VIDYASAGAR UNIVERSITY

STATISTICS

(Honours & General)

Under Graduate Syllabus

(3 Tier Examination Pattern)

w.e.f. 2014-2015

REVISED

Vidyasagar University

Midnapore 721 102

West Bengal

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VIDYASAGAR UNIVERSITY
B.Sc. STATISTICS (HONOURS)

For each Paper : Full Marks – 100

Examination	Paper	Marks in				Full Marks
		Written Exam	Internal Assessment	Practical Note Book	Viva-voce	
PART - I	Paper-I (Theory)	90	10	x	x	100
	Paper – II (Theory)	90	10	x	x	100
PART – I TOTAL						200
PART-II	Paper – III (Theory)	90	10	x	x	100
	Paper – IV Groups – A & B (Theory)	45	5	x	x	50
	Paper – IV Group – C (Practical)	40	x	5	5	50
	Paper – V Group – A (Practical)	40	x	5	5	50
	Paper – V Group – B (Practical)	40	x	5	5	50
PART – II TOTAL						300
	Paper – VI (Theory)	90	10	x	x	100
	Paper – VII Group – A (Theory)	45	5	x	x	50
	Paper – VII Group – B (Practical)	40	x	5	5	50
	Paper – VIII Group – A (Practical)	40	x	5	5	50
	Paper – VIII Group – B (Project)	x	x	40	10	50
PART – III Total						300

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VIDYASAGAR UNIVERSITY
B.Sc. STATISTICS (HONOURS)
SYLLABUS STRUCTURE
W.E.F. 2014-2015
For each Paper : Full Marks – 100

Part I

Theory

Paper I	A	Descriptive Statistics	45
	B	Matrix Algebra	20
	C	Mathematical Analysis	25
		Internal Assessment	10
		Total	100

Paper II	A	Probability Theory-I Probability Distributions & Scaling	45
	B	Numerical Analysis	20
	C	Indian Statistical System & Economic Statistics	25
		Internal Assessment	10
		Total	100

Part – II

Theory :

Paper III	A	Probability Theory – II & Sampling Distributions	35
	B	Statistical Inference-I	30
	C	Multivariate Analysis	25
		Internal Assessment	10
		Total	100

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Paper IV	A	Computer Programming & Use of Software packages	20
	B	Demography	25
		Internal Assessment	05
Total			50

Practical :

Paper IV	C	Practical Based on Descriptive Statistics of Paper I A. Probability Distributions & Scaling of Paper IIA and Multivariate Analysis of Paper III C	40
		Viva & Practical Note book (5+5)	10
		Total	50

Paper V	A	Practical based on Economic Statistics of Paper II C. Statistical Inference-I of Paper II B & Demography of Paper IV B	40
		Viva & Practical Note book (5+5)	10
		Total	50

Paper VI	B	Practical based on Matrix Algebra of Paper I B. Numerical Analysis of Paper II B & Computer Programming & Use of Software packages of Paper IV A	40
		Viva & Practical Note book (5+5)	10
		Total	50

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Part – III

Theory :

Paper VI	A	Statistical Inference - II	35
	B	Theory of Sample Survey	35
	C	Statistical Quality Control (SQC)	20
		Internal Assessment	10
		Total	100

Paper VII	A	ANOVA, ANCOVA & Design of Experiments	40
		Internal Assessment	10
		Total	50

Practical :

Paper VII	B	Practical based on Statistical Inference-II of Paper VI A, Drawing of random samples under Sampling Distribution of Paper III A and Sample Survey of Paper VI B	40
		Viva & Practical Note book (5+5)	10
		Total	50

Paper VIII	A	Practical based on SQC of paper VI C and ANOVA, ANCOVA & Design of Experiments of Paper VII A	40
		Viva & Practical Note book (5+5)	10
		Total	50

Paper VIII	B	Project Work (Using Computer Software)	40
		Project Viva	10
		Total	50

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STATISTICS (HONOURS)
Detailed Syllabus

PART - I

Paper -I

Full Marks -100
(University Exam. - 90 & Internal Assessment -10)

GROUP-A

DESCRIPTIVE STATISTICS
45 Marks :: 60 Lectures

Introduction:
Nature of Statistics, Population and sample, Uses and abuses of Statistics, Statistics and other disciplines.

Types of data:
Primary and secondary data, Qualitative and quantitative data, Nominal, ordinal and cardinal data, Different types of scale. Cross-sectional and time-series data, Discrete and continuous data, Frequency and non-frequency data.

Collection and scrutiny of data:
Collection of primary data-direct observation method. interview method, mailed questionnaire method, Types of schedules and questionnaires and their designing, Data from controlled experiments. Scrutiny of data for internal consistency and detection of errors in recording, Ideas of cross validation.

Presentation of data:
Construction of tables with one or more factors of classification, Diagrammatic presentations of non-frequency data. Construction of frequency distributions and cumulative frequency distributions and their graphical and diagrammatic presentations. Stem and leaf displays.

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Analysis of quantified data:

Univariate data -Different characteristics of frequency distributions with their measures including quintiles: central tendency, dispersion and relative dispersion of grouped and ungrouped data, moments including Sheppard's corrections (without derivation), skewness and kurtosis, Box plot, Outlier Detection

Bivariate data - Introduction. scatter diagram, product-moment correlation coefficient and its properties, correlation ratio and correlation index (*) with their associated results, rank correlation Spearman's and Kendall's measures with tie and non-tie cases, intra-class correlation with equal and unequal group sizes, principle of least squares, fitting of regression lines and curves (*) and related results.

[(*) For ***practical's, curves up to polynomial of degree two should be considered.]***

Analysis of Categorical data – Consistency of categorical data, independence and association of attributes measures of association in2×2, m×n tables – Pearson's. Yule's, Tschuprow's and Vandermode's measures. Odds ratio, fitting of logistic regression equation by least-square method.

References:

1. Goon AM, Gupta MK. Dasgupta B: Fundamentals or Statistics (Vol-I)
2. Yule G.U & Kendall M:G':' An Introduction to the Theory of Statistics
3. Snedecor & Cochran: Statistical Methods
4. Croxton F.E., Cowden DJ. & Klein: Applied General Statistics
5. Wallis F.E. & Roberts H.V. : Statistics- a new approach
6. Lewis-Beck M.S. (edt.) : Regression Analysis
7. Agresti A.: Categorical Data Analysis
8. Agresti A.: An Introduction to Categorical Data Analysis
9. Agresti A.: Analysis of Ordinal Categorical Data
10. Tukey J.W.: Exploratory Data Analysis

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GROUP-B
MATRIX ALGEBRA
20 Marks :: 25 Lectures

Arrays of numbers: Vectors and Matrices.

Vectors as n-tuples of real numbers - addition and scalar multiplication. linear combination, linear dependence and independence. basis. dimension, subspaces. inner product and orthogonality. Gram-Schmidt orthogonalization process.

Matrices - Type of matrices including non-singular and orthogonal. Operations on matrices including elementary transformations. partition of matrices, determinant, rank and inverse of a matrix.

Simple results on characteristic roots and vectors of a real symmetric matrix. Quadratic forms classification and cannonical reduction.

Solution of system 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 CR.: Linear Statistical Inference & its Applications
5. Goon A.M. : Vectors and Matrices
6. Mapa, S. K.: Abstract and Linear Algebra

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GROUP-C
MATHEMATICAL ANALYSIS
25 Marks :: 30 Lectures

Sequences, monotone sequences, limit of sum and product of sequences, series of numbers, simple test of convergence, power series, absolute convergence.

Continuity and its different characterization, uniform continuity, types of discontinuities, intermediate value theorem. absolute continuity.

Successive differentiation, MVT, L' Hospital rule, Taylor's theorem, Statement of Taylor's theorem for several variables, Extrema of functions (with or without constraints).

Improper integral, Gamma and Beta integrals. Integration by parts, Change of variable formula. Preliminary concept of Riemann integral. Multiple Integral and Jacobian (without proof).

Concepts of o and O, Polar & Orthogonal transformations.

References

1. Goldberg. R.R. : Methods of Real Analysis
2. Apostol. T.M. : Mathematical Analysis
3. Apostol T.M.: Calculus (Vols 1 & 2)
4. Widder D. V. : Advanced Calculus
5. Piskunov N. : Calculus (Vols 1 & 2)
6. Malik, S.C. : Principles of Real Analysis
7. Malik, S.C. and Arora, S, : Mathematical Analysis
8. Mapa, S.K. : Real nalysis
9. Chakraborty, Arnab: Real Analysis (Vols 1,2 & 3)

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Paper -II Full Marks - 100
(University Exam.-90 & Internal Assessment -10)
GROUP-A
PROBABILITY THEORY-I,
PROBABILITY DISTRIBUTIONS AND SCALING
45 Marks :: 60 Lectures

Probability Theory-I: 30 Lectures

Subjective and objective probability, random experiment, sample space and events, different operations on events. Classical. empirical and Kolmogorov's axiomatic definitions of probability (detailed discussion on discrete space only) limitations of classical and empirical definitions of probability. Examples based on classical definition of probability and repeated trials.

Theorems on probability of events. Probabilities of exactly m and at least m among n (> m) events. Sequences of events and their limits; Continuity of probability measures.

Conditional probability, Bayes' theorem and its applications independence of events.

Discrete and continuous random variables, probability mass function (p.m.f) and probability density function (p.d.f). cumulative distribution function (c.d.f), its properties and its relation with p.m.f and p.d.f.

Expectation and theorems on expectation. Quartiles and moments (including absolute and factorial moments). Characteristics of probability distributions (measures of central tendency: measures of dispersion; measures of skewness and measures of kurtosis).

Joint p.m.f, p.d.f and c.d.f of two random variables - both discrete and continuous. marginal and conditional distributions, conditional means and variances, independence of random variables. Theorems on expected value of sum and product of random variables, Correlation and regression.

Probability generating function (p.g.f.). and moment generating function (m.g.f.) for both univariate and bivariate cases.

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Probability Distributions & Scaling: 30 Lectures

Probability Distributions:

Univariate discrete distributions:
Uniform, Bernoulli, Binomial, Hypergeometric, Poisson, Geometric. Negative Binomial and Power Series distributions and their properties, Truncated Binomial and Poisson distributions.

Univariate continuous distributions:
Rectangular, Exponential, Laplace, Gamma, Beta, Normal. Lognormal. Pareto, Logistic, Cauchy and Truncated normal distributions and their properties.

Bivariate normal distribution and its properties.

Scaling:
Idea, scaling of items according to difficulty; scaling of test scores (Z, percentile. Thurstone. equivalent); scaling of rates and ranks; scaling of judgments).

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-I)
4. Rohatgi V.K. : An Introduction to Probability Theory & Math. Statistics
5. Rohatgi V.K. & Saleh: An Introduction to Probability & Statistics
6. Hoel PJ., Port S.c. & Stone CJ.: Introduction to Probability Theory (Vol-I)
7. Parzen E. : Modern Probability Theory and its Applications
8. Uspensky J.V. : Introduction to Mathematical Probability
9. Cacoullos T. : Exercises in Probability
10. Goon A.M. & Roy Debesh : Problems in Probability Theory
11. Rahman N.A.: Practical Exercises in Probability and Statistics
12. Chandra T.K. & Chatterjee D. : A First Course in Probability
13. Bhat B.R. : Modern Probability Theory
14. Mukhopadhyay Parimal : Mathematical Statistics

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15. Goon AM. Gupta MK, Dasgupta B: Fundamentals of Statistics (Vol-2)
16. Gupta S.c. & Kapoor V.K. - Fundamentals of Mathematical Statistics

GROUP-B

NUMERICAL ANALYSIS

20 Marks :: 25 Lectures

Errors due to rounding off, Δ & E Operators and related problems.
Interpolation formulae – Newton's forward and backward interpolation.
Newton's divided difference and Lagrange's interpolation. Error terms. Inverse interpolation.
Numerical differentiation.
Numerical integration -Trapezoidal rule. Simpson's one third rule. Euler-Maclaurin's expansion. Stirling's approximation (result only).
Numerical solution of equation in one unknown -method of false position, method of iteration, Newton-Raphson method. Convergence criterion and Geometrical interpretation of each method.

References:

1. Scarborough J.B. : Numerical Mathematical Analysis
2. Sastry S.S.: Introductory Methods of Numerical Analysis
3. Hildebrand F.B. : Introduction to Numerical Analysis
4. Mollah, S. A. : Numerical Analysis & Computational Procedures
5. Mukherjee. Kalyan.: Numerical Analysis

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GROUP-C
INDIAN STATISTICAL SYSTEM & ECONOMIC STATISTICS
25 Marks :: 30 Lectures

Indian Statistical System:

Central and State Govt. Statistical Organizations, Functions of CSO. NSSO and W B. Bureau of Applied Economics and Statistics.

Sources of official Statistics in India and West Bengal relating to population, agriculture, industry, trade. price and employment.

Brief ideas of National Income Statistics.

Economic Statistics:

Index Number:

Price. Quantity and Value indices. Construction and uses. Various formulae and their comparisons. limitations. Tests for Index Number. Chain Index Number. Consumer Price Index. Wholesale Price Index and Index of Industrial Production -methods of construction and uses.

Measures of inequality:

Gini's coefficient, Lorenz curves - use of Pareto and Lognormal distributions as income or allied distributions.

Time Series Analysis:

Examples of time series from various fields. Components of a times series. Additive and Multiplicative models.

Estimation of trend by linear fitting (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. Weak stationarity, Autocorrelation Function and Correlogram.

Exponential smoothing.

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References:

I. Goon A.M., Gupta M.K., Dasgupta B.: Fundamentals of Statistics (Vol-2)
2. Mukhopadhyay Parimal. : Applied Statistics
3. Gupta S.C. & Kapoor V.K. - Fundamentals of Applied Statistics'
4. Nagar A.L. & Das R.K.: Basic Statistics
5. C.S.O. (1984) : Statistical System in India
6. MOSPI Website (http://mospi.nic.in)
7. DOSPI, W.B. Website (http://www.dospiwb.org.in)
8. Chatfield c.: The Analysis of Time Series -An Introduction
9. Kendall M.G.: Time Series
10. Johnston J. & Dinardo J.: Econometric Methods
II. Yule G.U. & Kendall M.G: An Introduction to the Theory of Statistics 12. Kendall M.G. & Stuart A. : Advanced Theory of Statistics (Vol 3)
13. Croxton F.E., Cowden D.J. & Klein: Applied General Statistics
14. Mudgett B.D.: Index Numbers
15. Allen R.G.D.: Index Numbers in Theory and Practice

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PART-II

Paper - III
Full Marks - 100
(University Exam. - 90 & Internal Assessment - 10)

GROUP-A
PROBABILITY THEORY-II AND SAMPLING DISTRIBUTIONS
35 Marks :: 45 Lectures

Probability Theory-II

Probability Inequalities:

Markov's inequality, Chebychev's lemma, Chebychev's inequality (one-sided and two-sided).

Limit Theorems:
Convergence in probability. Weak Law of Large numbers and its applications. Convergence in distribution. Statement of Central Limit Theorem (II D case only), De Moivre-Laplace limit Theorem as an application of C.L T.

Sampling Distributions:
Concept of simple random sampling (SRS) - SRSWR and SRSWOR, random number table and its uses in the context of drawing random samples from finite population and probability distributions.

Statistic, Sampling distribution of a statistic and its standard error. Illustration using sampling from small finite populations under SRSWR and SRSWOR with special reference to sample mean and sample proportion.

Some standard sampling distributions: χ^2, t and F distributions - derivation and properties. Distribution of mean and variance of a random sample from a normal population. Distribution of means, variances and correlation coefficient (null case) of a random sample from a bivariate normal population. .

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Distribution of the sample regression co-efficient (for both stochastic and non-stochastic independent variable cases)

Distribution of order statistics and sample range.

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-I)
4. Rohatgi V.K.: An Intro. to Probability Theory & Math. Statistics
5. Rohatgi V.K. & Saleh: An Intro. to Probability & Statistics
6. Hoel PJ. Port S.C. & Stone CJ.: Introduction to Probability Theory (Vol-I)
7. Parzen E. : Modern Probability Theory and its Applications
8. Uspensky J.V. : Introduction to Mathematical Probability
9. Cacoullos T. : Exercises in Probability
10. Goon A.M. & Roy Debesh : Problems in Probability Theory
11. Rahman N.A.: Practical Exercises in Probability and Statistics
12. Chandra T.K. & Chatterjee D. : A First Course in Probability
13. Bhat B.R. : Modern Probability Theory
14. Mukhopadhyay Parimal : Mathematical Statistics
15. Goon AM. Gupta MK, Dasgupta B: Fundamentals of Statistics (V 01-2)
16. Gupta S.C. & Kapoor V.K. - Fundamentals of Mathematical Statistics
17. Johnson. N.I. & Kotz S. : Distributions in Statistics
18. Hogg R.Y. & Craig A.T.: Introduction to Mathematical Statistics
19. Mood A.M., Graybill F. & Boes D.C.: An Introduction to the Theory of Statistics
20. Ross S.M. : Introduction to Probability Models

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GROUP-B

STATISTICAL INFERENCE - I

30 Marks :: 40 Lectures

Introduction:

Parameter and parameter space; estimator. estimate, point and interval estimation: Testing of hypothesis.

Point estimation:

Mean square error. unbiasedness, minimum variance unbiasedness. consistency. efficiency and asymptotic efficiency, best linear unbiasedness. related results.

Cramer-Rao lower bound of variance and related results.

Sufficiency, factorisation theorem (proof for discrete case only). completeness. Rao-Blackwell Theorem, Statement of Lehmann-Schefte theorem.

Methods of estimation:

Least square method, method of moments, method of maximum likelihood and its properties (excluding proofs for large sample cases). method of minimum χ^2.

Testing of hypothesis-I:

Concepts of null and alternative hypotheses, simple and composite hypotheses; critical region. Type I and Type II errors, level of significance and size, power, p-value approach.

Tests of significance relating to single binomial-proportion and single Poisson parameter. two independent binomial proportions and two independent Poisson parameters. Tests of significance and associated confidence intervals for mean and variance of a univariate normal population, difference of means and ratio of variances of two independent normal populations, difference of means, ratio of variances, correlation coefficient of a bivariate normal population and the inference problems related to regression 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
3. Hogg R. V. & Craig AT : Introduction to Mathematical Statistics
4. Rao C.R. : Linear Statistical Inference and its Applications

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5. Rohatgi V X.: An Introduction to Probability Theory & Mathematical Statistics
6. Kale BX.: A First Course on Parametric Inference
7. Mukhopadhyay P.: Mathematical Statistics
8. Casella G & Berger R L: Statistical Inference
9. Lehmann E.L. & Casella G : Theory of Point estimation
10. Lehmann E.L. : Testing Statistical Hypotheses
11. Rohatgi V.K. & Saleh: An Introduction to Probability & Statistics

GROUP-C
MULTIVARIATE ANALYSIS
25 Marks :: 30 Lectures

Multivariate data: Motivation, Multiple regression and partial regression coefficients; multiple and partial correlation coefficients; properties and related results.

Random vector, Probability mass, probability density and cumulative distribution functions, mean vector and dispersion matrix, marginal and conditional distributions, concentration ellipsoid, Multiple regression, multiple and partial correlation in the context of the probability distribution.

Multivariate probability distributions: Multinomial and multivariate normal distributions and their properties.

References:

1. Kendall M.G. & Stuart A. : Advanced Theory of Statistics (Vol-I)
2. Anderson T.W. : An Introduction to Multivariate Statistical Analysis
3. Goon A.M., Gupta M.K. & Dasgupta B.: An Outline of Statistical Theory (Volumes-l & 2)
4. Rohatgi V.K. : An Introduction to Probability Theory & Mathematical Statistics
5. Johnson, N.L. & Kotz S. : Distributions in Statistics
6. Hogg R.V. & Craig AT : 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

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Paper- IV
GROUP-A

COMPUTER PROGRAMMING & USE OF SOFTWARE PACKAGES
20 Marks :: 25 Lectures

Introduction to computers: Positional number system. Binary arithmetic, Binary and Hexadecimal representation of integer and real numbers. Computer memory, Operating system, Computer languages, Problem solving using computer.

Introduction to C, Historical development, The C character set - constants, variables and keywords. Types of C constants and variables. C instruction-Type Declaration Instruction; Arithmetic Instruction, Integer and Float conversion, Type conversion in Assignment. Control instructions. The Decision Control Structure-if statement; Multiple Statements within if, if-else statement; Nested if else; Forms of if. Use of Logical operators. The Loop Control Structure-while loop, for loop; Odd loop; Break Statement; Continue Statement; do-while loop. Case control Structure-Decisions using switch; go to statement. Function - use of functions; Pointers. Floats and doubles. Storage classes in C. C Pre-processor - features-; - Arrays-Pointers and Arrays. Structures; Array of Structure. Input / Output in C- Types of I/O; Console Input/ Output functions. Disk I/O functions. I/O Redirection in DOS.

Use of spread sheet of MS EXCEL; Use of MINITAB / STATISTICA **(for Practical only)**

References:

1. Kanetkar, Y. : Let Us C
2. Chatterjee, AX. & Chatterjee, T. : Computer Applications of Mathematics and Statistics
3. Xavier C : C Language and numerical methods
4. Kernighan B.W and Ritchie D.M : The C programming language
5. Rajaraman V : Fundamentals of Computers
6. Sarma K.V.S. : Statistics Made Simple - Do It Yourself On PC

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Group-B
DEMOGRAPHY
25 Marks:: 30 Lectures

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, Specific, Standardised death, Cause of Death, Infant Morality. Maternal Mortality rates.

Life Tables: Descriptions of Complete and Abridged life tables and their uses, Construction of complete life table, Stable and Stationary population.

Measurement of Morbidity : Morbidity incidence and morbidity prevalence rates.

Measurements of Fertility: Crude, General, Age specific and Total fertility rates.

Measurement of Population Growth: Crude rate of natural increase and vital Index, Gross and Net Reproduction rates.

Population Estimation, Projection and Forecasting: Use of AP and GP methods for population estimates. Use of component method for population projection, Fitting of Logistic curve for population forecasting, using Rhode's and Fisher's methods.

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
7. Gupta S.C. & Kapoor V.K. - Fundamentals of Applied Statistics

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Paper-IV: Group-C (Practical)
Marks -50 :: Time - 4 hours

Practical based on Descriptive Statistics of Paper IA, Probability Distributions & Scaling of Paper II A .and Multivariate Analysis of Paper IIIC (Marks-40) ; Viva & Practical Note book (Marks -5+5)

DESCRIPTIVE STATISTICS OF PAPER IA

Introduction:
Nature of Statistics, Population and sample, Uses and abuses of Statistics, Statistics and other disciplines.

Types of data:
Primary and secondary data, Qualitative and quantitative data, Nominal, ordinal and cardinal data, Different types of scale, Cross-sectional and time-series data, Discrete and continuous data, Frequency and non-frequency data.

Collection and scrutiny of data:
Collection of primary data - direct observation method, Interview method, mailed questionnaire method, Types of schedules and questionnaires and their designing, Data from controlled experiments, Scrutiny of data for internal consistency and detection of errors in recording, Ideas of cross validation.

Presentation of data:
Construction of tables with one or more factors of classification, Diagrammatic presentations of nonfrequency data, Construction of frequency distributions and cumulative frequency distributions and their graphical and diagrammatic presentations, Stem and leaf displays.

Analysis of quantified data:
Univariate data -Different characteristics of frequency distributions with their measures including quantiles: central tendency, dispersion and relative dispersion of grouped and ungrouped data, moments including Sheppard' corrections (without derivation), skewness and kurtosis, Box plot, Outlier Detection

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Bivariate data - Introduction, scatter diagram, product moment correlation coefficient and its properties, correlation ratio and correlation index (*) with their associated results, rank correlation Spearman's and Kendall's measures with tie and non-tie cases, intra-class correlation with equal and unequal group sizes, principle of least squares, fitting of regression lines and curves (*) and related results.

[(*) ***For practicals, curves up to polynomial of degree two should be considered.*** **]**

Analysis of Categorical data - Consistency of categorical data, independence and association of attributes, measures of association in 2×2, m×n tables – Pearson's, Yule's, Tschuprow's and Vandermode's measures, Odds ratio, fitting of logistic regression equation by least-square method.

PROBABILITY DI TRIBUTIONS & SCALING OF PAPER II A

Probability Distributions:

Univariate discrete distributions:

Uniforn:1, Bernoulli, Binomial, Hypergeometric, Poisson, Geometric, Negative Binomial and Power Series distributions and their properties ,Truncated Binomial and Poisson distributions.

Univariate continuous distributions:

Rectangular, Exponential, Laplace, Gamma, Beta, Normal, Lognormal, Pareto, Logistic, Cauchy and Truncated normal distributions and their properties.
Bivariate normal distributor and its properties.

Scaling:

Idea, scaling of items according to difficulty; scaling of test scaling of test scores (Z, percentile, Thurstone, equivalent); scaling of rates and ranks; scaling of judgments.

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MULTIVARIATE ANALYSIS OF PAPER-IIIC

Multivariate data: Motivation, Multiple regression and partial regression coefficients; multiple and partial correlation coefficients; properties and related results.

Random vector, Probability mass, probability density and cumulative distribution functions, mean vector and dispersion matrix, marginal and conditional distributions, concentration ellipsoid, Multiple regression, multiple and partial correlation in the context of the probability distribution.

Multivariate probability distributions: Multinomial and multivariate normal distributions and their properties.

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Paper-V: Group-A (Practical)
Marks -50 :: Time :- 4 hours

Practical based on Economic Statistics of Paper II C, Statistical Inference-I of Paper III B &
Demography of Paper IV B(Marks -40); Viva & Practical Note book (Marks -5+5)

ECONOMIC STATISTICS OF PAPER II C

Index Number:
Price, Quantity and Value indices. Construction and uses, Various formulae and their comparisons, Limitations, Tests for Index Number. Chain Index Number. Consumer Price Index, Wholesale Price Index and Index of Industrial Production -methods of construction and uses.

Measures of Inequality:
Gini's coefficient, Lorenz curves - use of Pareto and Lognormal distributions as income or allied distributions.

Time Series Analysis:
Examples of time series from various fields, Components of a times series, Additive and Multiplicative models.
Estimation of trend by linear fitting (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. Weak stationary, Autocorrelation Function and Correlogram. Exponential smoothing.

STATISTICAL INFERENCE-I OF PAPER III B

Introduction:
Parameter and parameter space; estimator, estimate, point and interval estimation; Testing of hypothesis.

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Point estimation:

Mean square error, unbiasedness, minimum variance unbiasedness, consistency, efficiency and asymptotic efficiency, best linear unbiasedness, related results.

Cramer-Rao lower bound of variance and related results.

Sufficiency, factorisation theorem (proof for discrete case only), completeness, Rao-Blackwell Theorem, Statement of Lehmann-Scheffe theorem.

Methods of estimation:

Least square method, method of moments, method of maximum likelihood and its properties (excluding proofs for large sample cases), method of minimum χ^2.

Testing of hypothesis-I:

Concepts of null and alternative hypotheses, simple and composite hypotheses; critical region, Type I and Type II errors, level of significance and size, power, p-value approach.

Tests of significance relating to single binomial-proportion and single Poisson parameter, two independent binomial proportions and two independent Poisson parameters. Tests of significance and associated confidence intervals for mean and variance of a univariate normal population, difference of means and ratio of variances of two independent normal populations, difference of means, ratio of variances, correlation coefficient of a bivariate normal population and the inference problems related to regression coefficients.

DEMOGRAPHY OF PAPER IVB

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, Specific, Standardised death, Cause of Death, Infant Morality, Maternal Mortality rates.

Life Tables: Descriptions of Complete and Abridged life tables and their uses, Construction of complete life table, Stable and Stationary population.

Measurement of Morbidity: Morbidity incidence and morbidity prevalence rates.

Measurements of Fertility: Crude, General, Age specific and Total fertility rates.

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Measurement of Population Growth: Crude rate of natural increase and vital Index, Gross and Net Reproduction rates.

Population Estimation, Projection and Forecasting: Use of AP and GP methods for population estimates. Use of component method for population projection, Fitting of Logistic curve for population forecasting, using Rhode's and Fisher's methods.

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Paper-V: Group-B (Practical)
Marks -50 :: Time :- 4 hours

Practical based on Matrix Algebra of Paper I B, Numerical Analysis of Paper II B & Computer Programming & Use of Software packages of Paper IV A (Marks -40); Viva & Practical Note book
(Marks -5+5)

MATRIX ALGEBRA OF PAPER I B

Arrays of numbers: Vectors and Matrices.

Vectors as n-tuples of real numbers - addition and scalar multiplication, linear combination, linear dependence and independence, basis, dimension, subspaces, inner product and orthogonality, GramSchmidt orthogonalization process.

Matrices - Type of matrices including non-singular and orthogonal, Operations on matrices including elementary transformations, partition of matrices, determinant, rank and inverse of a matrix.

Simple results on characteristic roots and vectors of a real symmetric matrix. Quadratic forms classification and canonical reduction.

Solution of system of Linear Equations: Homogeneous and non-homogeneous systems - conditions for solvability.

NUMERICAL ANALYSIS OF PAPER II B

Errors due to rounding off. Δ & E Operators and related problems.
Interpolation formulae - Newton's forward and backward interpolation, Newton's divided difference and Lagrange's interpolation, Error terms. Inverse interpolation.
Numerical differentiation.
Numerical integration - Trapezoidal rule, Simpson's one third rule. Euler-Maclaurin's expansion. Stirling's approximation (result only).

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Numerical solution of equation in one unknown -method of false position, method of iteration. Newton-Raphson method. Convergence criterion and Geometrical interpretation of each method.

COMPUTER PROGRAMMING & USE OF SOFTWARE PACKAGES OF PAPER IV A

Some suggested programming problems for computer practical:

A. Programs:

1. Computing AM, GM, and HM of grouped and ungrouped data.
2. Sorting data set; finding minimum and maximum.
3. Computing median, the first and second quartiles.
4. Computing range, variance and quartile deviation.
5. Computing moments and quantiles of ungrouped and grouped data
6. Factorial of a positive integer.
7. Correlation Coefficient of ungrouped and grouped data.
8. Fitting a straight line or a exponential curve to a given data.
9. Fitting Binomial and Poisson distributions.
10. Transpose, addition and multiplication of matrices; finding inverses and determinants of square (non-singular) matrices.
11. The Sweep-out and Pivotal Condensation methods.
12. Solutions of equations (Iteration, N-R, Bisection methods)
13. Interpolation by Lagrange's formula
14. Numerical Integration (Simpson's ⅓rd, Trapezoidal)
15. Generation of random sample from normal distribution

Using Spreadsheets:

Introduction to MS - EXCEL

1. Bar Chart, Column Chart, Pie Chart, Stem-and-Leaf displays; Box Plot.
2. Moments and Quantiles of univariate data
3. Scatter Plot, Correlation Coefficient and fitting a regression line, Residual Plot
4. Multivariate Correlation and Regression
5. Binomial and Poisson distributions with varying parameters
6. Tests of significance -Fisher's test, paired t-test, F -test for equality of variances, t-test for correlation and regression coefficients

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7. Line diagrams showing different types of time series data, determination of trend by moving-averages and curve-fitting methods, plotting fitted values.
8. Exponential smoothing of time-series.

C. Using Software packages: Introduction to MINITAB / STATISTICAL

Some suggested Problems:

1. Basic Statistics -Display Descriptive Statistics, Plot, TS plot, Chart, Histogram, Box plot, Matrix plot, Stem-and-Leaf
2. Inference -One Sample z and t test, Two sample and paired t-test, One and two proportions Test for one and two variances.
3. Bivariate data -Scatter plot, Regression, Residual Plots, Binary Logistic regression.
4. Time Series - TS plots, Trend analysis, Moving averages, Simple exponential smoothing.

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PART-III

Paper -VI

Full Marks -100
(University Exam. -90 & Internal Assessment -10)

GROUP-A
STATISTICAL INFERENCE -II
35 Marks:: 45 Lectures

Testing of hypothesis-II :

Most powerful (MP), Uniformly Most Powerful (UMP) and Uniformly Most Powerful Unbiased (UMPU) tests; Consistency of tests, Neyman – Pearson's Fundamental Lemma (Sufficiency part only) and its use in the construction of MP, UMP and UMPU (Type-A and Type-A_1) tests (for single parameter under normal set-up); randomized tests; combination of probabilities in tests of significance; likelihood ratio test and its applications to test for the equality of means and variances of several independent normal populations.

Sequential test for a simple hypothesis against a simple alternative and its use in tests for binomial proportion and normal mean, expressions for OC and ASN functions (without proof).

Interval estimation:
Confidence intervals and confidence sets, concepts of uniformly Most Accurate (UMA), Uniformly Most Accurate Unbiased (UMAU) confidence sets; relationship with UMP and UMPO tests of hypothesis; confidence interval with shortest expected length.

Large Sample Theory :
Large sample tests and confidence intervals for Binomial proportions, Poisson and Normal means (single and two independent sample cases).

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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.

Transformation of statistics to stabilize variance: derivation and use of $\sin^{-1}$, square-root, logarithmic and z-transformation.

Tests of goodness of fit, homogeneity and independence based on Pearsonian χ^2.

Non - parametric tests:

Sign test and Wilcoxon's signed rank test (samples from single and two correlated populations); Median test and Mann-Whitney U-test; Run test; confidence interval for quantiles based on sign test; Tolerance interval.

References:

1. Goon A.M., Gupta M.K. & Dasgupta B.: An Outline of Statistical Theory (Vols-1 &2)
2. Mood A.M., Graybill F.& Roes D.C.: An Introduction to the Theory of Statistics
3. Hogg R.Y. & Craig A.T. : Introduction to Mathematical Statistics
4. Rao C.R. : Linear Statistical Inference and its Applications .
5. Rohatgi Y.K.: An Introduction to Probability Theory & Mathematical Statistics
6. Kale B.K.: A First Course on Parametric Inference
7. Mukhopadhyay Parimal: Mathematical Statistics
8. Casella G & Berger R L: Statistical Inference
9. Lehmann E.L. & Casella G : Theory of Point estimation
10. Lehmann E.L. : Testing Statistical Hypotheses
11. Serfling R.J. : Approximation Theory of Mathematical Statistics
12. Chandra T.K. : A First Course in Asymptotic Theory in Statistics
13. Gibbons J.D. : Non - parametric Inference

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GROUP B
THEORY OF SAMPLE SURVEY
35 Marks: 45 Lectures

Introduction: Concept of a finite population and sample, need for sampling, complete enumeration and sample surveys.

General Ideas: Planning & execution of sample survey, Analysis of data and reporting, biases of errors. Judgment sampling and probability sampling. Tables of random numbers, their uses and simple tests of random numbers.

Basic Sampling and estimation procedures: Simple random sampling with and without replacements, stratified random sampling with allocation problem. Determination of sample size in simple random sampling.

Linear and circular systematic sampling, cluster sampling, two-stage (with equal size first stage units) sampling with equal selection probability at each stage. Associated unbiased estimator of population total, mean and proportion, their variances and unbiased variance estimators, 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.

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
5. Mukhopadhyay Parimal : Theory and Methods of Survey Sampling
6. Sukhatme P.V. & Sukhatme B.V.: Sampling Theory of Surveys with Applications
7. Sampath S.: Sampling Theory and Methods
8. NSSO Publicaions
9. CSO Publications

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GROUP- C
STATISTICAL QUALITY CONTROL (SQC)
20 Marks :: 25 Lectures

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

Process Control:

General Theory of control Charts -chance and assignable causes of variation, state of statistical control. Choice of rational sub-groups. 3σ limits and Probability limits. Construction and uses of x-bar, R, S, np, p and c charts (including unequal subgroup size). Interpretation of non-random patterns of points, Modified control charts.

Product Control:

Principles of acceptance sampling -acceptance -rejection and acceptance-rectification plans, concepts of AQL, LTPD, Producer's risk, Consumer's risk, OC, ASN, ATI, AOQ and AOQL. Single and double Sampling plans for attributes. Determination of plan parameters . Single sampling plan for inspection by variables (one-sided specification, known and unknown standard cases). Use IS plans and tables.

References

1. Goon A. M.. Gupta M. K., Dasgupta B. : Fundamentals of Statistics (Vol-2)
2. Duncan AJ. : Quality Control and Industrial Statistics
3. Cowden OJ.: 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 Control 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

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Paper -VII: GROUP-A (THEORY)
(University Exam -45 & Internal Assessment -5)
ANALYSIS OF VARIANCE & COVARIANCE AND DESIGN OF EXPERIMENTS
Marks 45 : 60 Lectures

Brief discussion: linear model and linear hypothesis

Sum of squares due to linear functions of observations, F-test for linear hypothesis (without proof).

Analysis of variance under fixed-effects model (one-way classification and balanced two-way classification) .
Analysis of covariance for one-way and two-way classification.

Tests of simple linear regression coefficients, correlation coefficient, partial regression coefficient and multiple correlation coefficients.

Design of experiments: Need for designing of experiments. Terminology used in design of experiments. Principles of design of experiments - randomisation, replication and local control.

Completely randomised design, randomised block design, Latin square design - their relative advantages disadvantages, and relative efficiency.

Factorial experiments -advantages, total and partial and balanced confounding with reference to 2 (n = 2,3,4, 5) experiments.

Split plot design and strip arrangements.

Missing plot technique - one missing observation in randomised block design and in Latin square design.

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References:

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2. Mood A.M., Graybill F. & Boes D.C. : An Introduction to the Theory of Statistics
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 (Vol-2)
8. Bhattacharya G.K. & Johnson R. A. : Concepts & Methods of Statistics
9. Schefte H. : The Analysis of Variance
10. Kempthorne O.: The Design and Analysis of Experiments
11. Das M.N. & Girl N.C. : Design and Analysis of Experiments
12. Montgomery D.C. : Design and Analysis of Experiments
13. Cochran W.G. & Cox G.M. : Experimental Designs
14. Federer W.T. : Experimental Designs - Theory and Application
15. Mukhopadhyay Parimal : Applied Statistics

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Paper- VII: Group-B (Practical)
Marks -50 :: Time :- 4 hours

Practical based on Statistical Inference-II of Paper VI A, Drawing of random samples under Sampling
Distribution of Paper III A, and Sample Survey of Paper VI B (Marks -40) ;
Viva & Practical Note book (Marks -5+5)

STATISTICAL INFERENCE-II OF PAPER-VI A

Testing of hypothesis-II :

Most powerful (MP), Uniformly Most Powerful (UMP) and Uniformly Most Powerful Unbiased (UMPU) tests; Consistency of tests, Neyman – Pearson's Fundamental Lemma (Sufficiency part only) and its use in the construction of MP, UMP and UMPU (Type-A and Type-A_1) tests (for single parameter under normal set-up); randomized tests; combination of probabilities in tests of significance; likelihood ratio test and its applications to test for the equality of means and variances of several independent normal populations.

Sequential test for a simple hypothesis against a simple alternative and its use in tests for binomial proportion and normal mean, expressions for OC and ASN functions (without proof).

Interval estimation:
Confidence intervals and confidence sets, concepts of uniformly Most Accurate (UMA), Uniformly Most Accurate Unbiased (UMAU) confidence sets; relationship with UMP and UMPO tests of hypothesis; confidence interval with shortest expected length.

Large Sample Theory :
Large sample tests and confidence intervals for Binomial proportions, Poisson and Normal means (single and two independent sample cases).

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.

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Transformation of statistics to stabilize variance: derivation and use of $\sin^{-1}$, square-root, logarithmic and z-transformation.

Tests of goodness of fit, homogeneity and independence based on Pearsonian χ^2.

Non - parametric tests:
Sign test and Wilcoxon's signed rank test (samples from :;ingle and two correlated populations); Median test and Mann-Whitney U-test; Run test; confidence interval for quantiles based on sign test; Tolerance interval.

DRAWING OF RANDOM SAMPLES UNDER SAMPLING DISTRIBUTION OF PAPER III A

Concept of simple random sampling (SRS) - SRSWR and SRSWOR, random number table and its uses in the context of drawing random samples from finite population and probability distributions.

Statistic, Sampling distribution of a statistic and its standard error. Illustration using sampling from small finite populations under SRSWR and SRSWOR with special reference to sample mean and sample proportion.

SAMPLE SURVEY OF PAPER VI B

Introduction: Concept of a finite population and sample, need for sampling, complete enumeration and sample surveys.

General Ideas: Planning & execution of sample survey, Analysis of data and reporting, biases of errors. Judgment sampling and probability sampling. Tables of random numbers, their uses and simple tests of random numbers.

Basic Sampling and estimation procedures: Simple random sampling with and without replacements, stratified random sampling with allocation problem. Determination of sample size in simple random sampling.

Linear and circular systematic sampling, cluster sampling, two-stage (with equal size first stage units) sampling with equal selection probability at each stage. Associated unbiased estimator of population total, mean and proportion, their variances and unbiased variance estimators, Optimum choice of sampling and sub-sampling fractions in two-stage

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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.

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Paper- VIII: Group-A (Practical)
Marks-50:: Time :- 4 hours

Practical based on Statistical Quality Control (SQC) of Paper VI C and ANOVA, ANCOVA & Design of Experiments of Paper VII A. (Marks -40); Viva & Practical Note book (Marks -5+5)

STATISTICAL QUALITY CONTROL (SQC) of Paper VI C

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

Process Control:
General Theory of control Charts -chance and assignable causes of variation, state of statistical control. Choice of rational sub-groups. 3σ limits and Probability limits. Construction and uses of x-bar, R, S, np, p and c charts (including unequal subgroup size). Interpretation of non-random patterns of points, Modified control charts.

Product Control:
Principles of acceptance sampling-acceptance-rejection and acceptance-rectification plans, concepts of AQL, LTPD, Producer's risk, Consumer's risk, OC, ASN, ATI, AOQ and AOQL. Single and double Sampling plans for attributes. Determination of plan parameters. Single sampling plan for inspection by variables (one-sided specification, known and unknown standard cases). Use IS plans and tables.

ANOVA, ANCOVA & DESIGN OF EXPERIMENTS OF PAPER VII A

Brief discussion: linear model and linear hypothesis

Sum of squares due to linear functions of observations, F-test for linear hypothesis (without proof).

Analysis of variance under fixed-effects model (one-way classification and balanced two-way classification).
Analysis of covariance for one-way and two-way classification.

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Tests of simple linear regression coefficients, correlation coefficient, partial regression coefficient and multiple correlation coefficients.

Design of experiments: Need for designing of experiments. Terminology used in design of experiments. Principles of design of experiments - randomisation, replication and local control.

Completely randomised design, randomised block design, Latin square design - their relative advantages disadvantages, and relative efficiency.

Factorial experiments -advantages, total and partial and balanced confounding with reference to 2^n = 2,3,4, 5) experiments.

Split plot design and strip arrangements.

Missing plot technique - one missing observation in randomised block design and in Latin square design.

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Paper – VIII : Group-B (Project)
Full Marks : 50
Project Work (using Computer Software) Marks-40); Project Viva (Marks-10)

Marks Distribution

TOTAL MARKS	NO. OF QUESTIONS TO BE ATTEMPTED	NO. OF QUESTIONS TO BE SET
20	2	4 each of 5 marks
	And 1	2 each of 10 marks
25	3	5/6 each of 5 marks
	And 1	2 each of 10 marks
30	4	7/8 each of 5 marks
	And 1	2 each of 10 marks
35	5	8/9 each of 5 marks
	And 1	2 each of 10 marks
40	4	7/8 each of 5 marks
	And 2	4 each of 10 marks
45	5	7/8 each of 5 marks
	And 2	4 each of 10 marks

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B.Sc. (General)
Statistics
Full Marks – 100
University Written Examination : 90
Internal Assessment in College: 10
Part-I

Theory		
Paper-I		
Group-A	Probability	25
Group-B	Descriptive Statistics	45
Group-C	Economic Statistics, Official Statistics	20
Theory		
Paper-II		
Group-A	Numerical Analysis	15
Group-B	SQC	10
Group-C	Demography	20
Group-D	Sampling Theory & Inference	45
Theory		
Paper-III		
Group-A	Practical based on Group B, C of Paper I & Group A of Paper - II	40
Group-B	Practical based on B,C,D of Paper-II	40
	VIVA & PNB (10+10)	20
Theory		
Paper-IV		
Group-A	ANOVA, Design of Experiments	25
Group-B	Sample Survey	20
Practical		
Group-C	Based on groups A & B of Paper-IV	20
Group-D	Project Work	20
	VIVA & PNB (5+5)	

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Statistics (General)

PART-I
Paper - I : F.M. 100
(University Written Examination-90, Int. Assessment in College-10)
Group - A Probability Theory (25 Marks: 30 Lectures)

Classical definition of probability and its limitations; conditional probability and independence of events; Theorems on total and conditional probability, Baye's theorem; Statistical definition of probability and its relation to axiomatic definition, Problems.
12 lectures

Random variable; p.m.f. pdf and cdf; expectation and variance; joint distribution on variables, marginal and conditional distribution. Theorems on expectation of sum of random variables and product of independent randon. variables. Chebychev's inequality and weak jaw of Large numbers(Statesment only). Problems 8 lectures

Binomial, Poisson, Hypergeometric and Normal distributions and their properties.
10 lectures

Group - B
Descriptive Statistics
45 Marks: 40 Lectures

Introduction: Nature of Statistics as a discipline, concept of population and sample. Uses and abuses of statistics. 2 lectures

Preliminary treatment of data: Classification, Collection and scrutiny of data; tabular, diagrammatic and graphical representation of non-frequency data; frequency distributions and their diagrammatic representation. 10 lectures
Analysis of quantified data: univariate Central tendency, dispersion, skewness and kurtosis and their measures; Sheppand's corrections for moments (without derivation)
10 lectures

Bivariate: Scatter diagram, least square regression equations, products moment correlation coefficient and their properties; correlation ratio; rank correlation (Spearman's

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measure only) Statement of general properties of bivariate normal distribution.
10 lectures

Multivariate-multiple regression involving two independent variables only; corresponding multiple and partial correlation coefficients. 6 lectures

Analysis of categorical data : Measures of association for two attributes, Odd's ratio.
2 lectures

Group - C
Economic Statistics
(20 Marks: 20 Lectures)

Index Number - Construction and uses of price index numbers and tests in connection with them, Consumer and Wholesale price index numbers. 8 lectures

Time Series Analysis - Different components of a time series; Determination of trend by free hand smoothing, method of moving averages and fitting mathematical curves by least squares.

Determination of seasonal indices: method of trend ratios and ratio to moving averages.
8 lectures

Official Statistics - Sources of Official Statistics in India relating to population, agriculture, industry; trade and prices. 4 lectures

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PART-II

Paper-II: F.M. 100
(University Written Examination-90, Int. Assessment in College-l0)
Group-A
Numerical Mathematics
(Marks 15 : 12 Lectures)

Error due to rounding of numbers, Δ and E operators 2 lectures

Interpolation formulae: Newton's forward and backward formulae, and Lagrange's formulae 4 lectures

Numerical integration- Trapezoidal and Simpson's one third rules 3 lectures

Numerical solution of equations in one unknown: Method of false position, method of iteration and Newton-Raphson method. 3 lectures

Group - B
Statistical Quality Control
(Marks-10: 10 Lectures)

Advantages of Statistical quality control. Rationale of control charts. Choice of rational subgroups. Construction and use of control charts for mean, range, number defectives, fraction defective and number of defects.
Criterion for detecting lack of control 10 lectures

Group - C
Demography
(20 Marks: 20 Lectures)

Vital events; Ratio and Ratios; Measurement of mortality - Crude Specific and Standardized death rates. Infant Mortality Rate 9 lectures

Complete Life table - description and uses 2 lectures

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Measurement of Fertility and Reproduction - Crude, General, Specific and Total fertility rates, Gross and Net reproduction rates 9 lectures

Group - D
Sampling Theory & Inference
(45 Marks: 40 Lectures)

Sampling distribution: Concepts of parameter, parameter space and statistics; sampling distribution and standard error of statistic 2 lectures

Definition and properties of χ^2, t and F distributions (without derivation) 3 lectures

Sampling distribution of sample mean and sample variance in sampling from a normal population 1 lecture

Problems of statistical inference: Point and interval estimator and testing of hypothesis

Testing of hypothesis: Null and alternative hypothesis; tests of hypothesis, two kinds of errors, level of significance, size and power, consistency and unbiasedness of tests (only definitions) 3 lectures

Small sample tests and confidence intervals for normal mean and variance; difference of mean and ratio of variances of two independent normal populations; significance of correlation coefficient, difference of means and ratio of variances of a bivariate normal population, significance of multiple and partial correlation coefficients 10 lectures

Large sample test and standard error of a function of statistics (statement only) and its use to derive standard error of standard derivation and coefficient of variation. Large sample tests for binomial proportion and Poisson mean, single and two independent populations; single and two means, single and two standard derivations. 8 lectures

Use of Pearsonian χ^2 test for goodness of fit, independence of attributes and homogeneity of populations 3 lectures

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Theory of estimation: Unbiasedness, minimum variance unbiasedness, consistency and efficiency of estimators. 5 lectures

Maximum likelihood method of estimation and its properties; use of the method to estimate parameters of binomial, poisson and univariate normal distributions.
4 lectures

Paper-III
(Practical) Marks-100: Time 4 hrs : 100 Lectures
Group - A: 40 Marks

Practical Work on the topic mentioned in Groups B and C of Paper-I and Group-A of Paper II
40 marks

Group - B: 60 Marks

Practical Work on the topic mentioned in Groups B, C and D of Paper-II 40 marks

Practical Note Book and VIVA VOCE 20 marks

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PART-III

Paper-IV: F.M. (Theory) 50
(University Written Examination-45, Int. Assessment-5)
Time- 2 hrs. : 40 Lectures
Group - A: 25 marks

ANOVA, Design of Experiments 20 lectures

Introduction to Linear Models, Analysis of fixed effects models- one way and two way classified data (with one observation per cell), Basic principles of Design - randomization, replication and local Control, Completely random design, randomized block design and Latin square design. Factorial Experiments, Estimation and Testing :Main effects and interactions in 2^2 and 2^3 experiments.

Group - B: 20 Marks

Theory of Sample Survey 20 Lectures

Concepts of Population and Sample. Need for sampling, Steps involved in a sampling enquiry, Requirements of a good sample.

Concept of probability sampling, Random number tables, Simple random sampling with and without replacement- associated unbiased estimators of population total, mean and proportion, their variances and unbiased variance estimators.

Stratified random sampling procedure-with estimates and their standard errors Forms and schedules for enquiry.

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Paper-IV C : 20 Marks
(Practical)

Full Marks: 20 Time:2hrs.

Practical based on Group A and B of paper - IV

Proper - IV D: 30 Marks

Full Marks: 20

Project work preferably using Computer Software

VIVA & PNB (5+5) Full Marks- 10

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2. Goon A.M. Gupta M & Dasgupta : *Fundamentals of Statistics* (vol-2), World Press.
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