DEPARTMENT OF STATISTICS
UNIVERSITY COLLEGE OF SCIENCE
OSMANIA UNIVERSITY, HYDERABAD – 500 007

M.Sc. STATISTICS
CBCS - SCHEME OF INSTRUCTION AND EXAMINATION
WITH EFFECT FROM 2022 – 2023

SEMESTER I

Paper	Sub. Code	Paper Title	Instruction Hrs/ Week	Duration of Exam (in Hrs)	Max. Marks	IA and Assign.	Credits
THEORY							
I	STAS1-I	Mathematical Analysis and Linear Algebra	3	3	70	30	3
II	STAS1-II	Probability Theory (PT)	3	3	70	30	3
III	STAS1-III	Distribution Theory (DT)	3	3	70	30	3
IV	STAS1-IV	Theory of Estimation (ET)	3	3	70	30	3
PRACTICALS							
V	STAS1-V	Statistical methods using Python Programming	4	2	50	***	2
VI	STAS1-VI	Linear Algebra (LA)	4	2	50	***	2
VII	STAS1-VII	Distribution Theory (DT)	4	2	50	***	2
VIII	STAS1-VIII	Theory of Estimation (ET)	4	2	50	***	2
Total				***			20
Semester Total							

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M. Sc. (Statistics) Semester I

STS1- I : Paper I - Mathematical Analysis and Linear Algebra (MA and LA)

UNIT–I

Riemann-Steiltjes (R-S) Integral and its linear properties. Integration by parts, Euler's summation, Riemann's condition. Integrators of BV. Statements of necessary and sufficient conditions of R-S integral. Differentiation under the integral sign. Interchanging the order of integration.

UNIT–II

Complex derivatives. Cauchy-Riemann equations. Analytic functions. Statements of Cauchy theorem and integral formula. Power, Taylor's and Laurent's series. Zeroes and poles. Statement of Cauchy residue theorem. Cantour integration. Evaluation of real valued integrals bymeans of residues.

Functions of several variables-concepts of limit, continuity, directional derivatives, partial derivatives, total derivative, extreme and saddle points with examples. Taylor's expansion.

UNIT – III

Vector spaces with an inner product, Gram-Schmidt orthogonolization process, orthonormal basis and orthogonal projection of a vector. Moore-Penrose and generalized inverses and their properties.

UNIT – IV

Solution of matrix equations. Sufficient conditions for the existence of homogeneous and non-homogeneous linear equations. Characteristic roots and vectors, Caley-Hamilton theorem.

UNIT – V

Algebraic and geometric multiplicity of a characteristic root and spectral decomposition of a real symmetric matrix.

Real quadratic forms (QFs), reduction and classification of QFs, index and signature. Simultaneous reduction of two QFs. Extreme form of a QF. Cauchy-Schwartz and Hadamard inequalities for matrices.

REFERENCES

1. Apostol,T.M. (1985) : Mathematical Analysis, Narosa, Indian Ed.
2. Malik,S.C. (1984) : Mathematical Analysis, Wiley – Eastern.
3. Rudin,W. (1976) : Principles of Mathematical Analysis, McGraw Hill.
4. Graybill,F.A. (1983) : Matrices with applications in statistics, 2nd ed, Wadsworth.
5. Rao,C.R. (1973) : Linear Statistical inference and its applications, 2nd Ed, John Wiley & SonsInc.
6. Searle,S.R. (1982) : Matrix algebra useful for statistics, John Wiley and Sons Inc.
7. Rao,C.R., Mithra,S.K. (1971) : Generalised inverse of matrices and its applications, JohnWiley & Sons Inc.
8. Rao, A.R. and Bhimasankaram, P(1992) : Linear algebra, Tata – McGrawhill Publishing Co.Ltd.

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M. Sc. (Statistics) Semester I

STS1- II : Paper II - Probability Theory (PT)

UNIT – I

Review on the concepts of Probability:Classical, Statistical, Axiomatic approaches to Probability, Conditional probability (Addition, Compound & Bayes theorem) and Problems on Probability.Probability as a measure.

Distribution function & Mathematical Expectation: Random variables, distribution function and its properties, Mathematical expectation, Expectations of functions of random variables, conditional expectation and conditional variance, their applications. (list model, uniform priors, Polyas' urn model and Bose-Einstein distribution).

UNIT-II

Characteristic functions: Characteristic function of a random variable and its properties. Levy's continuity theorem, uniqueness theorem, Inversion theorem, (Functions which cannot be Characteristic functions). Levy's continuity theorem (Statement only).

Inequalities: Chebychev, Basic, Markov, Cauchy-Schwartz, Jenson, Liapunov, Holder's, Minkowsky's, Triangular, Crammers; simple applications and interrelationships (if any)among them.

UNIT – III

Theory of Convergence: Sequence of Random variables, Concept of convergence, Convergence in distribution, Convergence in Probability,Convergence in almost sure, Convergence in quadratic mean; Slutskey's theorem, interrelationships among Convergence or implications, problems on mode of convergence identification.

Borel-Cantelli lemma,Borel 0-1 law, Statement of Kolmogorov 0-1 law (Glevenko – Cantelli Lemma -Statement only).

UNIT-IV

Law of large numbers (LLN): Weak law of large numbers, Chebychevs, Bernoulli and Khintchen's WLLN's, necessary and sufficient condition for WLLN, Problems on identification of WLLN; Strong law of large numbers, Kolmogorov SLLN for independent random variables and statement only for i.i.d. case,Kolomogorov Inequality, Problems on identification of SLLN, applications of law of large numbers.

UNIT-V

Central Limit Theorems: Central limit Theorem, Demoviere-Laplace CLT, Lindberg-Levy CLT, Liapounou's CLT, Statement of Lindberg-Feller CLT, Simple problems on Central limit theorem and its applications.

REFERENCES

1. Bhat,B.R. : Modern Probability Theory, 3rd Edition, New Age India
2. Basu, A. K. : Probability and Measure, Narosa (PHI)
3. Rohatgi,V.K.: Introduction to Probability Theory and Mathematical Statistics.
4. W.Feller : An Introduction to Probability theory and its Applications Vol I and II, John Wiely.

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M. Sc. (Statistics) Semester I

STS1- III : Paper III - Distribution Theory (DT)

UNIT – I

(Review on basic Discrete & Continuous distributions covered at U.G. level)

Distributions: Definitions, Properties and Applications of Lognormal, Weibull, Pareto and Laplace distributions. Bivariate Normal distribution

UNIT-III

Distributional Transformations: Functions of Random variables and their distributions, Jacobian transformation for Univariate & Bivariate distributions.

UNIT – II

Families of Distributions: Power series distributions, Exponential family of distributions..

Compound Distributions: Binomial-Poisson, Poisson-Gamma (α,β).

Truncated Distributions: Binomial, Poisson, Normal and Lognormal

Mixture Distributions: Definition and examples.

UNIT – IV

Sampling Distributions: Concept of sample distribution, exact sampling distributions and their properties, (χ^2, t and F distributions: Central and Non-central). Sampling distribution of Mean and variance, independence of $\overline{X}$ and s^2.

UNIT – V

Order Statistics: Order statistics their distributions and properties. Joint and marginal distributions of order statistics and Distribution of Range. Applications of order statistics. Distributions of Quadratic forms under normality.

REFERENCES

1. Rohatgi,V.K.(1984) : An introduction to probability theory and mathematical Statistics,Wiley Eastern.
2. Rao,C.R. (1972) : Linear Statistical Inference and its applications, 2/e, Wiley Eastern
3. Milton and Arnold – Introduction to probability and Statistics (4th Edition)-TMHpublication.

ADDITIONAL REFERENCES

1. Pittman,J. (1993) : Probability, Narosa Publishing House
2. Johnson,S. and Kotz,(1972) : Distributions in Statistics,Vol. I,II and III, Houghton andMiffin.
3. Cramer, H. (1946) : Mathematical methods of statistics, Princeton.
4. Dudewicz,E.J., and Mishra, S.N. (1988) : Modern Mathematical statistics, WileyInternational Students edition.

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M.Sc. (Statistics) Semester I

STS1- IV :Paper IV - Estimation Theory (ET)

UNIT – I

(**Review on the topics covered at UG level:**Concepts of population, sample, statistic, parameter, sampling distributions, Estimation, Point Estimation, Interval Estimation, Likelihood function, exponential family of distributions)

Criteria for Good estimation: Desirable properties of a good estimator: Unbiasedness (Mean, Median and Modal unbiased), consistency, efficiency and sufficiency –examples.

UNIT II

Neyman factorization theorem (Proof in the discrete case only), examples. UMVU estimation, Rao-Blackwell theorem, Fisher's Information. Cramer-Rao inequality and Bhattacharya bounds. Completeness and Lehmann-Scheffe theorem related examples.

UNIT III

Resampling methods: Estimation of bias and standard deviation of point estimation by the Jackknife, the bootstrap methods with examples.
Methods of estimation:Method of moments and maximum likelihood method, examples. Properties of MLE. Simple examples

UNIT IV.

CAN & BAN estimators: Definition of CAN and BAN, estimation and their properties, examples. Consistency and asymptotic normality of the consistent solutions of likelihood equations.
Kernal & U-statistics: Concept of U statistics and examples. Statement of Asymptotic distributions of U – statistics.

UNIT-V

Interval estimation: Interval estimation, confidence level CI using pivots and shortest length CI. Confidence intervals for the parameters for Normal, Exponential, Binomial and Poisson Distributions. Confidence Intervals for quintiles. Concept of tolerance limits and examples.

REFERENCES

1. Goon, Gupta and Das Gupta : Outlines of Statistics, Vol. 2, World Press, Calcutta.
2. Kale, B.K. (1999): A first course on parametric inference, Narosa publishing house.
3. Rohatgi, V.K.: An introduction to Probability theory and mathematical statistics, Wiley Eastern.

ADDITIONAL REFERENCES

1. Rao, C.R.: Linear Statistical Inference and its applications, John Wiley
2. Gray and Schucany : Generalized Jackknife; Marcel Decker
3. BradelyEfron and Robert J. Tibshirani : An Introduction to the Bootstrap, Chapmen and Hall.
4. Lehman, E.L. (1983) : Theory of point estimation, John Wiley
5. Gray, Schncory and Watkins : Generalized Jacknife, Dovenpul

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M.Sc. (Statistics) Semester I

STS1- V : Paper V - Practical – I Statistical methods using Python Programming

Topics to be covered (25% Weight for Theory): Introduction to Python Programming, Input, Processing and Output, Displaying Output with the Print Function, Comments, Variables, Reading Input from the Keyboard, Performing Calculations Operators. Type conversions, Expressions, More about Data Output. Decision Structures and Boolean Logic: if, if-else, if-elif-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables. Repetition Structures: recursion and non recursion, while loop, for loop, Calculating a Running Total, Input Validation Loops, Nested Loops. python-syntax, statements, functions, Built-in-functions and Methods, Modules in python, Exception Handling. Functions: Defining and Calling a Void Function, Designing a Program to Use Functions, Local Variables, Passing Arguments to Functions, Global Variables and Global Constants, Value-Returning Functions, Generating Random Numbers, Writing Our Own Value-Returning Functions, The math Module, Storing Functions in Modules. File and Exceptions: Introduction to File Input and Output, Using Loops to Process Files, Processing Records, Exceptions. Finding Items in Lists with in-Operator, List Methods and Useful Built-in Functions, Copying Lists, Processing Lists, Two-Dimensional Lists, Tuples. Strings: Basic String Operations, String Slicing, Testing, Searching, and Manipulating Strings.

List of Practical's using Python programming: (75% including Execution of Program)

A. Basic Programs (2 out of 4)

1. Program to examine the given number is a prime number or not.
2. Program to find the Factorial of positive integer.
3. Program to find the largest among the given three numbers.
4. Program to generate Fibonacci sequence up to given number n.
5. Program to construct a Pascal Triangle.
6. Program to find the value of e^x, Sin x and Cos x using series expansion
7. Program to find the sum of two matrices $[A]_{mxp}$ and $[B]_{mxp}$
8. Program to find the product of two matrices $[A]_{mxp}$ and $[B]_{pxr}$.
9. Program to sort the given set of numbers using bubble sort and finding median.
10. Program with a function that accepts a string as an argument and returns the no. of vowels that thestring contains. Another function to return number of consonants.
11. Program that opens specified text file and then displays list of all unique words found in the file.
12. Program to find the Median, Mode for the given of array of elements.
13. Program to find the first four Central & Non-central moments to the given array of elements.
14. Program to generate random numbers from Uniform, Binomial, Poisson, Normal, Exponential.
15. Program for preparation of frequency tables and computing mean, median, mode, variance and standarddeviation of the frequency distribution.
16. Program to Fitting of Binomial distribution for the given frequency distribution (recursive)
17. Program to Fitting of Poisson distribution for the given frequency distribution (recursive)
18. Program to Fitting of Negative Binomial distribution for the given frequency distribution (recursive).
19. Program to Fitting of Exponential Distribution for the given frequency distribution (recursive)
20. Program for finding the Correlation and regression lines for the given Bi-variate data.
21. Program for finding the roots of a quadratic equation.
22. Solution to simultaneous equations by Gauss - Siedal method (minimum 3 variables)

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References:

1. Tony Gaddis, Starting Out With Python (3e)
1. Kenneth A. Lambert, Fundamentals of Python
2. Clinton W. Brownley, Foundations for Analytics with Python
3. James Payne, Beginning Python using Python 2.6 and Python 3
4. Charles Dierach, Introduction to Computer Science using Python
5. Paul Gries, Practical Programming: An Introduction to Computer Science using Python 3

NOTE: Examination Pattern for the practical of Statistical Methods using Python Programming

Section – A (Short Type Questions)

Answer any 7 questions out of 10 questions : 7 x 2 = 14 Marks

Section – B (Writing of Programming code)

Answer any 2 out of 4 programs : 2 x 12 = 24 Marks

Execution of the Program = 12 Marks

Total = 36 Marks

Marks for Section – A + Section – B = 14 + 36 = 50

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M.Sc. (Statistics) Semester I

STS1-VI : Paper VI Practical (LA)

NOTE: Answer any 2 questions out of 5 questions : 2 x 25 = 50 Marks

LINEAR ALGEBRA

1. Inverse of a matrix by partition method
2. Solutions of linear equations by sweep-out method
3. Solutions of linear equations by Doolittle Method
4. Computation of Moore-Penrose inverse by Penrose method
5. Computation of generalized inverse of a matrix.
6. Formation of characteristic equation by using traces of successive powers
7. Spectral decomposition of a square matrix of third order
8. Simultaneous reduction of a pair of quadratic forms to diagonal and canonical forms.
9. Finding orthonormal basis by Gram – Schmidt process.

M.Sc. (Statistics) Semester I

STS1-VII : Paper VI Practical (DT)

NOTE: Answer any 2 questions out of 5 questions : 2 x 25 = 50 Marks

DISTRIBUTION THEORY

1. Discrete Bivariate distributions
2. Fitting of Cauchy distributions
3. Fitting of Gamma distribution with two parameters
4. Fitting of Lognormal Distribution
5. Fitting of Weibull Distribution
6. Fitting of Pareto distribution.

M.Sc. (Statistics) Semester I

STS1-VIII : Paper VI Practical (ET)

NOTE: Answer any 2 questions out of 5 questions : 2 x 25 = 50 Marks

ESTIMATION THEORY

1. Computation of Jackknife estimates
2. Computation of Boot-strap estimates
3. MLE by Scoring method
4. Confidence limits for parameters of normal population
5. Large sample confidence limits in case of Binomial, Poisson, Exponential distributions.

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DEPARTMENT OF STATISTICS
UNIVERSITY COLLEGE OF SCIENCE
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M.Sc. APPLIED STATISTICS
CBCS - SCHEME OF INSTRUCTION AND EXAMINATION
WITH EFFECT FROM 2022 – 2023

SEMESTER I

Paper	Sub. Code	Paper Title	Instruction Hrs/ Week	Duration of Exam (in Hrs)	Max. Marks	IA and Assign.	Credits
THEORY							
I	STAS1-I	Linear Algebra and Linear Models (LA and LM)	3	3	70	30	3
II	STAS1-II	Probability Theory (PT)	3	3	70	30	3
III	STAS1-III	Distribution Theory and Estimation Theory (DT and ET)	3	3	70	30	3
IV	STAS1-IV	Sampling Theory and Surveys (STS)	3	3	70	30	3
PRACTICALS							
V	STAS1-V	Statistical methods using Python Programming	4	2	50	***	2
VI	STAS1-VI	Linear Algebra and Linear Models (LA & LM)	4	2	50	***	2
VII	STAS1-VII	Distribution Theory and Estimation Theory (DT & ET)	4	2	50	***	2
VIII	STAS1-VIII	Sampling Theory and Surveys (ST)	4	2	50	***	2
Total				***			20
Semester Total							

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M.Sc. (Applied Statistics) Semester I

STAS1- I : Paper I - Linear Algebra and Linear Models (LA and LM)

UNIT – I

Vector spaces with an inner product, Gram-Schmidt orthogonolization process, orthonormal basis and orthogonal projection of a vector. Moore-Penrose and generalized inverses and their properties.

UNIT – II

Solution of matrix equations. Sufficient conditions for the existence of homogeneous and non-homogeneous linear equations. Characteristic roots and vectors, Caley-Hamilton theorem.

UNIT – III

Algebraic and geometric multiplicity of a characteristic root and spectral decomposition of a real symmetric matrix.

Real quadratic forms (QFs), reduction and classification of QFs, index and signature. Simultaneous reduction of two QFs. Extreme form of a QF. Cauchy-Schwartz and Hadamard inequalities for matrices.

UNIT – IV

Formulation of a linear model through examples. Estimability of a linear parametric function. Guass-Markov linear model, BLUE for Linear functions of parameters, relationship between BLUEs and linear Zero-functions. Gauss Markov theorem, Aitkens generalized least squares. Concept of Multicollinearity.

UNIT – V

Simple Linear regression – precision of the estimated regression, examining the regression equation - lack of fit and pure error. Analysis of multiple regression model, estimation and testing of regression parameters, Sub-hypothesis. Testing a general linear hypothesis, Multiple and partial correlations - derivation and testing. Use of dummy variables in multiple regression.

REFERENCES

1. Graybill, F.A. (1983) : Matrices with applications in Statistics, 2nd ed., Wards worth.
2. Searle, S.R.(1982) : Matrix Algebra useful for Statistics, John Wiley & Sons.
3. Rao, C.R. and Mithra, S.K.(1971) : Generalized inverse of matrices and its applications, John Wiley & Sons.
4. Rao, A.R. and Bhimasankaram, P. (1992) : Linear Algebra, Tata McGraw Hill Publishing Co. Ltd.
5. Draper and Smith:Applied Regression Analysis ,John Wiley
6. Montgomery :Introduction to Linear Regression Analysis .John Wiley.
7. Searle, S.R.(1982) : Linear models, John Wiley & Sons.
8. Kshirsagar.A.M. (1972) : A Course in Linear Models.

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M. Sc. (Applied Statistics) Semester I

STAS1- II : Paper II - Probability Theory (PT)

UNIT – I

(Review on the concepts of Probability:Classical, Statistical, Axiomatic approaches to Probability, Conditional probability (Addition, Compound & Bayes theorem) and Problems on Probability.Probability as a measure).

Distribution function & Mathematical Expectation: Random variables, distribution function and its properties, Mathematical expectation, Expectations of functions of random variables, conditional expectation and conditional variance, their applications. (list model, uniform priors, Polyas' urn model and Bose-Einstein distribution).

UNIT-II

Characteristic functions: Characteristic function of a random variable and its properties. Levy's continuity theorem, uniqueness theorem, Inversion theorem, (Functions which cannot be Characteristic functions). Levy's continuity theorem (Statement only).

Inequalities: Chebychev, Basic, Markov, Cauchy-Schwartz, Jenson, Liapunov, Holder's, Minkowsky's, Triangular, Crammers; simple applications and interrelationships (if any)among them.

UNIT – III

Theory of Convergence: Sequence of Random variables, Concept of convergence, Convergence in distribution, Convergence in Probability,Convergence in almost sure, Convergence in quadratic mean; Slutskey's theorem, interrelationships among Convergence or implications, problems on mode of convergence identification.

Borel-Cantelli lemma,Borel 0-1 law, Statement of Kolmogorov 0-1 law (Glevenko – Cantelli Lemma -Statement only).

UNIT-IV

Law of large numbers (LLN): Weak law of large numbers, Chebychevs, Bernoulli and Khintchen's WLLN's, necessary and sufficient condition for WLLN, Problems on identification of WLLN; Strong law of large numbers, Kolmogorov SLLN for independent random variables and statement only for i.i.d. case,Kolomogorov Inequality, Problems on identification of SLLN, applications of law of large numbers.

UNIT-V

Central Limit Theorems: Central limit Theorem, Demoviere-Laplace CLT, Lindberg-Levy CLT, Liapounou's CLT, Statement of Lindberg-Feller CLT, Simple problems on Central limit theorem and its applications.

REFERENCES

1. Bhat,B.R. : Modern Probability Theory, 3rd Edition, New Age India
2. Basu, A. K. : Probability and Measure, Narosa (PHI)
3. Rohatgi,V.K.: Introduction to Probability Theory and Mathematical Statistics.
4. W.Feller : An Introduction to Probability theory and its Applications Vol I and II, John Wiely.

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M.Sc. (Applied Statistics) Semester I

STAS1- III : Paper III - Distribution Theory and Estimation Theory (DT and ET)

UNIT – I

Distributions: Lognormal, Weibull, Pareto, Laplace distributions definitions, properties and their Applications. **Compound distributions** (Binomial-Poisson only). **Truncated distributions** (Binomial, Poisson, and Normal distributions). **Mixture Distributions**. Bivariate Normal distribution.

UNIT – II

Distributional Transformations: Functions of random variables and their distributions using Jacobian of transformations. Joint and Marginal.

Order Statistics: Order statistics their distributions and properties. Joint and marginal distributions of order statistics and Distribution of Range. Applications of order statistics.

UNIT-III

Sampling Distributions: Concept of sample distribution, exact sampling distributions and their properties, (χ^2, t and F distributions: Central and Non-central). Sampling distribution of Mean and variance, independence of $\overline{X}$ and s^2.

UNIT – IV

(Review on Concepts of point and Interval estimation, Criterion for good estimator and method of moments)

MLE and its properties (statements only). Minimum variance unbiased estimator, Fisher's information, Cramer-Rao lower bound and its applications. Rao–Blackwell theorem, completeness, Lehmann – Scheff's theorem.

UNIT – V

Jackknife and Bootstrap methods: Estimation of bias and standard deviation of point estimation by the Jackknife and Bootstrap methods with examples.

CAN & BAN: Consistency and asymptotic normality of the consistent solutions of likelihood equations. Definition of CAN and BAN estimators and their properties, related examples,

REFERENCES

1. Rohatgi,V.K. (1984) : An Introduction to Probability theory and Mathematical Statistics, Wiley Eastern.
2. Dudewicz,E.J. and Mishra,S.N. (1988) : Modern Mathematical Statistics, Wiley International, Students Edition.
3. Parimal Mukhopadhya: Mathematical Statistics.
4. Milton and Arnold – Introduction to probability and Statistics (4th Edition)-TMH publication.

ADDITIONAL REFERENCES

1. Ferguson, T.S. (1967) : Mathematical Statistics, A decision theoretic approach, Academic Press.
2. Rao,C.R.(1973) : Linear Statistical Inference and its applications,2/e, Wiley Eastern.
3. Johnson,S. and Kotz (1972) : Distribution in Statistics, Vol. I,II and III.
4. Lehman, E.L. (1983) : Theory of Point Estimation, John Wiley and Sons.

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M.Sc. (Applied Statistics) Semester I

STAS1- IV : Paper IV - Sampling Theory and Surveys (ST)

UNIT – I

Review of SRSWR, SRSWOR, Stratified random sampling and Systematic Sampling.
Unequal probability Sampling – Probability proportional to size (PPS) sampling with and without replacements (ppswr / wor) methods - drawing samples using Cumulative total and Lahiri's methods. Horwitz -Thompson, Hansen – Horwitz and Yates and Grundy estimators for population mean, total and their variances.

UNIT – II

Ratio Method of Estimation - Concept of ratio estimators, Ratio estimators in SRS, their bias, variance/MSE. Ratio estimators in Stratified random sampling – Separate and combined estimators, their variances/MSE.

UNIT – III

Regression method of estimation – Concept Regression estimators, Regression estimators in SRS with pre–assigned value of regression coefficient (Difference Estimator) and estimated value of regression coefficient, their bias, variance/MSE, Regression estimators in Stratified Random sampling – Separate and combined regression estimators, their variances/ MSE.

UNIT – IV

Cluster Sampling - Cluster sampling with clusters of equal sizes, estimator of mean per unit, its variance in terms of intracluster correlation coefficient, determination of optimum sample and cluster sizes for a given cost. Cluster sampling with clusters of unequal sizes, estimator of population mean and its variance/MSE.
Sub sampling (Two–Stage only) - Equal first stage units – Estimator of population mean, variance/MSE, estimator of variance. Determination of optimum sample size for a given cost. Unequal first stage units – estimator of population mean and its variance/MSE.

UNIT – V

Planning of Sample Surveys - Methods of data collection, problem of sampling frame, choice of sampling design, pilot survey, processing of survey data.
Non-sampling errors - Sources and treatment of non-sampling errors. Non – sampling bias and variance.

REFERENCES

1. Parimal Mukhopadhyay (1998) : Theory and methods of Survey sampling, Prentice – Hall of India, New Delhi.
2. Cochran, W.C. (1977) : Sampling Techniques, Third Edition, Wiley Eastern.
3. Daroga Singh and Chowdary (1986) : Theory and Analysis of Sample Survey Designs – Wiley Eastern Ltd.

ADDITIONAL REFERENCES

1. Des Raj (1976) : Sampling Theory, Tata McGraw Hill, New Delhi.
2. Sukhatme et. Al (1984): Sampling Survey methods and its applications, Indian society of Agricultural Statistics.
3. Murthy, M.N. (1967) : Sampling theory, Tata McGraw Hill, New Delhi.

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M.Sc. (Applied Statistics) Semester I

STS1- V : Paper V - Practical – I Statistical methods using Python Programming

Topics to be covered (25% Weight for Theory): Introduction to Python Programming, Input, Processing and Output, Displaying Output with the Print Function, Comments, Variables, Reading Input from the Keyboard, Performing Calculations Operators. Type conversions, Expressions, More about Data Output. Decision Structures and Boolean Logic: if, if-else, if-elif-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables. Repetition Structures: recursion and non recursion, while loop, for loop, Calculating a Running Total, Input Validation Loops, Nested Loops. python-syntax, statements, functions, Built-in-functions and Methods, Modules in python, Exception Handling. Functions: Defining and Calling a Void Function, Designing a Program to Use Functions, Local Variables, Passing Arguments to Functions, Global Variables and Global Constants, Value-Returning Functions, Generating Random Numbers, Writing Our Own Value-Returning Functions, The math Module, Storing Functions in Modules. File and Exceptions: Introduction to File Input and Output, Using Loops to Process Files, Processing Records, Exceptions. Finding Items in Lists with in-Operator, List Methods and Useful Built-in Functions, Copying Lists, Processing Lists, Two-Dimensional Lists, Tuples. Strings: Basic String Operations, String Slicing, Testing, Searching, and Manipulating Strings.

List of Practical's using Python programming: (75% including Execution of Program)

A. Basic Programs (2 out of 4)

1. Program to examine the given number is a prime number or not.
2. Program to find the Factorial of positive integer.
3. Program to find the largest among the given three numbers.
4. Program to generate Fibonacci sequence up to given number n.
5. Program to construct a Pascal Triangle.
6. Program to find the value of e^x, Sin x and Cos x using series expansion
7. Program to find the sum of two matrices [A] mxp and [B] mxp
8. Program to find the product of two matrices [A]mxp and [B]pxr.
9. Program to sort the given set of numbers using bubble sort and finding median.
10. Program with a function that accepts a string as an argument and returns the no. of vowels that thestring contains. Another function to return number of consonants.
11. Program that opens specified text file and then displays list of all unique words found in the file.
12. Program to find the Median, Mode for the given of array of elements.
13. Program to find the first four Central & Non-central moments to the given array of elements.
14. Program to generate random numbers from Uniform, Binomial, Poisson, Normal, Exponential.
15. Program for preparation of frequency tables and computing mean, median, mode, variance and standarddeviation of the frequency distribution.
16. Program to Fitting of Binomial distribution for the given frequency distribution (recursive)
17. Program to Fitting of Poisson distribution for the given frequency distribution (recursive)
18. Program to Fitting of Negative Binomial distribution for the given frequency distribution (recursive).
19. Program to Fitting of Exponential Distribution for the given frequency distribution (recursive)
20. Program for finding the Correlation and regression lines for the given Bi-variate data.
21. Program for finding the roots of a quadratic equation.
22. Solution to simultaneous equations by Gauss - Siedal method (minimum 3 variables)

References:

1. Tony Gaddis, Starting Out With Python (3e)
1. Kenneth A. Lambert, Fundamentals of Python
2. Clinton W. Brownley, Foundations for Analytics with Python

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3. James Payne, Beginning Python using Python 2.6 and Python 3
4. Charles Dierach, Introduction to Computer Science using Python
5. Paul Gries, Practical Programming: An Introduction to Computer Science using Python 3

NOTE: Examination Pattern for the practical of Statistical Methods using Python Programming

Section – A (Short Type Questions)

Answer any 7 questions out of 10 questions : 7 x 2 = 14 Marks

Section – B (Writing of Programming code)

Answer any 2 out of 4 programs : 2 x 12 = 24 Marks

Execution of the Program = 12 Marks

Total = 36 Marks

Marks for Section – A + Section – B = 14 + 36 = 50

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M.Sc.(Applied Statistics) Semester I

STAS1-VI : Paper VI - Practical (LA and LM)

NOTE: Answer any 2 questions out of 5 questions : 2 x 25 = 50 Marks

LINEAR ALGEBRA

1. Inverse of a matrix by partition method.
2. Solutions of linear equations by sweep-out method.
3. Computation of Moore-Penrose inverse by Penrose method.
4. Computation of Generalized inverse of a matrix.
5. Formation of characteristic equation by using traces of successive powers.
6. Spectral decomposition of a square matrix of third order.

LINEAR MODELS

1. Fitting of a simple linear regression model - Computation of Pure error and lack of fit.
2. Computation and Testing of Multiple Correlation coefficient.
3. Computation and Testing of Partial Correlation Coefficients.

M.Sc.(Applied Statistics) Semester I

STAS1-VII : Paper VI - Practical (DT and ET)

NOTE: Answer any 2 questions out of 5 questions : 2 x 25 = 50 Marks

DISTRIBUTION THEORY AND ESTIMATION

1. Distributions: Fitting of
   - (i) Lognormal
   - (ii) Weibull
   - (iii) Cauchy
   - (iv) Gamma with parameters
2. Estimation:
   a. Computation Jackknife estimator
   b. Computation of Bootstrap estimator
   c. Method of MLE (Scoring Method)
   d. Computation of Bayes estimator (Binomial)

22/2/23

22/02/2023

M.Sc.(Applied Statistics) Semester I

STAS1-VIII : Paper VI - Practical (ST)

NOTE: Answer any 2 questions out of 5 questions : 2 x 25 = 50 Marks

SAMPLING THEORY AND SURVEYS

1. PPS sampling with and without replacements.
2. Ratio estimators in SRS , comparison with SRS
3. Separate and combined ratio estimators, Comparison.
4. Regression estimators in SRS, Comparison with SRS and Ratio estimators
5. Separate and combined Regression estimators, Comparison.
6. Cluster sampling with equal cluster sizes.
7. Sub sampling (Two–stage sampling) with equal first stage units.

22/2/23

22/02/2023

PROPOSED 1st SEMESTER EXAMINATION PATTERN
80 CREDITS

EXTERNAL EXAMINATION

↓

70 MARKS

INTERNAL EXAMINATION

↓

30 MARKS

Short Answers	Long Answers	Assignment
5 X 2 MARKS = 10	2X 5 MARKS = 10	10

INTERNALS= 10 + 10 = 20MARKS

ASSIGNMENT = 10 MARKS

TOTAL = 30 MARKS

External- 70 + Internal- 30 = 100

22/2/23

22/02/2023

PROPOSED 1st SEMESTER EXAMINATION PATTERN

70 Marks – 5 UNITS

PART – A

Answer all questions 5 x 5 = 25 Marks

1.

2.

3.

4.

5.

PART- B

Answer All Questions 5X 9=45 MARKS

6 A

Or

B

7 A

Or

B

8 A

Or

B

9 A

Or

B

10 A

Or

B

22/2/23

22/02/2023