COURSES OF STUDIES

MA./MSC. (STATISTICS), 2023-25

Choice Based Credit System

(Passed in the BOS meeting 05.07.2023)

P.G. DEPARTMENT OF STATISTICS
GOVERNMENT AUTONOMOUS COLLEGE, ROURKELA
ODISHA
769004

MISSION

M1	Educate society for generations by providing transformative education with deep disciplinary knowledge and concern for Environment
M2	Develop problem solving, leadership and communication skill in student participants to serve the organisation of today and Tomorrow
M3	Aim for the holistic development of the students by giving them value based ethical education with concern for society
M4	Foster entrepreneurial skills and mindset in the students by giving life-long learning to make the them responsible citizens

Programme Education Objectives

PEO1	Understand the nature and basic concepts of **Statistics.**
PEO2	Analyse the relationships among different concepts
PEO3	Perform procedures as laid down in the areas of study
PEO4	Apply the Basic Concepts learned to execute them

Programme Outcomes

PO-1	**Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions
PO-2	**Effective Communication:** Will be able to speak, read, write and listen clearly in person and through electronic media in English and in one Indian Language
PO-3	**Social Interaction (Interpersonal Relation):** Elicit views of others, mediate disagreements and prepared to work in team
PO-4	Entrepreneurship Capability: Demonstrate qualities to be prepared to become an Entrepreneurship
PO-5	Ethics: Recognize different value systems including your own, understand the moral dimensions and accept responsibility for them
PO-6	Environment and Sustainability: Understand the issues of environmental contexts and sustainable development
PO-7	Life-Long Learning: Acquire the ability to engage in independent and life-long learning in the context of socio-technological changes

SEMESTER-WISE SKELETON OF THE TWO YEARS P.G. PROGRAMME IN UNIVERSITY P.G. DEPARTMENTS AND COLLEGES UNDER SAMBALPUR UNIVERSITY

P.G. IN STATISTICS			
	From the Dept		
Semester	Credit		Credit
First	20	Entrepreneurship Development/ Env. Studies & Disaster Management	2
Second	20	Inter Dept. course (IDC) or Open Elective	3
Third	20	Env. Studies & Disaster Management/ Entrepreneurship Development	2
Fourth (including Project of 4 credit)	20		
Total	80	MOOCs one paper (in 2nd or 3rd Sem)	3
Total credit for2 year course = 90 credits			
Furthermore, the following non-credit course will be taken by the student			
1. Yuva Sanskar	2. N.C.C./ N.S.S./Sports/ Performing Arts/Yoga (of which one has to be opted)		

- In each Semester, the Department can offer either 5 papers of 4 credits(i.e.,5x4=20credits)
- The results of 1st, 2nd and 3rd Semester will be published on the basis of 20 credits core course only. The results of fourth and final semester results will incorporate taking into consideration 80 credits core course offered by the Department and 10 credit courses comprising (i) Env. Studies & Disaster Management (2 credit), (ii) Inter Dept. Course (IDC) or Open elective (3 credit), (iii) Entrepreneurship Development (2 credit) (iv) MOOCs (3 credit).
- The students will take one MOOCs Course according to his/her preference in consultation with HOD and submit the document in support of undertaking the MOOCs course to the respective Department.
- Students will apply in prescribed form their preference for NCC/NSS/Sports/ Performing Art/Yoga at the beginning of the session. The consolidated list of the same will be forwarded by the HODs to the office of the Chairman, PG Council. Depending upon the number of application, maximum capacity and preference, the students will be allotted one of the above non-credit courses.

1. Distribution of Marks in % for the theory Papers

Theory Papers offered by the own Department		Theory Paper offered by other Department	
End Term	Mid Term	End Term	Mid Term
80%	20%	60%	40%
Mid- term will consist of (10% for 2 class tests, 5% for assignment, 5% for case study in case of mid-term of 20%; 20% for 2 class tests, 10% for assignment, 10% for case study in case of mid-term of 40%)			

2. Project work of 4th Semester will be assigned to the students (jointly or individually) at the beginning of the III Semester and will be completed in the IV semester. The distribution of the work/marks will be as follows:

Semester wise work and distribution of marks in % for Project			
III Semester (20%) Evaluation of Interim Report of the Project Work			
Background of the Problem (5%)	Review of Literature (5%)	Objectives (5%)	Methodology (5%)
IV Semester (80%) Evaluation of Final Report of the Project Work			
Project work (50%)		Viva (30%)	

3. Question Pattern and Mark Distribution of the Theory Paper
   a. For End-Term Examination of Total Marks 80 (Four Units Course)
      Q.1 Twenty Questions of 1 mark each (Questions patterns should be of MCQ, Fill in the Blanks, True/False, Definition etc.)
      (20 x 1 = 20)
      For Unit-I, Unit-II, Unit-III and Unit-IV
      Each question will be of 15 marks, and it should have alternative in each unit. The distribution of 15 marks will be decided by the paper setter.
      [Suggested patterns distribution of 15 marks are 15; 8+7; 7.5+7.5; 5+10,2+3+10, 5+5+5 etc.]
   b. For End-Term Examination of Total Marks 60 (Four Units Course)
      Q.1 Twelve Questions of 1 mark each (Questions patterns should be of MCQ, Fill in the Blanks, True/False, Definition etc.)
      (12 x 1 = 12)
      For Unit-I, Unit-II, Unit-III and Unit-IV
      Each question will be of 12 marks and there should have alternative in each unit. The distribution of 12 marks will be decided by the paper setter.
      [Suggested patterns distribution of 12 marks are 12; 8+4; 6+6; 2+3+7, 4+4+4 etc.]
4. Pass percentage
   For each paper pass percentage is 30% (Credit 4). For clearing the semester Overall Grade Point should be 4.5 (40%).

   For IDC, Environmental Studies and Disaster Management and Entrepreneurship Development Programme the pass percentage is 30% (Credit 4).

   For MOOC course the pass percentage is as per the programme guideline.

POST GRADUATE DEPARTMENT OF STATISTICS

GOVERNMENT AUTONOMOUS COLLEGE, ROURKELA,PANPOSH - 769004, ODISHA

OUTLINE OF COURSE STRUCTURE FOR M.Sc. STATISTICS (Session: 2023-2025)

SEMESTER	SubjectCode	Title of the Course	End Term Marks	Internal Marks	Practical marks	Total	Credit Hour
I	AECC-1	Entrepreneurship Development	60	20+20(assignment)		100	2 CH
	MSC 101	Statistical Methods-I	80	20		100	4 CH
	MSC 102	Probability-1	80	20		100	4 CH
	MSC 103	Mathematical Analysis and Algebra	80	20		100	4 CH
	MSC 104	Sampling Methods	80	20		100	4 CH
	MSC 105	Practical – I			50	50	2 CH
	MSC 106	Practical – II			50	50	2 CH
		Total Credit Hours for Semester I				600	22 CH
II	AECC – II	Environmental studies and disaster management	60	20+20(assignment)		100	2 CH
	MSC 201	Statistical Methods-II	80	20		100	4 CH
	MSC 202	Probability-II	80	20		100	4 CH
	MSC 203	Statistical Inference-I	80	20		100	4 CH
	MSC 204	Stochastic Modeling	80	20		100	4 CH
	MSC 205	Practical – I			50	50	2 CH
	MSC 206	Practical – II			50	50	2 CH
		Total Credit Hours for Semester II				600	22 CH
III	IDC	Basic statistics and data analysis (for non-core students)	60	20+20(assignment)		100	3 CH
	MSC 301	Statistical Inference-II	80	20		100	4 CH
	MSC 302	Multivariate Analysis	80	20		100	4 CH
	MSC 303	Optimization Technique-I	80	20		100	4 CH
	MSC 304	Econometrics	80	20		100	4 CH
	MSC 305	Practical – I			50	50	2 CH
	MSC 306	Practical – II			50	50	2 CH
	MSC 307	MOOC's one paper from Swayam or others					3 CH
		Total Credit Hours for Semester III				600	26 CH
IV	MSC 401	Design and Analysis of Experiment	80	20			4 CH
	MSC 402	Linear Model and Regression Analysis	80	20			4 CH
	MSC 403	Demography	80	20			4 CH
	MSC 404	Project (Project Work (50)+ Viva (30)+ Presentation(20))			50+30+20		4 CH
	MSC 405	Practical – I			50		2 CH
	MSC 406	Practical – II			50		2 CH
		Total Credit Hours for Semester IV				500	20 CH
	TOTAL (A)		**1520**	**480**	**300**	**2300**	**90 CH**

PROGRAMME OUTCOME

PO-1	**Critical Thinking** Take informed actions after identifying the assumptions that frame our thinking and actions
PO-2	**Effective Communication** Will be able to speak, read, write and listen clearly in person and through electronic media in English and in one Indian Language
PO-3	**Social Interaction (Interpersonal Relation)** Elicit views of others, mediate disagreements and prepared to work in team
PO-4	**Entrepreneurship Capability** Demonstrate qualities to be prepared to become an entrepreneurship
PO-5	**Ethics** Recognize different value systems including your own, understand the moral dimensions and accept responsibility for them
PO-6	**Environment and Sustainability** Understand the issues of environmental contexts and sustainable development
PO-7	**Life-Long Learning** Acquire the ability to engage in independent and life-long learning in the context of socio-technological

POST GRADUATE DEPARTMENT OF STATISTICS
GOVERNMENT AUTONOMOUS COLLEGE, RORKELA
M.A/M.Sc. STATISTICS COURSES OF STUDY FOR 2023-2025

MA/MSc. STATISTICS

SEMESTER-I

STATISTICAL METHODS-I

MSC- 101 **4CH**

Objective: Statistical methods provide scientific view to conduct the survey in proper way to collect the data about specific perspective. It helps to learn how to develop regression model and apply for the specific perspective data appropriate manner. This paper presents the general theory of statistical distributions as well as the standard distributions found.

CO-1	Remember and understand the basic concepts/Principles of Statistical Methods-I
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Unit-I
Introduction to different measures such as measures of location, dispersion and skewness, Basic concept of discrete and continuous probability distributions and their properties. Basic discrete distributions- Bernoulli, Binomial, Poisson and Uniform, Computations of their moments, means, Variances and Beta coefficients, recurrence relations between moments, M.G.F. and C.F. Basic continuous distributions: - Uniform and normal distributions their properties and applications. Computation of their M.G.F., C.F. and Moments.

Unit-II
Analytical Statistics: - Bivariate data, Scatter diagram, Simple correlations and linear regression. Their properties and applications. Curve fitting, linear and second-degree curve and their applications.

Unit-III
Random vectors, joint distribution, joint M.G.F., Independence of random variables. Multinomial distributions and its mean vector and variance and co-variance matrix, bivariate normal distributions, conditional expectation and conditional variance. Its marginal and conditional distributions.

Unit-IV
Sampling distributions of Statistics: Sampling distributions of sample mean, sample variance, Derivations of Chi- square, z, t and F distributions, tests of significance based on them and their applications.

Books Recommended:

1. Fundamental of Mathematical Statistics (2009)- S Chand & Sons- S.C. Gupta and V.K. Kapoor
2. Introduction to Theory and Mathematical Statistics (1988) - Wiley – V.K. Rohatgi,

3. Linear Statistical Inference and its Applications (1975) – Wiely- C.R. Rao
4. An Introduction to Theory of Statistics - Charles Griffiu Yale, G.U. and Kendall, M.G. (1953)
5. Probability and Statistics with Engineering and Computer Science Applications (2005) – Kalyani Swain, A.K.P.C.
6. John E. Freud's Mathematical Statistics with Applications(2006); (7th Edition- Pearson Education; Asia-Miller; Irwin and Miller; Marylees.
7. Applied Statistics (1999)- New Central Book Agency- Mukhapaddhyay P.

PROBABILITY-I

MSC- 102 **4CH**

Objective: This paper helps to understand basics of set theory and probability theory which deals with uncertain occurrence situations in logical manner.

CO-1	Remember and understand the basic concepts/Principles of Probability-I
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Unit-I
Algebra of sets, Fields and Sigma fields, Limit of sequence of subsets, Sigma field generated by a class of subsets, Borel fields. Probability space, continuity of probability measure.

Unit-II
Sample space, Probability axioms, Conditional probability, Independence of events. Bayes' theorem, Real and vector valued random variables, Distribution function, Discrete and continuous random variables, Distribution of L.V.S. Marginal and conditional distribution. Independence of random variables.

Unit-III
Poisson theorem, Interchangeable events and their limiting properties, Expectation of a random variable. Linear properties of expectations. Conditional expectation, Moment generating function. Moment inequalities. Characteristic function and its properties.

Unit-IV
Convergence of a sequence of random variables, Convergence in distribution, Convergence in probability, almost sure convergence and Convergence in quadratic mean and their interrelations. Monotone and dominated convergence theorem, Central limit theorem: Lindberg-Levy and Demoivre-Lapalce theorem.

Books Recommended:
1. Bhat, B.R. (1985): Modern probability theory (Wiley).
2. Billingsley, P. (1986): Probability and measure (Wiley).
3. Feller, W. (1969): Introduction to probability theory and applications, Vol . II (Wiley)
4. Rohatgi, V.K. (1976): Introduction to theory of probability and mathematical Statistics (Wiley).

5. H.G. Tucker (1967): A graduate course in probability theory (AP)
6. Y.S. Chow and H Teicher(1979): Probability theory (Springer-Verlag),

MATHEMATICAL ANALYSIS AND ALGEBRA

(Scientific calculator is allowed)

MSC-103 **4CH**

Objective: To introduce fundamental concept of Mathematical analysis such as sequence, series of real numbers and their convergence, continuity, differentiability of real valued functions and complex analysis. It will cover the analysis and implementation of algorithms used to solve linear algebra problems in practice. Apply numerical methods to obtain approximate solutions to mathematical problems.

CO-1	Remember and understand the basic concepts/Principles of Mathematical Analysis & Algebra
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Unit-I

Sequences, subsequences, convergence, divergence, bounded sequences, limits superior and inferior, monotone sequences, Cauchy sequences, completeness, Series of real numbers. Heine-Borel Theorem, Bolzano Weierstrass Theorem. Functions: limits, continuity, uniform continuity, intermediate value theorem, Differentiability; Chain rule, mean value theorem, Taylor's theorem (statement), extreme, Multivariate calculus: partial, directional and total derivatives mean value theorem, Gamma function and Beta function, Multiple integrals, change of variables, Jacobian formula.

Unit-II

Algebra of complex numbers, operations of absolute value and conjugate, standard inequalities for absolute value, concept of analytic functions like power series, and differentiability methods, exponential and logarithmic functions, Cauchy integral formula, Holomorphic functions, Laurent Series, Singularity, calculus of residues evaluation of integration using contour. Vector Spaces, Subspaces. Linear independence, Basis, Dimensions.

Unit-III

Algebra of matrices, Operation on matrices, Properties of matrix, Rank, row space, column space and inverse of a matrix. Caylay –Hamilton theorem, symmetric, skew-symmetric, Hermitian, skew-Hermitian, orthogonal, unitary matrices and their eigen values. Elementary operation, Echelon, normal and Hermite canonical forms, linear equations. Inner product, norm. Characteristic roots of real matrices, right and left characteristic vectors, Eigen values and Eigen vectors. Independence of characteristic vectors corresponding to distinct characteristic roots. Generalized inverse. Definition of a real quadratic form, Classification of quadratic forms.

Unit-IV

Root finding using Newton-Raphson, Secant, Regula-Falsi methods and their convergence, Interpolation - Newton's formulae, Lagrange, Hermite, Numerical differentiation. Numerical integration -Trapezoidal, Simpson and Weddle rules, Gaussian quadrature formulae -Gauss-Laguerre, Transcendental Algebraic equations- Gauss elimination, Jacobi, Gauss Seidal methods and their convergence.

Books Recommended:

l. Bartle G.R. & Sherbert D. R. (2000): Introduction to Real Analysis- John Wiley & Son Inc.
2. Royden (1988): Principles of Real Analysis - Macmillian.
3. Widder (1989): Advanced Calculus - Dover Publication.
4. W, Rudin (2013): Real and Complex Analysis, Tata Mc-Graw Hill. 5. E. M. Strein, R, Shakarchi (2003): Complex Analysis, Princeton University Press.
5. Rao, A.R. and Bhimasankaram,P .(2000): Linear Algebra, Hindustan Book Agency, New Delhi.
6. Scoule, S.R. (1982): Matrix Algebra Useful for Statistics, John Wiley & Sons.
7. Rao, C.R. (1995): Linear Statistical Inference and its Applications (Wiley Eastern).
8. Hohn, F .E. (1973): Elements of Matrix Algebra, McMillan.
9. M.K. Jain, S.R.K. Iyengar, R.K. Jain (1995): Numerical Methods for Scientific and Engineering Computation, Willey Eastern Ltd, New Delhi.

SAMPLING METHODS

MSC-104 **4 CH**

Objective: This paper helps to learn variety of probability and non-probability sampling methods depending on the type of the population for selecting a sample from it and estimation of various population parameters.

CO-1	Remember and understand the basic concepts/Principles of Sampling Methods
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Unit-I

Concept of population and sample, need for sampling, complete enumeration versus sampling, basic concepts in sampling, sampling and non-sampling error, Methodologies in sample surveys (questionnaires, sampling design and methods followed in field investigation) by NSSO. Subjective or purposive sampling, probability sampling or random sampling, simple random sampling with and without replacement, estimation of population mean, population proportions and their standard errors. Stratified random sampling, proportional and optimum allocation, comparison with simple random sampling for fixed sample size. Covariance and Variance Function, formation of strata and number of strata.

Unit-II

Use of supplementary information for estimation, Ratio, product and regression methods of estimation, estimation of population mean, evaluation of Bias and Variance to the first order of approximation, comparison with simple random sampling. Systematic sampling (when

population size (N) is an integer multiple of sampling size (n)). Estimation of population mean and standard error of this estimate, comparison with simple random sampling.

Unit-III

Equal size cluster sampling: estimators of population mean and total and their standard errors, comparison of cluster sampling with SRS in terms of intra-class correlation coefficient. Concept of multistage sampling and its application, two-stage sampling with equal number of second stage units, estimation of population mean and total. Double sampling in ratio and regression methods of estimation. Concept of sub-sampling.

Unit-IV

Sampling with probability proportional to size (with and without replacement method): PPSWR/WOR methods (including Lahiri's scheme), Des Raj and Das estimators for n=2, Horvitz-Thomson's estimator and its properties, Murthy estimator. Non-sampling error with special reference to non-response problems.

Books Recommended:

1. Des, Raj and Chandok, P. (1998): Sample Survey Theory (Narosa).
2. Sukhatme, P.V; Sukhatme, B.V. and Asok, C. (1984): Sampling Theory of Surveys with Applications, Indian Soc. of Ag. Stats., New Delhi.
3. Cochran, W.G. (1984): Sampling Technique (Wiley).
4. Swain, A.K.P.C. (2003): Finite Population Sampling - Theory and Methods, South Asian Publishers.
5. Mukhopadhyay, P. (1996): Inferential Problems in Survey Sampling, New Age International (P).
6. Chaudhuri, A. and R. Mukherjee (1988): Randomised response: theory and techniques, New York, Marcel Deckker Inc.
7. Singh D. and Chaudhary, F.S. (1986): Theory and Analysis of Sample Survey Designs, New Age International Publishers.

C-PROGRAMMING

MSC- 105 **2 CH**

Objective: Data structure and algorithms introduces about the basic and elementary concepts of data structures. This paper involves learning of programming in C, with an emphasis on problem solving skills.

CO-1	Remember and understand the basic concepts/Principles of Data Structure & C-Programming
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Introduction to programming, History and importance of C, Components, basic structure programming, Data types, Constant and variables, declaration and assignment of variables, Operators and Expressions: Arithmetic, relational, logical, assignment, increment/decrement, operators, precedence of operators in arithmetic, relational and logical expression. Implicit

and explicit type conversions in expressions, library functions. Managing input and output operations: reading and printing formatted and unformatted data.

Decision making and branching – if-else, nesting of if-else, else if ladder, switch, conditional-operator. Looping in C: for, nested for, while, do…while, jumps in and out of loops. Switch case statement, break and continue statement. Arrays: Declaration and initialization of one-dim and two-dim arrays. Character arrays and strings: Declaring and initializing string variables, reading and writing strings from Terminal (using scanf and printf).

Overview of Functions, built in and user defined functions, recursive function, Function call by value and call by reference. Passing arrays to functions, Storage class of Variables. Arrays and its applications, Strings, Pointers, Structures and Unions, Data Files.

Time and space complexity of algorithm, Representation of stack and queue using arrays and its operations. Binary Tree representation, Binary Tree traversal methods, Binary search tree and its operations, Graph representation, Adjacency matrix, Depth first search, Breadth first search, Sequential and Binary Searching, Bubble sort, selection sort.

Books Recommended:

1. Balguruswamy E.: Programming in ANSI C; Tata-McGraw Hill New Delhi
2. Byron S. Gottfried: Theory and Problems of Programming with C; Tata- McGraw Hill Edition (Schaum's Outline Series)
3. T Cormen, C Leisersson, R Rivest, C Stein, Introduction to Algorithms, PHI
4. E Horowitz, S Sahni, S Rajasekaran, Fundamentals of Computer Algorithms, Universities Press

LABORATORY USING MS-EXCEL

MSC- 106 **2 CH**

Objective: Use of MS EXCEL/Calculator to draw graphs, diagrams, charts, classification and tabulation of data, frequency distribution, computation of summary statistics and analytical statistics.

CO-1	Remember and understand the basic concepts/Principles of Lab using of MS EXCEL/Calculator to draw graphs, diagrams, charts, classification and tabulation of data, frequency distribution, computation of summary statistics and analytical statistics.
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Problem Solving using MS EXCEL/CALCULATOR:

Using of MS EXCEL/Calculator to draw graphs, diagrams, charts, classification and tabulation of data, frequency distribution, computation of summary statistics and analytical statistics and to analyze data from the following areas: MSC 101 & MSC 104.

Examination: Practical (80%) and Record & Viva Voce (20%).

MA/MSc. STATISTICS
SEMESTER-II

STATISTICAL METHODS-II

MSC- 201 **4 CH**

Objective: To identify appropriate sources of data and to perform basic demographic analyses using various techniques across populations. To develop a deeper understanding of the linear and non-linear regression model and its limitations. To develop scientific view to analyze the industrial data about specific perspective.

CO-1	Remember and understand the basic concepts/Principles of Statistical Methods-II
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Unit-I

Basic discrete distributions- Negative Binomial, and Hyper geometric distributions, Computations of their moments, means, Variances and Beta coefficients, recurrence relations between moments, M.G.F. and C.F. Basic continuous distributions: - Lognormal, Beta, Gamma, and Weibull distributions their properties and applications. Computation of their M.G.F., C.F. and Moments.

Unit-II

Curve fitting- Polynomial, Orthogonal, Exponential, Logarithmic and Growth curves. Their applications.

Associations of attributes: - Contingency table and coefficients of contingency and their interpretations.

Unit-III

Theory of residues and their properties. Multiple and partial correlation coefficients. Their relationship and properties. Rank correlation coefficient and correlation ratio and their applications. Test of significance of multiple, partial and simple correlation coefficient.

Unit-IV

Order statistics- Distribution of range, smallest and biggest observations, distribution of rth order statistics and their functions, probability integral transformation

Books Recommended:

1. Fundamental of Mathematical Statistics (2009)- S Chand & Sons- S.C. Gupta and V.K. Kapoor
2. Introduction to Theory and Mathematical Statistics (1988) - Wiley – V.K. Rohatgi,
3. Linear Statistical Inference and its Applications (1975) – Wiely- C.R. Rao
4. An Introduction to Theory of Statistics - Charles Griffiu Yale, G.U. and Kendall, M.G. (1953)
5. Probability and Statistics with Engineering and Computer Science Applications (2005) – Kalyani Swain, A.K.P.C.
6. John E. Freud's Mathematical Statistics with Applications(2006); (7th Edition- Pearson Education; Asia-Miller; Irwin and Miller; Marylees.
7. Applied Statistics(1999)- New Central Book Agency- Mukhapaddhyay P.

PROBABILITY-II

MSC- 202 **4CH**

Objective: to provide students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science like disease modeling, climate prediction and computer networks etc.

CO-1	Remember and understand the basic concepts/Principles of Probability-II
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Unit-I

Definition and properties of Lebegue integral, Monotone Convergence Theorem, Indefinite integral, Uniform integrability, Jensen's, Holder's, Cauchy and Schwartz, Luaponov inequalities.

Unit-II

Levy inversion Theorem and Levy Continuity Theorem. Conditional expectation and properties, Three series theorem for independent random variables.

Unit-III

Bernoulli's Theorem, Borel Theorem, Borel-Canteili Lemma. Convergence of Distribution Functions. Heily-Compactness Theorem, Heily-Bray Theorem.

Unit-IV

Central Limit Theorem for binomial random variables. Law of Large Numbers and Law of the Iterated Logarithm.

Books Recommended:

1. Bhat, B.R. (1985): Modern probability theory (Wiley).
2. Billingsley, P. (1986): Probability and measure (Wiley).
3. Feller, W. (1969): Introduction to probability theory and applications, Vol. II (Wiley)
4. Rohatgi, V.K. (1976): Introduction to theory of probability and mathematical Statistics (Wiley).
5. H.G. Tucker(1967): A graduate course in probability theory (AP)
6. Y.S. Chow and H Teicher(1979): Probability theory (Springer-Verlag)

STATISTICAL INFERENCE - I

MSC- 203 **4 CH**

Objective: To derive suitable point estimators of the parameters of the distribution of a random variable and give a measure of their precision. To perform Test of Hypothesis as well as obtain MP, UMP tests. To derive suitable point estimators of the parameters of the distribution of a random variable and give a measure of their precision. To learn computational skills to implement various statistical inferential approaches.

CO-1	Remember and understand the basic concepts/Principles of Statistical Inference-I
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Unit-I

Parametric Point estimation: properties of estimators – Unbiasedness, Sufficiency, Completeness. Uniformly minimum variance unbiased estimators. Rao-Blackwell theorem. Cramer-Rao inequality. Fishers Information measure and its properties.

Unit-II

Asymptotic properties of estimators- Consistency and Efficiency. Their relationship and properties. Some special classes of distribution admitting complete sufficient statistics. Methods of estimation- Method of maximum likelihood estimation and it's properties. Methods of moments and it's properties.

Unit-III

Bayesian estimation, prior distributions, posterior distributions, loss function and risk function, Quadratic loss function and other common loss functions. Bayes and minimax estimators and their inter relationship. Properties of Bayes and minimax estimators.

Unit-IV

Theory of Least squares. Gauss-Markov set-up, Normal equations, least squares estimators of linear parametric functions. Variances and Covariances of the estimators of linear parametric functions. Estimation of error variance.

Books Recommended:

1. Linear Statistical Inference and its Applications (1973) - Wiley Eastern. Rao, C.R.
2. An Outline of Statistical Theory - Vol-II, World Press, Calcutta Goon, M.A., Gupta, M.K., and Dasgupta, B
3. Introduction to Theory of Probability and Mathematical Statistics (1970) - Wiley Rohatgi, V.K

STOCHASTIC MODELING

MSC- 204 **4CH**

Objective: To learn and to understand stochastic processes predictive approach. To develop an ability to analyze and apply some basic stochastic processes for solving real life situations.

CO-1	Remember and understand the basic concepts/Principles of Stochastic Modelling
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Unit-I

Definition and classification of stochastic processes, Notion of stochastic processes, Markov chain, one step transition probabilities, Chapman-Kolmogorov equations, evaluation of higher step transition probabilities, Some examples such as gamblers ruin problem and one-dimensional random walk. Concept of absorption probabilities, Use of these to compute probability of winning the game of Gambler's Ruin Problem.

Unit-II

Classification of states of a Markov chain, Periodicity, Recurrence, Basic limit theorems of Markov chain, Absorption probability, Criteria for recurrence.

Unit-III

Introduction to birth process, birth and death process, linear birth and death process, Growth model with immigration and related results, Expression for mean and variance of a birth process and, birth and death process, Applications of these processes.

Unit-IV

Martingale-Elementary results. Brownian Motion-Definition, Continuity of paths. Branching Processes-Definition, generating function relation.

Books Recommended:

1. Karlin, S and Taylor, H.M (1975): A First Course in Stochastic Processes. Academic Press.
2. Bhatt, B.R. (2000): Stochastic Models: Analysis and application, New Age International Publication.
3. Feller, W. (1968): Introduction to Probability and its Applications, Vol. 1, Wiley Eastern.
4. Hoel, P.G., Port, S.C. and Stone, C.J. (1972): Introduction to Stochastic Processes, Houghton Miffin & Co.
5. Medhi, J. (1982): Stochastic Processes, Wiley Eastern.
6. Parzen, E. (1962): Stochastic Processes, Holden-Day.

APPLIED STATISTICS PRACTICAL
BY USING SPSS/EXCEL

MSC- 205 **2CH**

Objective: To learn and develop scientific view to understand the time series data and its analysis.

CO-1	Remember and understand the basic concepts/Principles of Applied Statistics
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Index Numbers: Price relatives and quantity or volume relatives, Link and chain relatives composition of index numbers; Laspeyre's, Paasches', Marshal Edgeworth and Fisher index numbers; chain base index number, tests for index number,

Vital statistics- Rates, Ratios of Births and Deaths, Their merits, demerits, and relative comparisons.

6

Analysis of consumer's demand, law of demand, price elasticity of demand, estimation of demand curves, forms of demand functions, income elasticity of demand. Analysis of income and graphical test, Lorenz curve, Gini's coefficient.

Time Series Analysis: Economic time series, determination of trend, seasonal and cyclical fluctuations. The stationary processes: moving average (MA) , auto regressive (AR).

Books Recommended:

1. Mukhopadhyay P. (1999): Applied Statistics, New Central Book Agency Pvt. Ltd., Calcutta.
2. Goon A.M., Gupta M.K. and Dasgupta B. (1986): Fundamentals of Statistics, Vol.II, World Press, Calcutta.
3. Croxton F.E. and Cowden, D.F.: Applied General Statistics.
4. Asthana B.N. and Srivastava S.S.: Applied Statistics in India.

LABORATORY USING SPSS

MSC- 206 **2 CH**

Objective: To learn statistical techniques and their implementation using comprehensive SPSS/STATA software packages.

CO-1	Remember and understand the basic concepts/Principles of Statistical Laboratory on Computer using SPSS/STATA
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Problem Solving using SPSS/ STATA:
Using of SPSS/ STATA software packages to gain the knowledge of software package and applications of Software for data analysis in the areas of MSC 201 and MSC 205.
Examination: Practical (80%) and Record & Viva Voce (20%).

MA/MSc. STATISTICS

SEMESTER-III

STATISTICAL INFERENCE-II

MSC- 301 **4CH**

Objective: To learn computational skills to implement various statistical inferential approaches. To learn types of errors, non-parametric tests.

CO-1	Remember and understand the basic concepts/Principles of Statistical Inference-II
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the Course

Unit-I

Basic concept of test of Hypothesis, Neyman-Pearson Lemma. Most powerful (MP) test Application of Neyman-Pearson Lemma for the test of simple hypothesis, Generalized Neyman-Pearson Lemma Uniformly most powerful (UMP) test. UMPU tests. Similar Regions, Application of Neyman- Pearson Lemma for the test of composite hypothesis.

Unit-II

Non-parametric tests: - One sample problem, Goodness of fit, Kolmogorov test, sign test, Run test, U statistic and its properties. Two sample problem- Kolmogorov-Smirnov test and its consistency, run test, Location problem, Wilcoxon-Mann Whitney test, median test, and their asymptotic normality.

Unit-III

Likelihood Ratio Test (LRT), Consistency of the test, Asymptotic distribution of LRT, Application of Likelihood Ratio Test (LRT), Comparison between Likelihood Ratio Test and Neyman- Pearson test procedure.

Unit-IV

Sequential probability ratio test (SPRT), procedures, Properties of SPRT, Fundamental identity of SPRT, Wald 's fundamental Identity. OC and ASN functions.

Books Recommended:

1. An Outline of Statistical Theory - Vol-II, World Press, Calcutta Goon, M.A., Gupta, M.K., and Dasgupta, B
2. Non-parametric Methods in Statistics - Second Edition, Marcel Dekker Gibbons, J
3. Linear Statistical Inference and its Applications (1973) - Wiley Eastern. Rao, CR

MULTIVARIATE ANALYSIS

MSC-302 **4CH**

Objective: To learn and develop scientific view to deal with multidimensional datasets and its uses in the analysis of research data. · To understand the extensions of univariate techniques to multivariate frameworks and learn to apply dimension reduction techniques used in the data analysis.

CO-1	Remember and understand the basic concepts/Principles of Multivariate Analysis
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Unit-I

Multivariate normal distribution: probability density function, moment generating function. Marginal and conditional distributions. Multivariate normal distribution and its properties. Random sampling from multivariate normal distribution. Maximum likelihood estimators of parameters, distribution of sample mean vector.

Unit-II

Wishart matrix – its distribution and properties, distribution of sample generalized variance, null and non-null distribution of multiple correlation coefficients.

Unit-III

Tests on mean vector for one or two multivariate normal populations. Hoteling's T^2 and Mahalanobes D^2 distributions (null case only) and related confidence regions. Classification problem: Standards of good classification, procedure of classification based on multivariate normal distributions.

Unit-IV

Principal components, dimension reduction, canonical variates and canonical correlation — definition, use, estimation and computation. Methods and applications of MANOVA (Derivation not included).

Books Recommended:

1. Anderson, T.W. (1984): Introduction to Multivariate Analysis, Wiley.
2. Kshirsagar, A.M. (1983): Multivariate Analysis, Marcel Dekkar.
3. Morrison, D.F. (1990): Multivariate statistical methods, McGraw Hill.
4. Rao, C .R. (1995): Linear statistical Inference and its Applications (Wiley).
5. Johnson, R.A. and Wichern, D.W. (1988): Applied Multivariate Statistical Analysis (Prentice Hall).

OPTIMIZATION TECHNIQUE-I

(General Calculator is allowed)

MSC-303 **4CH**

Objective: To develop the optimization techniques that will be useful in the personal and professional life.

CO-1	Remember and understand the basic concepts/Principles of Optimization Technique-I
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Unit-I

Introduction to LPP, Mathematical formulation, Standard form and canonical form, Graphical solution, Simplex Method including Big-M and two phase method, Degeneracy, Solution of simultaneous equations and inversion matrix by simplex method.

Unit-II

Duality in Linear Programming, Duality Theorems, Dual simplex method with justifications, Transportation and Assignment algorithms.

Unit-III

Introduction to sensitivity analysis, variation in cost and requirement vectors, coefficient matrix and applications, Simulation, Parametric programming and revised simplex methods.

Unit-IV

Game Theory, two persons zero sum game, Maxmin Minimax principle, Mixed strategy, Graphical solutions, Dominance Property, Arithmetic Method and general solution.

Books Recommended:

1. Kambo., N.S. (1991): Mathematical Programming Tech., Affiliated
2. East-West press. Hadley, G. (1987): Linear Programming
3. Taha H. A. (l992): Operations Research, 5th Ed. (McMillan)

ECONOMETRICS

MS - 304 **4CH**

Objective: Econometrics is the use of statistical and mathematical models to develop theories or test existing hypotheses in economics and to forecast future trends from historical data. It subjects real-world data to statistical trials and then compares the results against the theory being tested.

CO-1	Remember and understand the basic concepts/Principles of Econometrics
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Unit-I

Nature of econometrics, the general linear model (GLM) and its extensions, ordinary least squares (OLS) estimation and prediction, generalized least squares (GLS) estimation and prediction, heteroscedastic disturbances, pure and mixed estimation.

Unit- II

Auto correlation, its consequences and tests. Theil BLUS procedure, estimation and prediction, multicollinearity problem, its implications and tools for handling the problem, ridge regression.

Unit- III

Linear regression and stochastic regression, instrumental variable estimation. errors in variables, autoregressive linear regression, lagged variables, distributed lag models, estimation of lags by OLS method, Koyck's geometric lag model.

Unit- IV

Simultaneous linear equations model and its generalization, identification problem, restrictions on structural parameters, rank and order conditions. Estimation in simultaneous equations model, recursive systems, 2 SLS estimators.

Book Recommended:

1. Apte, P.G. (1990): Text books of Econometrics, Tata McGraw Hill.
2. Cramer, J.S. (1971): Empirical Econometrics, North Holland.
3. Gujarathi, D. (1979): Basic Econometrics, McGraw Hill.
4. Intrulligator, M.D. (1980): Econometric models—Techniques and applications, Prentice Hall of India.
5. Johnston, J. (1984): Econometric methods. Third edition, McGraw Hill.
6. Klein, L.R. (1962): An introduction to Econometrics, Prentice Hall of India.
7. Koutsoyiannis, A. (1979): Theory of Econometrics, Macmillan Press.
8. Malinvaud, E. (1966): Statistical methods of Econometrics, North Holland.
9. Srivastava, V.K. and Giles D.A.E. (1987): Seemingly unrelated regression equations models, Maicel Dekker.
10. Theil, H. (1982): Introduction to the theory and practice of Econometrics, John Wiley.
11. Walters, A. (1970): An introduction to Econometrics, Macmillan & Co.

TIME SERIES AND FORECASTING
BY USING SPSS/EXCEL

MSC- 305 **2 CH**

Objective: To learn and develop scientific view to understand the time series data and its analysis. To learn stationary and non-stationary, and seasonal and nonseasonal time series models. Learn to estimate model parameters and compare different models developed for the same dataset in terms of their estimation and prediction accuracy.

CO-1	Remember and understand the basic concepts/Principles of Time Series and Forecasting
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Time series : Auto. covariance and auto correlation functions

Detailed study of stationary processes - moving average (MA), Auto-regressive (AR), ARMA, AR integrated MA (ARIMA) models.

Forecasting, Periodogram and Correlogram.

The auto-regressive integrated moving Average problem (ARIMA), three explicit forms of ARIMA, integrated moving average problems.

Books Recommended:

1. Box, GEP and Jenkins, G.M. (1976): Time Series Analysis - Forecasting and Control, Holdenday, Sanfransico.
2. Anderson, T.W. (1971): The Statistical Analysis of Time Series. Wiley.
3. Brockwell, P.J. and Davis, RA : Time Series: Theory and Methods, 2nd Ed., Springer-Verlas.

LABORATORY USING R/PYTHON

MSC-306 **2CH**

Objective: To learn statistical techniques and their implementation using comprehensive R/PYTHON software packages.

CO-1	Remember and understand the basic concepts/Principles of R / Python
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Problem Solving using R / PYTHON:
Using of R/ PYTHON software packages to gain the knowledge of software package and applications of Software for data analysis in the areas of MSC 302 and MSE 304()* & MSC 305.
Examination: Practical (80%) and Record & Viva Voce (20%).

MA/MSc. STATISTICS

SEMESTER- IV

DESIGN AND ANALYSIS OF EXPERIMENTS

MSC- 401 **4 CH**

Objective: To learn the basic principles in the design of simple experiments. · To learn different tests for comparing pairs of treatment means, ANCOVA, factorial experiments, fractional factorial experiments, confounding, BIBD, PBIBD with solving real life examples. · To learn the applications of different designs in agriculture.

CO-1	Remember and understand the basic concepts/Principles of Design and Analysis of Experiments
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Unit-I

Linear estimation. Theory of least squares. Gauss Markov Theorem. Normal equations, least square estimators of linear parametric functions. Variance and covariance of estimators.

Analysis of variance - fixed, random and mixed models. Analysis of variance. One-way and two-way classification with unequal and equal number of observation per cell. Basic principles of designs - CRD, RBD and Latin square and their analysis - missing plot technique. Connectedness, balance, orthogonality.

Unit-II

Factorial experiments – 2^n and 3^2, 3^3 Presentation of main effects and interactions. Analysis. Asymmetrical factorial experiments.

Unit-III

Confounding - Total confounding of 2^n design in 2^P blocks, partial confounding in 2^P blocks. Fractional factorial experiments and their analysis, Total and partial confounding in 3^2 and 3^2 designs. Split plot designs.

Unit-IV

Incomplete block designs - BIBD and Lattice designs - Construction and analysis. Concept of rotable design. Control composite design. Response surface methodology.

Books Recommended:

1. Kshirasagar, A.M. (1983): Linear Models, Marcel Dekkar.
2. John, P. W.M. (1971): Linear Models, Wiley.
3. Montgomery, D.C. (2001). Design and Analysis of Experiments, Wiley.
4. Das, M.N. and Giri, N.C. ( ): Design of Experiments

LINEAR MODELS AND REGRESSION ANALYSIS

MSE- 402 **4 CH**

Objective: This course is primarily about data analysis and developing a deeper understanding of the generalized linear model. The focus is on practice, and this focus is reflected in the choice of texts and in the emphasis on applied coursework. While this course deals to some degree with the generalized linear model on a mathematical and theoretical level, its main focus is practical, the ability to use the techniques when faced with the need in practical research. Consequently the learning method combines lectures and reading with hands-on statistical programming exercises using real datasets.

CO-1	Remember and understand the basic concepts/Principles of Linear Models and Regression Analysis
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Unit-I

Gauss-Markov linear models, estimable functions, error and estimation space, normal equations and least square estimators, estimation of error variance, estimation with correlated observations, properties of least square estimators, generalized inverse of matrix and solution of normal equations, variances and covariances of least square estimators

Unit-II

One way and two-way classifications, fixed, random and mixed effects models. Analysis of variance (two-way classification only), Multiple comparison tests due to Tukey, Scheffe and Student-Newmann-Karl.

Unit-III

Simple linear regression, multiple, regression, fit of polynomials and use of orthogonal polynomials. Residuals and their plots as tests for departure from assumptions such as fitness of the model, normality, homogeneity of variances and detection of outliers. Remedies

Unit-IV

Multi co-linearity, ridge regression, sub-set selection of explanatory variables, Mallows Cp Statistics.

Book Recommended:

1. Goon, A.M., Gupta, M.K. and Das Gupta, B. (1967): An Outline of Statistical Theory, Vol.
2. The World Press Pvt. Ltd., Calcutta. 2. Rao, C.R. (1973); Linear Statistical Inference and its Application, Wiley Eastern.
3. Graybill, I.A. (1961): An Introduction to Linear Statistical Models, Vol. 1, McGraw Hill Book Co. Inc.
4. Draper, N.R. and Smith H. (1998); Applied Regression Analysis, 3rd Ed. Wiley.
5. Weisberg, S. (1985): Applied Linear Regression, Wiley.
6. Cook, R.D. and Weisherg, S. (1982): Residuals and Inference in Regression, Chapman and Hall.

DEMOGRAPHY

MSE-403 **4CH**

Objective: To describe current population trends in terms of fertility, mortality and population growth and the concepts stable population.

CO-1	Remember and understand the basic concepts/Principles of Demography
CO-2	Analyse the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Unit-I

Sources of demographic data, Coverage and content errors in demographic data, Chandrasekharan Deming formula. Adjustment of age data, Whiples, Mayers and UN indices. Population projection methods: Component & Growth Models, Leslie Matrix, Population distribution: Lorenz curve and Gini concentration ratio, Population pyramid.

Unit-II

Measures of fertility (period and cohort), Coales fertility index, Measures of reproduction, Calculation of PPR, Fertility models, Birth Intervals. Nuptiality rate, Net Nuptiality table, Proportion Single and Singulate. Mean age at marriage, Hajnal"s method of estimating SMAM, Mean duration of fertile union.

Unit-III

Measures of mortality, comparative mortality index, Lexis Diagram and IMR, life table functions, Construction of Reed Merell, Greville life table, UN and Coale- Demeny model life tables, multiple decrement life table, measures of morbidity.

Unit-IV

Measures of internal migration & international migration methods of estimation, Migration models. Stationary and stable population models, simplified example of stable population, Lotka"s demonstration of conditions producing a stable population, the equations characterizing a stable Population, Identification of the intrinsic growth rate.

Books Recommended:

1. Altman D G: Practical Statistics for Medical Research, London: Chapman and Hall, 2006.
2. Rosner B: Fundamentals of Biostatistics, ed. 6, 2006.
3. Bonita R, Beaglehole R, Kjellstrom T: Basic Epidemiology, ed. 2. World Health Organization, 2006.
4. Gordis L: Epidemiology, ed. 3. Philadelphia, 2004.
5. Baker, D. et al.: Environmental Epidemiology: A Text Book on Study Methods and Public Health Applications, WHO/SDE/99.7, 1999.
6. Dunn G, Everitt B: Clinical Biostatistics: An Introduction to Evidence-based Medicine. Edward Arnold, 1995.

PROJECT AND VIVA VOCE

MSC- 404 **4 CH**

The Project Work will be taken in the final semester and spread over the whole semester. A project may be undertaken by a group of students. However, the project report shall be submitted by each member of the group separately. A project report shall clearly state the problem addressed, the methodology adopted, the assumptions and the hypotheses formulated, any previous reference to the study undertaken, statistical analyses performed and the broad conclusion drawn. The evaluation will be based on the total 100 marks assigned to the project, 60 marks will be assigned on the evaluation of the project work and 40 marks will be assigned jointly by the examiners on the oral presentation and viva – voce.

LABORATORY USING R/SPSS/PYTHON

MSC- 405 **2 CH**

Objective: To understand the concept of R and/or SPSS and/or PYTHON for data management and as a cutting edge technology tool. To enable to identify data sources, processing and imparting knowledge tools to analyze sets of data to gain useful business and health related issues for understanding.

CO-1	Remember and understand the basic concepts/Principles of R/ SPSS / PYTHON
CO-2	Analyze the Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Problem Solving using R and/or SPSS and/or PYTHON:
Using of R/ SPSS/ PYTHON software packages to gain the knowledge of software package and applications of Software for data analysis in the areas of MSC 401 and MSE 402()*
Examination: Practical (80%) and Record & Viva Voce (20%).

LABORATORY USING R/SPSS/PYTHON

MSC- 406 **2 CH**

Objective: To understand the concept of R/SPSS/PYTHON for data management and as a cutting edge technology tool. To enable to identify data sources, processing and imparting knowledge tools to analyze sets of data to gain useful business and health related issues for understanding.

CO-1	Remember and understand the basic concepts/Principles of R/SPSS/PYTHON
CO-2	Analyze tne Various Concepts to understand them through case studies
CO-3	Apply the knowledge in understanding practical problems
CO-4	Execute/Create the Project or field assignment as per the knowledge gained in the course

Problem Solving using R/SPSS/PYTHON:
Using of R/SPSS/PYTHON software packages to gain the knowledge of software package and applications of Software for data analysis in the areas of and MSE 403()*.
Examination: Practical (80%) and Record & Viva Voce (20%).

INTER DISCIPLINARY COURSE- Department of STATISTICS (2022-2024)

ELECTIVE COURSE (OPEN ELECTIVE) SEMESTER-II IDC: BASIC STATISTICS AND DATA ANALYSIS- 3 CH

Objective: To understand the concept of Basic Statistics and Data Analysis for processing and imparting knowledge tools to analyze sets of data to gain useful business understanding.

CO-1 Remember and understand the basic concepts/Principles of Basic Statistics and Data Analysis

CO-2 Analyze the Various Concepts to understand them through case studies

CO-3 Apply the knowledge in understanding practical problems

CO-4 Execute/Create the Project or field assignment as per the knowledge gained in the course

Unit-I

Definition - Scope and limitations of Statistics - Collection of data - Census, Sampling surveys - Classification and tabulation - diagrammatic and graphical representation of data - Nominal, ordinal and interval scaling.

Unit-II

Measures of central tendency - Measures of dispersion and Coefficient of variation - Problems based on raw data and grouped data - Moments - raw and central - Measures of skewness - Measures of Kurtosis and their applications.

Unit-III

Basics of Curve fitting: Meaning and types; Principle of least squares - linear, nonlinear, exponential and growth curves.

Unit-IV

Test of relationship: Meaning of Correlation and type; Simple and Rank Correlation; Regression analysis - Problems based on raw data and grouped data.

Books Recommended:

1. Bansilal and Arora (1989). New Mathematical Statistics, Satya Prakashan, New Delhi.
2. Gupta, S.C. & Kapoor,V.K. (2002) . Fundamentals of Mathematical Statistics , Sultan Chand & Sons Pvt. Ltd. New Delhi.
3. Goon A.M. Gupta. A.K. & Das Gupta, B (1987) . Fundamentals of Statistics, Vol.2, World Press Pvt. Ltd., Calcutta.
4. Kapoor, J.N. & Saxena, H.C. (1976) . Mathematical Statistics . Sultan Chand and Sons Pvt. Ltd, New Delhi.

NC. - 481/PGS

25/08/2023

Professor & Head
Department of Statistics
Sambalpur University