EXCEL (not covered in Paper 204) and modules of MINITAB (not covered in Paper 304)
6; 608 (Paper VIIIB in annual system)	Computation and Data Analysis encompassing all topics taught in the six semesters. Use may be made of all computational methods taught in all the semesters along with analysis tool pack of EXCEL (not covered in Paper 204) and modules of MINITAB (not covered in Paper 304)

Rules for the Practical Examinations

For the Part I examination, the Practical Examination (for Paper IIB) will be of 5 (FIVE) hours duration including problems to be solved with EXCEL. The Notebooks need to be submitted during the course of the examination. The Viva-Voce will either be held concurrently with the examination or a separate day may be allotted for it depending on the discretion of the examiners and to be decided in the meeting of the UG Board of Studies.

For the Part II examination, the Practical Examination (for Paper IVB) will be of 5 (FIVE) hours duration including problems to be solved with MINITAB and C. The Notebooks need to be submitted during the course of the examination. The Viva-Voce will either be held concurrently with the examination or a separate day may be allotted for it depending on the discretion of the examiners and to be decided in the meeting of the UG Board of Studies.

For the Part III examination, the Practical Examination for the two papers viz. Papers VIIA and VIIB will be held on two separate days each of 5 (FIVE) hours duration. The Notebooks need to be submitted during the course of the examination. The Viva-Voce will either be held concurrently with the examination or on a separate day depending on the discretion of the examiners and to be decided in the meeting of the UG Board of Studies.

The examination for Papers VIIIA and VIIIB will be held on two separate days each of 5 (FIVE) hours duration. This examinations may be held in batches (on the same or on separate days) or simultaneously for all students depending on the availability of computers. The Viva-Voce will be held during the course of the examination. A Practical Notebook, comprising of the exercises pertaining to *Computer Programming* corresponding to Paper VIIIA done during the year, will need to be submitted during the course of the examination for evaluation. *For these two practical papers it is imperative that the respective colleges arrange for their own computers and printers and allow the students sufficient time to practice on them so that they are able to compile their Practical Notebook as also to ready themselves for the examination.* If necessary, the examination for this paper may also be held in the colleges which must make sure of the availability of sufficient computers and printers for the purpose for the benefit of their students. The Viva-Voce will either be held concurrently with the examination or on a separate day depending on the discretion of the examiners and to be decided in the meeting of the UG Board of Studies.

GENERAL

101 Descriptive Statistics I

Types of statistical data, Compilation, Classification, Tabulation and Diagrammatic representation of data, Frequency Distribution, Cumulative Distribution and their graphical representation, Histogram, Frequency Polygon, Frequency Curve and Ogive. (11L)

Analysis of Univariate Quantitative Data – concepts of central tendency, dispersion, relative dispersion, skewness and kurtosis and their measures based on quantiles and moments. (14L)

References:

1. Goon A.M., Gupta M. & Dasgupta B.(2001) : Fundamentals of Statistics (Vol. 1), World Press
2. Yule G.U. & Kendall M.G.(1950) : Introduction to the Theory of Statistics, Charles Griffin
3. Nagar A.L. & Das R.K. (1976): Basic Statistics
4. Bhattacharyya G. K. & Johnson R. A. (1977) : Concepts & Methods of Statistics, J.Wiley

102 Probability I

Random Experiments and Random Events, Statistical regularity and meaning of Probability, Classical and Axiomatic definitions of Probability (discrete sample space only), Conditional Probability, Independence of Events, Principal Theorems including union and intersection of events and Bayes Theorem. (13L)

Random Variable and its Probability Distribution, Cumulative Distribution Function, Probability Mass Function and Probability Density Function, Mathematical Expectation, Variance and Moments. Joint Distribution of two random variables, Marginal and Conditional distributions, Covariance and Correlation, Simple Theorems including theorems on expectation and variance of a sum of random variables and expectation of product of random variables. (12L)

References:

1. Goon A.M., Gupta M. & Dasgupta B.(1997): An Outline of Statistics(Vol 1), World Press
2. Feller W.(1968) : An Introduction to Probability Theory & its Applications, John Wiley
3. Cacoullos T. (1973): Exercises in Probability, Narosa
4. Bhattacharyya G. K. & Johnson R. A. (1977) : Concepts & Methods of Statistics, J.Wiley
5. Freund J.E. (2001): Mathematical Statistics, Prentice Hall
6. Pitman J. (1993): Probability, Narosa
7. Stirzaker D. (1994): Elementary Probability, Cambridge University Press
8. Rathie and Mathai: Probability and Statistics

201 Descriptive Statistics II

Fitting of Binomial, Poisson and Normal distributions (2L)

Analysis of Bivariate Quantitative Data – Scatter Diagram, Product Moment Correlation Coefficient and its properties, Regression Analysis, Fitting of Linear and Polynomial equations by the principle of Least Squares, Correlation Index, Spearman's Rank Correlation Coefficient. (15L)

Analysis of Multivariate Quantitative Data – Multiple Regression, Multiple Correlation and Partial Correlation in *three* variables, their measures and related results. (8L)

References:

1. Goon A.M., Gupta M. & Dasgupta B.(2001) : Fundamentals of Statistics (Vol. 1), World Press
2. Yule G.U. & Kendall M.G.(1950) : Introduction to the Theory of Statistics, Charles Griffin
3. Nagar A.L. & Das R.K. (1976): Basic Statistics
4. Bhattacharyya G. K. & Johnson R. A. (1977) : Concepts & Methods of Statistics, J.Wiley

202 Probability II

Standard Univariate Discrete Distributions and their properties – Discrete Uniform, Binomial, Poisson, Hypergeometric, Geometric and Negative Binomial distributions (10L)

Standard Univariate Continuous Distributions – Uniform, Normal, Exponential, Gamma, Beta and Lognormal distributions, Bivariate Normal distribution and statement of its general properties (10L)

Chebychev's Inequality, Weak Law of Large Numbers, Statement of Central Limit Theorem (i.i.d. case) and its uses. (5L)

References:

1. Goon A.M., Gupta M. & Dasgupta B.(1997): An Outline of Statistics(Vol 1), World Press
2. Feller W.(1968) : An Introduction to Probability Theory & its Applications, John Wiley
3. Cacoullos T. (1973): Exercises in Probability, Narosa
4. Bhattacharyya G. K. & Johnson R. A. (1977) : Concepts & Methods of Statistics, J.Wiley
5.Freund J.E. (2001): Mathematical Statistics, Prentice Hall
6.Pitman J. (1993): Probability, Narosa
7.Stirzaker D. (1994): Elementary Probability, Cambridge University Press
8. Rathie and Mathai: Probability and Statistics

301 Sampling Distributions and Point Estimation

Concepts of Population and sample, Random Sampling and Sampling Distributions of Statistics, sampling distribution of sum of independent Binomial and Poisson variables, χ^2, t and F distributions (derivations excluded), sampling distribution of mean and variance of independent Normal variables. (13L)

Point Estimation of a population parameter – concepts of Bias and Standard Error of an estimator, concepts of Unbiasedness, Minimum Variance, Consistency and Efficiency of an estimator, Method of Moments, Maximum Likelihood Method of estimation, Method of Least Squares, Point estimators of the parameters of Binomial, Poisson, and univariate Normal distributions. (12L)

References:

1. Goon A.M., Gupta M. & Dasgupta B.(1997) : An Outline of Statistics (Vol 1), World Press
2. Goon A.M.,Gupta M.& Dasgupta B.(2001): Fundamentals of Statistics (Vol 1), World Press
3. Mood A.M., Graybill F. & Boes D.C.(1974) : An Introduction to the theory of Statistics (3rd ed.), McGraw Hill
4. Rohatgi V.K. (1984): An Introduction to Probability Theory and Mathematical Statistics, John Wiley
5. Goon A.M.,Gupta M.& Dasgupta B.(2001): Fundamentals of Statistics (Vol 1), World Press

302 Economic Statistics, Time Series Analysis

Economic Statistics: Index Number –construction and use of price index numbers and tests in connection with them, Consumer and Wholesale price index numbers, their uses and major steps in their construction. (12L)

Time Series Analysis: Different components of a times series, determination of Trend by method of simple moving-averages and by fitting mathematical curves by least squares principle, determination of seasonal indices by methods of trend ratios and ratios to moving averages. (13L)

References:

1. Goon A.M.,Gupta M.& Dasgupta B.(2001): Fundamentals of Statistics (Vol 2), World Press
2. Yule G.U.& Kendall M.G.(1950) : Introduction to the Theory of Statistics, Charles Griffin
3. Nagar A.L. & Das R.K. (1976): Basic Statistics
4. Mukhopadhyay P. (1999): Applied Statistics
5. Croxton F. E., Cowden D. J. & Klein (1969) : Applied General Statistics, Prentice Hall

401 Statistical Inference

Statistical tests of Hypotheses – Null and Alternative hypotheses, Types of Errors, Critical Region, Level of Significance, Power and p-values, Exact tests of hypotheses under Normal set-up for a single mean, the equality of two means, a single variance and the equality of two variances, Test of Significance of sample correlation coefficient (null case) and tests of hypotheses for the equality of means and equality of variances of a bivariate Normal distribution. (13L)

Interval Estimation – Confidence Interval and Confidence Coefficient, Exact confidence interval under Normal set-up for a single mean, single variance, the difference of two means and the ratio of two variances. (5L)

Large Sample Tests and related Interval Estimates of a single mean and a single proportion and difference of two means & two proportions, Pearsonian χ^2 tests for goodness of fit & for homogeneity and independence in a contingency table. (7L)

References:

1. Goon A.M., Gupta M. & Dasgupta B.(1997) : An Outline of Statistics (Vol 1), World Press
2. Goon A.M.,Gupta M.& Dasgupta B.(2001): Fundamentals of Statistics (Vol 1), World Press
3. Mood A.M., Graybill F. & Boes D.C.(1974) : An Introduction to the theory of Statistics (3rd ed.), McGraw Hill
4. Rohatgi V.K. (1984): An Introduction to Probability Theory and Mathematical Statistics, John Wiley
5. Goon A.M.,Gupta M.& Dasgupta B.(2001): Fundamentals of Statistics (Vol 1), World Press

402 Population Statistics and Statistical Quality Control

Population Statistics:

Vital events, Rates and Ratios, Measurement of Mortality – Crude, Specific and Standardized death rates, Complete Life Table, Measurement of Fertility and Reproduction – Crude Birth Rate, General, Specific and Total fertility rates, Gross and Net reproduction rates. (14L)

Statistical Quality Control:

Advantages of statistical quality control, Construction of control charts by attributes (p, c, np) and variables ($\bar{x}$, R). (7L)

Sampling Inspection Plan by attributes, OC, ASN (and ATI), LTPD and AOQL for single sampling plan (4L)

References:

1. Goon A.M.,Gupta M.& Dasgupta B.(2001): Fundamentals of Statistics (Vol 2), World Press
2. Yule G.U.& Kendall M.G.(1950) : Introduction to the Theory of Statistics, Charles Griffin
3. Nagar A.L. & Das R.K. (1976): Basic Statistics
4. Mukhopadhyay P. (1999): Applied Statistics
5. Croxton F. E., Cowden D. J. & Klein (1969) : Applied General Statistics, Prentice Hall

501 Sample Survey Methods:

Concepts of population and sample, Need for sampling, Stages in the design and conduct of sample surveys. Concept of probability sampling, Random Number tables. Simple random sampling with and without replacement (8L)

Stratified random sampling – associated unbiased estimators of population mean, total and proportion, their variances and unbiased variance estimators, Linear Systematic sampling, Two-stage sampling (with primary units of equal size and equal selection probability at each stage) – unbiased estimation of population mean and total. (17L)

References:

1. Goon A.M.,Gupta M.& Dasgupta B.(2001): Fundamentals of Statistics (Vol 2), World Press
2. Cochran W.G. (1984): Sampling Techniques (3rd ed.), Wiley Eastern
3. Nagar A.L. & Das R.K. (1976): Basic Statistics
4. Mukhopadhyay P. (1999): Applied Statistics

601 Design & Analysis of Experiments

Analysis of Variance in one-way classified data and two-way classified data with equal number of observations in each cell. (10L)

Basic principles of design – Randomization, Replication and Local Control, Completely Randomized design, Randomized Block design and Latin Square design, applications of the technique of Analysis of Variance for the analysis of data collected under these designs. (15L)

References:

1. Goon A.M.,Gupta M.& Dasgupta B.(2001): Fundamentals of Statistics (Vol 2), World Press
2. Kempthorne O.(1965): The Design & Analysis of Experiments, Wiley Eastern
3. Nagar A.L. & Das R.K. (1976): Basic Statistics
4. Mukhopadhyay P. (1999): Applied Statistics

Question Pattern for B.Sc. Honours Examinations in Statistics (1+1+1) - 2010

Theoretical

Part I

Paper IA:

- Short Questions of 5 marks each: No. of questions to be given = 8
  No. of questions to be answered = 4
  Total marks = 5 x 4 = 20
- Broad Questions of 15 marks each: No. of questions to be given = 4
  No. of questions to be answered = 2
  Total marks = 15 x 2 = 30

Paper IB:

- Short Questions of 5 marks each: No. of questions to be given = 8
  No. of questions to be answered = 4
  Total marks = 5 x 4 = 20
- Broad Questions of 15 marks each: No. of questions to be given = 4
  No. of questions to be answered = 2
  Total marks = 15 x 2 = 30

Paper IIA:

Group A (25 marks)

- Short Questions of 5 marks each: No. of questions to be given = 4
  No. of questions to be answered = 2
  Total marks = 5 x 2 = 10
- Broad Questions of 15 marks each: No. of questions to be given = 2
  No. of questions to be answered = 1
  Total marks = 15 x 1 = 15

Group B (25 marks)

- Short Questions of 5 marks each: No. of questions to be given = 4
  No. of questions to be answered = 2
  Total marks = 5 x 2 = 10
- Broad Questions of 15 marks each: No. of questions to be given = 2
  No. of questions to be answered = 1
  Total marks = 15 x 1 = 15

Part II

Paper IIIA:

Group A (25 marks)

- Short Questions of 5 marks each: No. of questions to be given = 4
  No. of questions to be answered = 2
  Total marks = 5 x 2 = 10
- Broad Questions of 15 marks each: No. of questions to be given = 2
  No. of questions to be answered = 1
  Total marks = 15 x 1 = 15

Group B (25 marks)

- Short Questions of 5 marks each: No. of questions to be given = 4
  No. of questions to be answered = 2
  Total marks = 5 x 2 = 10
- Broad Questions of 15 marks each: No. of questions to be given = 2
  No. of questions to be answered = 1
  Total marks = 15 x 1 = 15

Paper IIIB:

Group A (25 marks)

- Short Questions of 5 marks each: No. of questions to be given = 4
  No. of questions to be answered = 2
  Total marks = 5 x 2 = 10
- Broad Questions of 15 marks each: No. of questions to be given = 2
  No. of questions to be answered = 1
  Total marks = 15 x 1 = 15

Group B (25 marks)

- Short Questions of 5 marks each: No. of questions to be given = 4
  No. of questions to be answered = 2
  Total marks = 5 x 2 = 10
- Broad Questions of 15 marks each: No. of questions to be given = 2
  No. of questions to be answered = 1
  Total marks = 15 x 1 = 15

Paper IVA:

Group A (25 marks)

- Short Questions of 5 marks each: No. of questions to be given = 4
  No. of questions to be answered = 2
  Total marks = 5 x 2 = 10
- Broad Questions of 15 marks each: No. of questions to be given = 2
  No. of questions to be answered = 1
  Total marks = 15 x 1 = 15

Group B (25 marks)

- Short Questions of 5 marks each: No. of questions to be given = 4
  No. of questions to be answered = 2
  Total marks = 5 x 2 = 10
- Broad Questions of 15 marks each: No. of questions to be given = 2
  No. of questions to be answered = 1
  Total marks = 15 x 1 = 15

Part III

Paper VA:

Group A (25 marks)

- Short Questions of 5 marks each: No. of questions to be given = 4
  No. of questions to be answered = 2
  Total marks = 5 x 2 = 10
- Broad Questions of 15 marks each: No. of questions to be given = 2
  No. of questions to be answered = 1
  Total marks = 15 x 1 = 15

Group B (25 marks)

- Short Questions of 5 marks each: No. of questions to be given = 4
  No. of questions to be answered = 2
  Total marks = 5 x 2 = 10
- Broad Questions of 15 marks each: No. of questions to be given = 2
  No. of questions to be answered = 1
  Total marks = 15 x 1 = 15

Paper VB:

- Short Questions of 5 marks each: No. of questions to be given = 8
  No. of questions to be answered = 4
  Total marks = 5 x 4 = 20
- Broad Questions of 15 marks each: No. of questions to be given = 4
  No. of questions to be answered = 2
  Total marks = 15 x 2 = 30

Paper VIA:

- Short Questions of 5 marks each: No. of questions to be given = 8
  No. of questions to be answered = 4
  Total marks = 5 x 4 = 20
- Broad Questions of 15 marks each: No. of questions to be given = 4
  No. of questions to be answered = 2
  Total marks = 15 x 2 = 30

Paper VIB:

Group A (25 marks)

- Short Questions of 5 marks each: No. of questions to be given = 4
  No. of questions to be answered = 2
  Total marks = 5 x 2 = 10
- Broad Questions of 15 marks each: No. of questions to be given = 2
  No. of questions to be answered = 1
  Total marks = 15 x 1 = 15

Group B (25 marks)

- Short Questions of 5 marks each: No. of questions to be given = 4
  No. of questions to be answered = 2
  Total marks = 5 x 2 = 10
- Broad Questions of 15 marks each: No. of questions to be given = 2
  No. of questions to be answered = 1
  Total marks = 15 x 1 = 15

Note:

1. There will be no choices among questions in the Practical Papers. The candidates will be required to answer all the questions.
2. The practical examination of Paper IIB in Part 1, Paper IVB in Part 2 and Papers VIIA and VIIB in Part 3 will be held simultaneously in all the centers on the basis of single question paper in respective papers. Papers VIIIA and VIIIB in Part 3 may be held in groups on different dates. However, the final modality will be decided in the UG Board of Studies meeting.
3. The division of marks for each subsection of all the questions in the Theoretical papers is to be given alongside. No such division need to be given for the questions in the Practical papers.

Question Pattern for B.Sc. General Examinations in Statistics (1+1+1) - 2010

Theoretical

Part I

Paper IA:

- Short Questions of 2 marks each: No. of questions to be given = 8
  No. of questions to be answered = 4
  Total marks = 2 x 4 = 8
- Broad Questions of 14 marks each: No. of questions to be given = 6
  No. of questions to be answered = 3
  Total marks = 14 x 3 = 42

Paper IB:

- Short Questions of 2 marks each: No. of questions to be given = 8
  No. of questions to be answered = 4
  Total marks = 2 x 4 = 8
- Broad Questions of 14 marks each: No. of questions to be given = 6
  No. of questions to be answered = 3
  Total marks = 14 x 3 = 42

Part II

Paper IIB:

- Short Questions of 2 marks each: No. of questions to be given = 8
  No. of questions to be answered = 4
  Total marks = 2 x 4 = 8
- Broad Questions of 14 marks each: No. of questions to be given = 6
  No. of questions to be answered = 3
  Total marks = 14 x 3 = 42

Paper IIIA:

- Short Questions of 2 marks each: No. of questions to be given = 8
  No. of questions to be answered = 4
  Total marks = 2 x 4 = 8
- Broad Questions of 14 marks each: No. of questions to be given = 6
  No. of questions to be answered = 3
  Total marks = 14 x 3 = 42

Part III

Paper IVA:

- Short Questions of 2 marks each: No. of questions to be given = 8
  No. of questions to be answered = 4
  Total marks = 2 x 4 = 8
- Broad Questions of 14 marks each: No. of questions to be given = 6
  No. of questions to be answered = 3
  Total marks = 14 x 3 = 42

Note:

1. There will be no choices among questions in the Practical Papers. The candidates will be required to answer all the questions.
2. The division of marks for each subsection of all the questions in the Theoretical papers is to be given alongside. No such division need to be given for the questions in the Practical papers.