Choice Based Credit System (CBCS)

NOWGONG COLLEGE

(AUTONOMOUS)

SYLLABUS

DEPARTMENT OF STATISTICS

Learning Outcomes-based Curriculum Framework (LOCF)

of

Undergraduate Programme

BACHELOR OF SCIENCE (HONOURS) IN STATISTICS

(Effective from Academic Year 2020-21)

Syllabus as approved by Academic Council, NC(A) on 17th May, 2021

Core Papers in Statistics

B.Sc. (Honours) in Statistics

SEMESTER-I

PAPER CODE: STAT-HCC-1016

(Descriptive Statistics & Index Number)

Credits: 6(Lecture-60, Practical-30) **Marks: 100**

Course Objectives:

The learning objectives include:

To summarize the data and to obtain its salient features from the vast mass of original data.

To understand the concept of attributes.

To understand the concept of index number.

Course Learning Outcomes:

After completing this course, the students should have developed a clear understanding of:Concepts of statistical population and sample, variables and attributes. Tabular and graphical representation of data based on variables.'Conditions for the consistency' and criteria for the independence of data based on attributes.Measures of central tendency, Dispersion, Skewness and Kurtosis. Moments and their use in studying various characteristics of data. Index number and its construction. Different methods of index number.

Contents:

UNIT I

Statistical Methods: Definition and scope of Statistics, concepts of statistical population and sample.Data: quantitative and qualitative, attributes, variables, scales of measurementnominal, ordinal, interval and ratio. Presentation: tabular and graphical, including histogram and ogives, consistency and independence of data with special reference to attributes.

UNIT II

Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, absolute moments, factorial moments, skewness and kurtosis, Sheppard's corrections.

UNIT III

Bivariate data: Definition, scatter diagram, simple, partial and multiple correlation (3 variables only), rank correlation. Simple linear regression, principle of least squares and fitting of polynomials and exponential curves.

UNIT IV

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

SUGGESTED READING:

1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.

2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

3. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

PRACTICAL/LAB. WORK: List of Practical

1. Graphical representation of data.

2. Problems based on measures of central tendency.

3. Problems based on measures of dispersion.

4. Problems based on combined mean and variance and coefficient of variation.

5. Problems based on moments, skewness and kurtosis.

6. Fitting of polynomials, exponential curves.

7. Karl Pearson correlation co-efficient.

8. Correlation coefficient for a bi-variate frequency distribution.

9. Lines of regression, angle between lines and estimated values of variables.

10. Spearman rank correlation with and without ties.

11. Partial and multiple correlations.

12. Planes of regression and variances of residuals for given simple correlations.

13. Planes of regression and variances of residuals for raw data.

14. Calculate price and quantity index numbers using simple and weighted average of price relatives

15. To calculate the Chain Base index numbers.

16. To calculate consumer price index number.

PAPER CODE: STAT-HCC-1026

(Calculus)

Credits: 6(Lecture-75, Tutorial-15) **Marks: 100**

Course Objectives:

The learning objectives include:

Fundamentals of differential calculus/Integral calculus/Differential Equation/Partial differential equation.

To analyse the problem and its solution.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of:

The fundamental concepts of Differential calculus. Solving complicated integrals.

Finding complete Solution of differential equations and partial differential equation.

Contents:

UNIT I

Differential Calculus: Limits of function, continuous functionsand properties of continuous functions, partial differentiation and total differentiation. Indeterminate forms: L-Hospital's rule, Leibnitz rule for successive differentiation. Euler's theorem on homogeneous functions. Maxima and minima of functions of one and two variables, constrained optimization techniques (with Lagrange multiplier) along with some problems. Jacobian, concavity, points of inflexion of function, singular points.

UNIT II

Integral Calculus: Review of integration and definite integral. Differentiation under integral sign, double integral, change of order of integration, transformation of variables. Beta and Gamma functions: properties and relationship between them.

UNIT III

Differential Equations: Exact differential equations, Integrating factors, change of variables, Total differential equations, Differential equations of first order and first degree, Differential equations of first order but not of first degree, Equations solvable for x, y, q, Equations of the first degree in x and y, Clairaut's equations. Higher Order Differential Equations: Linear differential equations of order n, Homogeneous and non-homogeneous linear differential equations of order n with constant coefficients, Different forms of particular integrals.

UNIT IV

Formation and solution of a partial differential equations. Equations easily integrable. Linear partial differential equations of first order.

SUGGESTED READINGS:

1. Gorakh Prasad: Differential Calculus, PothishalaPvt. Ltd., Allahabad (14th Edition - 1997).

2. Gorakh Prasad: Integral Calculus, PothishalaPvt. Ltd., Allahabad (14th Edition -2000).

3. Zafar Ahsan: Differential Equations and their Applications, Prentice-Hall of India Pvt. Ltd., New Delhi (2nd Edition -2004).

4. Piskunov, N: Differential and Integral Calculus, Peace Publishers, Moscow.

SEMESTER-II

PAPER CODE: STAT-HCC-2016

(Probability and Probability Distributions)

Credits: 6(Lecture-60, Practical-30) **Marks: 100**

Course Objectives:

The learning objectives include:

To understand the concepts of probability and its applications.

To understand the concept of random variables, probability distributions and expectation.

Different approaches to the theory of probability.

Important theorems on probability and their use in solving problems. Concept of random variables and its probability distributions.

Concept of joint, marginal and conditional probability distribution for two dimensional random variables and their independence.

Univariate transformation and expectation of random variables.

Course Learning Outcomes:

After completing this course, there should be a clear understanding of:

The fundamental concept of expectation for univariate and bivariate random variables with their distributions and properties.Moment generating function, cumulant generating function and characteristic function. Discrete probability distributions with their properties.Continuous probability distributions with their properties.

Contents:

UNIT I

Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical, and axiomatic. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.

UNIT II

Random variables: discrete and continuous random variables, p.m.f., p.d.f. and c.d.f., illustrations and properties of random variables, univariate transformations with illustrations. Two dimensional random variables: discrete and continuous type, joint, marginal and conditional p.m.f, p.d.f., and c.d.f., independence of variables, bivariate transformations with illustrations.

UNIT III

Mathematical Expectation and Generating Functions: Expectation of single and bivariate random variables and its properties. Moments and Cumulants, probability generating function, moment generating function, cumulant generating function and characteristic function. Uniqueness and inversion theorems (without proof) along with applications. Conditional expectations.

UNIT IV

Discrete probability distributions: Uniform, Binomial, Poisson, geometric, Negative Binomial, Hyper-geometric distributions along with their characteristics, properties and limiting/approximation cases.

Continuous probability distributions: Normal, Exponential, Uniform, Cauchy, Beta, Gamma, Lognormal and Laplace distributions along with their characteristics, properties and limiting/approximation cases.

SUGGESTED READING:

1. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.

2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

3. Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi

PRACTICAL/LAB. WORK:

List of Practical

1. Problem based on Bayes' theorem

2. Fitting of binomial distributions for n and p = q = ½.

3. Fitting of binomial distributions for given n and p.

4. Fitting of binomial distributions after computing mean and variance.

5. Fitting of Poisson distributions for given value of lambda.

6. Fitting of Poisson distributions after computing mean.

7. Fitting of negative binomial.

8. Application problems based on binomial distribution.

9. Application problems based on Poisson distribution.

10. Application problems based on negative binomial distribution.

11. Problems based on area property of normal distribution.

12. To find the ordinate for a given area for normal distribution.

13. Application based problems using normal distribution.

14. Fitting of normal distribution when parameters are given.

15. Fitting of normal distribution when parameters are not given.

PAPER CODE: STAT -HCC- 2026

(Mathematical Methods in Statistics)

Credits: 6(Lecture-60, Practical-30) **Marks: 100**

Course Objectives:

The learning objectives include:

Algebra serves as a building block that will enable students to learn more advanced techniques that will help them to solve problems more quickly and easily.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of:

Theory of Equations, The fundamental concepts of matrices and determinants Echelon form, Linear equations, Rank of a Matrix, Characteristic roots and vectors Quadratic forms, Partitioning of matrices, Generalized inverse

Contents:

UNIT I

Theory of equations, statement of the fundamental theorem of algebra and its consequences. Relation between roots and coefficients or any polynomial equations. Solutions of cubic and biquadratic equations when some conditions on roots of equations are given. Evaluation of the symmetric polynomials and roots of cubic and biquadratic

equations. Vector spaces, Subspaces, sum of subspaces, Span of a set, Linear dependence and independence, dimension and basis, dimension theorem.

UNIT II

Algebra of matrices - A review, theorems related to triangular, symmetric and skew symmetric matrices, idempotent matrices, Hermitian and skew Hermitian matrices, orthogonal matrices, singular and non-singular matrices and their properties. Trace of a matrix, unitary, involutory and nilpotent matrices. Adjoint and inverse of a matrix and related properties.

UNIT III

Determinants of Matrices: Definition, properties and applications of determinants for 3rd and higher orders, evaluation of determinants of order 3 and more using transformations. Symmetric and Skew symmetric determinants, Circulant determinants and Vandermonde determinants for nth order, Jacobi's Theorem, product of determinants. Use of determinants in solution to the system of linear equations, row reduction and echelon forms, the matrix equations AX=B, solution sets of linear equations, linear independence, Applications of linear equations, inverse of a matrix.

UNIT IV

Rank of a matrix, row-rank, column-rank, standard theorems on ranks, rank of the sum and the product of two matrices. Generalized inverse (concept with illustrations).Partitioning of matrices and simple properties. Characteristic roots and Characteristic vector, Properties of characteristic roots, Cayley Hamilton theorem, Quadratic forms, Linear orthogonal transformation and their digitalization.

SUGGESTED READINGS:

1. Lay David C.: Linear Algebra and its Applications, Addison Wesley, 2000.

2. Schaum'sOutlines : Linear Algebra, Tata McGraw-Hill Edition, 3rdEdition, 2006.

3. Krishnamurthy V., Mainra V.P. and Arora J.L.: An Introduction to Linear Algebra (II, III, IV, V).

4. Jain P.K. and Khalil Ahmad: Metric Spaces, Narosa Publishing House, New Delhi, 1973

5. Biswas, S. (1997): A Textbook of Matrix Algebra, New Age International, 1997.

6. Gupta S.C.: An Introduction to Matrices (Reprint). Sultan Chand & Sons, 2008.

7. Artin M.: Algebra. Prentice Hall of India, 1994.

8. Datta K.B.: Matrix and Linear Algebra. Prentice Hall of India Pvt. Ltd., 2002.

9. Hadley G.: Linear Algrbra. Narosa Publishing House (Reprint), 2002.

10. Searle S.R.: Matrix Algebra Useful for Statistics. John Wiley &Sons., 1982.

PRACTICAL/LAB. WORK:

List of Practical

1. Finding inverse using Cayley Hamilton theorem.
2. For a real Skew Symmetric matrix S, show that matrix A defined by (I-S) (I+S)-1 is an orthogonal matrix.
3. Reducing a Quadratic Form to its canonical form and finding its rank and index.
4. Proving that a quadratic form is positive or negative definite.
5. Finding the product of two matrices by considering partitioned matrices.
6. Finding inverse of a matrix by partitioning.
7. Finding Generalized Inverse of a matrix and symmetric generalized inverse of a matrix\
8. To show that matrix A defined as A= (In - X $(X'X)^{-1}X'$) is idempotent. Also, determine its rank and characteristic root. Repeat the process by finding a generalized inverse of X'X if inverse does not exist.
9. Find XGX' for any X of order nxk, where G is generalized inverse and show that XGX' is invariant with respect to G.
10. To find whether a given set of vectors is linearly dependent or linearly independent.
11. Constructing an Orthonormal Basis using Gram Schmidt Orthogonalization Process.

SEMESTER-III

PAPER CODE: STAT-HCC-3016

(Sampling Distributions)

Credits: 6(Lecture-60, Practical-30) **Marks: 100**

Course Objectives:

The learning objectives include:

To understand the concept of sampling distributions and their applications in statistical inference.

To understand the process of hypothesis testing.

To have a clear understanding of when to apply various tests of hypothesis about population parameters using sample statistics and draw appropriate conclusions from the analysis.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of:

Laws of convergence, their inter relations and applications. Central Limit Theorem and its applications.Order statistics and distribution of sample median and range.Basic concepts of hypothesis testing, including framing of null and alternative hypothesis.Hypothesis testing based on a single sample and two samples using both classical and p value approach.Chi square distribution.Analyze categorical data by using Chi square techniques. t and F distributions and their applications.

Contents:

UNIT I

Limit laws: convergence in probability, almost sure convergence, convergence in mean square and convergence in distribution and their inter relations, Chebyshev's inequality, W.L.L.N., S.L.L.N. and their applications, De-Moivre Laplace theorem, Central Limit Theorem (C.L.T.) for i.i.d. variates, applications of C.L.T. and Liapunov Theorem (without proof).

Order Statistics: Introduction, distribution of the rth order statistic, smallest and largest order statistics. Joint distribution of rth and sth order statistics, distribution of sample median and sample range.

UNIT II

Definitions of random sample, parameter and statistic, sampling distribution of a statistic, sampling distribution of sample mean, standard errors of sample mean, sample variance and sample proportion. Null and alternative hypotheses, level of significance, Type I and Type II errors, their probabilities and critical region. Large sample tests, use of CLT for testing single proportion, difference of two proportions, single mean, difference of two means, standard deviation and difference of standard deviations by classical and p-value approaches.

UNIT III

Exact sampling distribution: Definition and derivation of p.d.f. of $\chi 2$ with n degrees of freedom (d.f.) using m.g.f., nature of p.d.f. curve for different degrees of freedom, mean, variance, m.g.f., cumulant generating function, mode, additive property and limiting form of $\chi 2$ distribution. Tests of significance and confidence intervals based on distribution.

UNIT IV

Exact sampling distributions: Student's and Fishers t-distribution, Derivation of its p.d.f., nature of probability curve with different degrees of freedom, mean, variance, moments and limiting form of t distribution. Derivation of distribution of sample correlation coefficient when population correlation coefficient is zero (Sawkin's Methods). Snedecore's F-distribution: Derivation of p.d.f., nature of p.d.f. curve with different degrees of freedom, mean, variance and mode. Distribution of 1/F(n1,n2). Relationship between t, F and χ^2 distributions. Test of significance and confidence Intervals based on t and F distributions.

SUGGESTED READING:

1. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2003): An Outline of Statistical Theory, Vol. I, 4th Edn. World Press, Kolkata.

2. Rohatgi V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. 2ndEdn. (Reprint) John Wiley and Sons.

3. Hogg, R.V. and Tanis, E.A. (2009): A Brief Course in Mathematical Statistics. Pearson Education.

4. Johnson, R.A. and Bhattacharya, G.K. (2001): Statistics-Principles and Methods, 4th Edn. John Wiley and Sons.

5. Mood, A.M., Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn. (Reprint).Tata McGraw-Hill Pub. Co. Ltd.

PRACTICAL/LAB. WORK:

List of Practical

1. Testing of significance and confidence intervals for single proportion and difference of two proportions

2. Testing of significance and confidence intervals for single mean and difference of two means and paired tests.

3. Testing of significance and confidence intervals for difference of two standard deviations.

4. Exact Sample Tests based on Chi-Square Distribution.

5. Testing if the population variance has a specific value and its confidence intervals.

6. Testing of goodness of fit.

7. Testing of independence of attributes.

8. Testing based on 2 X 2 contingency table without and with Yates' corrections.

9. Testing of significance and confidence intervals of an observed sample correlation coefficient.

10. Testing and confidence intervals of equality of two population variances

PAPER CODE: STAT-HCC-3026

(Survey Sampling and Indian Official Statistics)

Credits: 6 (Lecture-60, Practical-30) **Marks: 100**

Course Objectives:

The learning objectives include:

To provide tools and techniques for selecting a sample of elements from a target population keeping in mind the objectives to be fulfilled and nature of population.

To obtain estimator of the population parameter on the basis of selected sample and study its properties.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of:

The fundamental concepts of population and sample. (or The basic concepts of survey) The principles of sample survey and the steps involved in selecting a sample.

Simple Random Sampling. Stratified Sampling.Systematic Sampling.Ratio and Regression Methods of Estimation. Cluster Sampling (equal size clusters).Sub Sampling.Indian Official Statistics.

Contents:

UNIT I

Concept of population and sample, complete enumeration versus sampling, sampling and non-sampling errors. Types of sampling: non-probability and probability sampling, basic principle of sample survey, simple random sampling with and without replacement, definition and procedure of selecting a sample, estimates of: population mean, total and proportion, variances of these estimates, estimates of their variances and sample size determination. Stratified random sampling: Technique, estimates of population mean and total, variances of these estimates, proportional and optimum allocations and their comparison with SRS. Estimation of gain in precision.

UNIT II

Systematic Sampling: Technique, estimates of population mean and total, variances of these estimates (N=nxk) and its efficiency. Comparison of systematic sampling with SRS and stratified sampling in the presence of linear trend and corrections. Cluster sampling (equal clusters only) estimation of population mean and its variance. Two stage sampling and calculation of its mean and variance. Idea of sub sampling.

UNIT III

Introduction to Ratio and regression methods of estimation involving one or more auxiliary variables, first approximation to the population mean and total (for SRS of large size). Probability proportional to size sampling with and without replacement, the Hansen-Hurwitz and the Horvitz Thompson estimators, non-negative variance estimation with reference to the Horvitz-Thompson estimator.

UNIT IV

Present official statistical system in India, Methods of collection of official statistics, their reliability and limitations. Role of Ministry of Statistics & Program Implementation (MOSPI), Central Statistical Office (CSO), National Sample Survey Office (NSSO), and National Statistical Commission.

SUGGESTED READING:

1. Cochran W.G. (1984):Sampling Techniques(3rd Ed.), Wiley Eastern.

2. Sukhatme,P.V., Sukhatme,B.V. Sukhatme,S. Asok,C.(1984). Sampling Theories of Survey With Application, IOWA State University Press and Indian Society of Agricultural Statistics

3. Murthy M.N. (1977): Sampling Theory & Statistical Methods, Statistical Pub. Society, Calcutta.

4. Des Raj and Chandhok P. (1998): Sample Survey Theory, Narosa Publishing House.

5. Goon A.M., Gupta M.K. and Dasgupta B. (2001): Fundamentals of Statistics (Vol.2), World Press.

6. Guide to current Indian Official Statistics, Central Statistical Office, GOI, New Delhi.

7. http://mospi.nic.in/

PRACTICAL/LAB. WORK:

List of Practical

1. To select a SRS with and without replacement.

2. For a population of size 5, estimate population mean, population mean square and population variance. Enumerate all possible samples of size 2 by WR and WOR and establish all properties relative to SRS.

3. For SRSWOR, estimate mean, standard error, the sample size

4. Stratified Sampling: allocation of sample to strata by proportional and Neyman's methods Compare the efficiencies of above two methods relative to SRS

5. Estimation of gain in precision in stratified sampling.

6. Comparison of systematic sampling with stratified sampling and SRS in the presence of a linear trend.

7. Cluster sampling: estimation of mean or total, variance of the estimate, estimate of intra-class correlation coefficient, efficiency as compared to SRS.

8. Ratio and Regression estimation: Calculate the population mean or total of the population. Calculate mean squares. Compare the efficiencies of ratio and regression estimators relative to SRS.

9. Calculate the mean, variance of PPS sampling.

PAPER CODE: STAT-HCC-3036

(Mathematical Analysis)

Credits: 6 (Lecture-60, Practical-30) **Marks:100**

Course Objectives:

The learning objectives include:

To study the Real Analysis, this deals with the analytical properties of real functions and sequences.

To study the Numerical Analysis, this is the study of algorithms that use numerical approximation for the problems of mathematical analysis.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of:

Fundamental properties of real number and real-valued functions. Analytical properties of sequences.

Infinite series, their properties and different tests.

Limits, continuity, differentiability and mean value theorems.

Fundamentals of numerical analysis, interpolation, numerical integration and difference equation.

Contents:

UNIT-I

Real Analysis: Representation of real numbers as points on the line and the set of real numbers as complete ordered field. Bounded and unbounded sets, neighbourhoods and limit points, Superimum and infimum, derived sets, open and closed sets, sequences and their convergence, limits of some special sequences such as $r^n, \left(1+\frac{1}{n}\right)^n, n^{\frac{1}{n}}$ and Cauchy's general principle of convergence, Cauchy's first theorem on limits, monotonic sequences, limit superior and limit inferior of a bounded sequence.

UNIT-II

Infinite series, positive termed series and their convergence, Comparison test, D'Alembert's ratio test, Cauchy's n^{th} root test, Raabe's test. Gauss test, Cauchy's condensation test and integral test (Statements and Examples only). Absolute convergence of series, Leibnitz's test for the convergence of alternating series, Conditional convergence. Indeterminate form, L' Hospital's rule.

UNIT-III

Review of limit, continuity and differentiability, uniform Continuity and boundedness of a function. Rolle's and Lagrange's Mean Value theorems. Taylor's theorem with lagrange's and Cauchy's form of remainder(without proof). Taylor's and Maclaurin's series expansions of sinx, cosx, log (1+x).

UNIT-IV

Numerical Analysis: Factorial, finite differences and interpolation. Operators, E and divided difference. Newton's forward, backward and divided differences interpolation formulae. Lagrange's interpolation formulae. Central differences, Gauss and Stirling interpolation formulae. Numerical integration. Trapezoidal rule, Simpson's one-third rule, three-eighth rule, Weddle's rule with error terms. Stirling's approximation to factorial n. Solution of difference equations of first order.

SUGGESTED READINGS

1. Malik S.C. and Savita Arora: Mathematical Analysis, Second Edition, Wiley Eastern Limited, New Age International Limited, New Delhi, 1994.

2. Somasundram D. and Chaudhary B.: A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1987.

3. Gupta S.L. and Nisha Rani: Principles of Real Analysis, Vikas Publ. House Pvt. Ltd., New Delhi, 1995. B. Sc. Honours (Statistics) 19

4. Appostol T.M.: Mathematical Analysis, Second Edition, Narosa Publishing House, NewDelhi, 1987.

5. Shanti Narayan: A course of Mathematical Analysis, 12th revised Edition, S. Chand & Co. (Pvt.) Ltd., New Delhi, 1987.

6. Singal M.K. and Singal A.R.: A First Course in Real Analysis, 24th Edition, R. Chand & Co., New Delhi, 2003.

7. Bartle, R. G. and Sherbert, D. R. (2002): Introduction to Real Analysis(3rd Edition), John Wiley and Sons (Asia) Pte. Ltd., Singapore.

8. Ghorpade, Sudhir R. and Limaye, Balmohan V. (2006): A Course in Calculus and Real Analysis,Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint.

9. Jain,M. K., Iyengar, S. R. K. and Jain, R. K. (2003): Numerical methods for scientific and engineering computation, New age International Publisher, India.

10. Mukherjee, Kr. Kalyan (1990): Numerical Analysis. New Central Book Agency.

11. Sastry, S.S. (2000): Introductory Methods of Numerical Analysis, 3rd edition, Prentice Hall of India Pvt. Ltd., New Del

PRACTICAL/LABWORK:

List of Practical

1. Formation of difference table, fitting of polynomial and missing terms for equal interval of differencing.
2. Based on Newton's Gregory forward difference interpolation formula.
3. Based on Newton's backward difference interpolation formula.
4. Based on Newton's divided difference and Lagrange's interpolation formula.
5. Based on Gauss forward, Gauss backward central difference interpolation formula.
6. Based on Stirling's central difference interpolation formula.
7. Based on Lagrange's Inverse interpolation formula.
8. Based on method of successive approximation or iteration.
9. Based on method of reversion of series.
10. Based on Trapezoidal Rule, Simpson's one-third rule, Simpson's three-eighth rule, Weddle's rule.
11. To find sum by Euler-Maclaurin summation formula.

Honours Generic/Regular Papers in Statistics

SEMESTER-I

PAPER CODE: STAT-HGE/RCC-1016

(Statistical Methods)

Credits: 6 (Lecture-60, Practical-30) **Marks:100**

Course Objectives:

The learning objectives include:

To introduce students to different measurement scales, qualitative and quantitative and discrete and continuous data.

To help students to organize data into frequency distribution graphs, including bar graphs, histograms, polygons, and Ogives.

Students should be able to understand the purpose for measuring central tendency, variation, skewness and kurtosis and should be able to compute them as well.

Students should be able to understand and compute various statistical measures of correlation, fitting of curve and regression.

Course Learning Outcomes:

Upon successful completion of this course students will demonstrate knowledge of:

Introduction to Statistics, definitions and data classification, types of studies and types of samples.

Graphical displays of data, frequency distributions, analyzing graphs.

Numerical descriptions of data, measures of central tendency, measures of dispersion, skewness and kurtosis.

Correlation and regression. Theory of attributes.

Contents:

UNIT I

Introduction: Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables, scales of measurement - nominal, ordinal, intervaland ratio. Presentation: tabular and graphic, including histogram and ogives.

UNIT II

Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, moments, skewness and kurtosis.

UNIT III

Bivariate data: Definition, scatter diagram, simple, partial and multiple correlation (3 variables only), rank correlation. Simple linear regression, principle of least squares and fitting of polynomials and exponential curves.

UNIT IV

Theory of attributes, consistency of data, independence and association of attributes, measures of association and contingency.

SUGGESTED READING:

1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.

2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

3. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

PRACTICAL/ LAB WORK

List of Practical

1. Graphical representation of data

2. Problems based on measures of central tendency

3. Problems based on measures of dispersion

4. Problems based on combined mean and variance and coefficient of variation

5. Problems based on moments, skewness and kurtosis

6. Fitting of polynomials, exponential curves

7. Karl Pearson correlation coefficient

8. Partial and multiple correlations

9. Spearman rank correlation with and without ties.

10. Correlation coefficient for a bivariate frequency distribution

11. Lines of regression, angle between lines and estimated values of variables.

12. Checking consistency of data and finding association among attributes.

SEMESTER-II

PAPER CODE: STAT-HGE/RCC-2016

(Introductory Probability)

Credits: 6(Lecture-60, Practical-30) **Marks: 100**

Course Objectives:

The learning objectives include:

Understanding probability theory at basic and advance level, random variables and also their convergences at weak and strong levels.

Different probability distribution (discrete and continuous).

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of:

The fundamental concepts of Probability Theory. Solving probabilistic problems.

Understanding random variables and computing properties of distribution they follow. Different

probability distributions and their implementation at realistic models.

Contents:

UNIT I

Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical, and axiomatic. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.

UNIT II

Random Variables: Discrete and continuous random variables, p.m.f., p.d.f. ,c.d.f. Illustrations of random variables and its properties. Expectation, variance, moments and moment generating function.

UNIT III

Convergence in probability, almost sure convergence, Chebyshev's inequality, weak law of large numbers, De-Moivre Laplace and Lindeberg-Levy Central Limit Theorem (C.L.T.).

UNIT IV

Standard probability distributions: Binomial, Poisson, geometric, negative binomial, hypergeometric, uniform, normal, exponential, beta, gamma.

SUGGESTED READING:

1. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.

2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

3. Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi

PRACTICAL/LAB. WORK:

List of Practical

1. Fitting of binomial distributions for n and p = q = ½ given

2. Fitting of binomial distributions for n and p given

3. Fitting of binomial distributions computing mean and variance

4. Fitting of Poisson distributions for given value of lambda

5. Fitting of Poisson distributions after computing mean

6. Application problems based on binomial distribution

7. Application problems based on Poisson distribution

8. Problems based on area property of normal distribution

9. To find the ordinate for a given area for normal distribution

10. Application based problems using normal distribution

11. Fitting of normal distribution when parameters are given

12. Fitting of normal distribution when parameters are not given

PAPER CODE: STAT-HGE/RCC-3016

(Basics of Statistical Inference)

Credits: 6 (Lecture-60, Practical-30) **Marks: 100**

Course Objectives:

The learning objectives include:

To learn how the mathematical ideas of Statistics carry over into the world of applications.

To analyse and interpret the data.

Course Learning Outcomes:

After completing this course, students should have developed a clear understanding of:

Theory of estimation. Tests of hypothesis.

Application of Chi-square test. Nonparametric tests.

Analysis of variance.

Fundamentals and analysis of basic designs (CRD, RCBD). Bioassay.

Contents:

UNIT I

Estimation of population mean, confidence intervals for the parameters of a normal distribution (one sample and two sample problems). The basic idea of significance test. Null and alternative hypothesis. Type I & Type II errors, level of significance, concept of p-value. Tests of hypotheses for the parameters of a normal distribution (one sample and two sample problems).

UNIT II

Categorical data: Tests of proportions, tests of association and goodness-of-fit using Chisquare test, Yates' correction.

UNIT III

Tests for the significance of correlation coefficient. Sign test for median, Sign test for symmetry, Wilcoxon two-sample test.

UNIT IV

Analysis of variance, one-way and two-way classification. Brief exposure of three basic principles of design of experiments, treatment, plot and block. Analysis of completely randomized design, randomized complete block design. Bioassay.

SUGGESTED READING:

1. Daniel, Wayne W., Bio-statistics: A Foundation for Analysis in the Health Sciences. John Wiley (2005).

2. Goon, A.M., Gupta M.K. & Das Gupta, Fundamentals of statistics, Vol.-I & II (2005).

3. Dass, M. N. &Giri, N. C.: Design and analysis of experiments. John Wiley.

4. Dunn, O.J Basic Statistics: A primer for the Biomedical Sciences .(1964, 1977) by John Wiley.

5. Bancroft, Holdon Introduction to Bio-Statistics (1962) P.B. Hoebar New York.

6. Goldstein, A Biostatistics-An introductory text (1971). The Macmillion New York.

PRACTICAL/LAB WORK

List of Practical

1. Estimators of population mean.

2. Confidence interval for the parameters of a normal distribution (one sample and two sample problems).

3. Tests of hypotheses for the parameters of a normal distribution (one sample and two sample problems).

4. Chi-square test of proportions.

5. Chi-square tests of association.

6. Chi-square test of goodness-of-fit.

7. Test for correlation coefficient.

8. Sign test for median.

9. Sign test for symmetry.

10. Wilcoxon two-sample test.

11. Analysis of Variance of a one way classified data

12. Analysis of Variance of a two way classified data.

13. Analysis of a CRD.

14. Analysis of an RBD.