SYLLABUS

For

M.Sc. Program

in

STATISTICS

Scheme and Course content for Sem. I & Sem. II

(Under NEP-2020)

Department of Mathematics and Statistics

DR. H. S. GOUR VISHWAVIDYALAYA

(A CENTRAL UNIVERSITY)

SAGAR (M.P.)

Revised after School Board Meeting 10/7/23

D Shukla 10/7/23

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अध्यक्ष / Chairman
बोर्ड ऑफ स्टडीज (गणित एवं सां. एस.)
Board of Studies (Mathematics & Statistics)
गणित एवं सांख्यिकी विभाग
Department of Mathematics and Statistics
डॉ. हरीसिंह गौर विश्वविद्यालय, सागर म.प्र.
Dr. H.S. Gour Vishwavidyalaya, Sagar, M.P.

In view of my letter No. D-

10/7/2023

10/7/23

About Department:

The Department of Mathematics and Statistics was established at very beginning of the establishment of year 1946.The founder of the university and the founder vice-Chancellor Dr. Harisingh Gour had himself appointed Mr. R.B. Rabugunday as the first Head of Department. Mr. Rabugunday was a scholar of Madras University and was Wrangler of Cambridge tradition.

Scope :

Statistics is the base of all applied sciences. It has predictive approach, computing approach and modeling approach for social, biological, anthropological and management sciences. Students possessing degrees in M.Sc.(Statistics), Ph.D.(Statistics) have a large numbers of job opportunities in fields of Banking, Teaching, Data analyst, Software testing, machine learning, artificial intelligence, Actuaries, Defense analyst, Statistical Assistant ,Statistical officer, Market researcher , Survey organizer etc. Students can also get administrative jobs through UPSC (like ISS).

The course is designed as the student can get employment worldwide. It has multidisciplinary and skill enhancement courses with computer based analytical proficiency.

1. **Name of the Program** : M.Sc.(Statistics)
2. **(A) Objectives**
   - **(i) To develop trained manpower for data analysis.**
   - **(ii) To develop trained manpower for coping challenges of Data Science and machine learning .**
   - **(iii) To produce students who can serve nation-wide as Statistics Administrator (like officer of Indian Statistics Services).**

(B) Program Learning Outcomes:

(a) After completion of this Program, student will be capable enough to handle the data with interpretation and effective analysis.

(b) He can be placed as Data Scientist in private sectors, can be placed in banking sector like Reserve bank of India

(c) He can get opportunity as District Statistical Officer, Statistical Assistant, Data Analyst in Pharmaceutical companies.

(d) He may get jobs in public and private survey organizations like NSSO , MARG , C-voter etc.

(e) After qualifying NET examination and completing the Ph.D. degree, student may be placed in faculty position in universities and colleges.

3. **Duration of Program** : Four Semesters (with multiple entry and exit) .
4. **Exit:** After exit of completing one year the degree of **Postgraduate Diploma in Statistics** will be provided.

5. **Medium of instruction :** Hindi and English.
6. **Intake : 20 seats**
7. **Eligibility for Admission:** B.Sc. with Statistics as a subject.
8. **Fee** : Same as in other PG courses of Science stream (with Lab Fee)
9. **Structure of Program:** The Program includes various courses in the duration of four semesters including discipline specific, elective papers and skill based papers. The pedagogic approach will be through lectures, field project, seminars, visit to statistical organization, assignments, dissertation, group discussion etc.

10. **Scheme of Evaluation:**

(a) Mid Semester Examination	:	20 marks
(b) Internal Assessment	:	20 marks
(c) End Semester Examination	:	60 marks
Total	:	100 marks

All rules and regulation mentioned in University Ordinance and practices for running PG programs of Science streams shall be applicable. The already running course of M.Sc.(Mathematics) shall be a model of reference wherever and whenever required.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics

Scheme of M.Sc. (Statistics) Program

and Syllabi for Sem. I & II (Under NEP-2020, Level 8)

	Paper Code	Title of Paper	Credit	Contact Hours
SEM I	STAT-DSM-121	Algebra	4	60
	STAT-DSM-122	Real Analysis	4	60
	STAT-SEC-121	Survey Sampling and Field work	4	60
	STAT-DSM-123	Statistics Practical –I	4	60
	Opt any one			
	STAT-MDM 121	Statistical Computing using Softwares	4	60
	STAT-MDM-122	Linear Models and Regression Analysis	4	60
	STAT-MDM-123	Mathematical Finance	4	60
SEM-II				
SEM II	STAT-DSM-221	Statistical Inference – I	4	60
	STAT-DSM-222	Stochastic Processes	4	60
	STAT-SEC-221	Multivariate Analysis using software	4	60
	STAT-DSM-223	Statistics Practical –II	4	60
	Opt any one			
	STAT-MDM-221	Distribution Theory	4	60
	STAT-MDM -222	Design and Analysis of Experiments	4	60

DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR

(A Central University)

Department of Mathematics and Statistics

M.Sc.–I Semester (Statistics)

STAT-DSM-121	ALGEBRA	L	T	P	C
		4	0	0	4
		Max.Marks-100			

Mid Sem-20
Internal Assessment-20
End Sem-60

Learning Objectives:

1. To inculcate the basic features of Advanced Abstract algebra.
2. To teach class equation, P-group and Sylow's theorem.
3. To teach solvable and nilpotent groups.
4. To introduce Galois Theory

Course Learning Outcomes:

CO1: After completion of this course students will understand the composition series.
CO2: Understand Jordan- Holder theorem, solvable groups, nilpotent groups.
CO3: understand field extension and Galois Theory and solvability of polynomial equation using the Galois theory.

Unit Wise Learning Outcomes:

UO1. To learn about Class equation, p-group, Sylow theorem.
UO2. To learn about normal series, solvable group and nilpotent group .
UO3. To learn about Rings .
UO4. To learn about polynomial rings and its .
UO5. To learn about Galois theory and example.

Unit-I Inner Automorphism, Characteristic Subgroup, Conjugate element, Conjugate class of H in G, Class equation, p-groups, Sylow p-subgroups, Sylow theorems.
Unit-II Normal series, subnormal series of group, composition series, Jordan- Holder theorem, solvable groups, nilpotent groups.
Unit- III Rings, Subrings, Sum of two subrings, Product of Rings, Ideals, Sum and product of two Ideals, Prime and maximal ideals, Quotient rings, Homomorphisms and imbedding of rings, Unique factorization domain (UFD), Principal ideal domain (PID), Euclidean domain, Polynomial rings.
Unit-IV Irreducible polynomial, Gauss lemma, Einstein criterion, Adjunction of roots, Algebraic extensions, Algebraically closed fields. Splitting fields, Uniqueness of splitting fields, Normal extensions, Multiple roots, Finite fields, Separable & inseparable extensions.
Unit-V Fields, Subfields, Automorphism groups and fixed fields, Dedekind lemma, Fundamental theorem of Galois theory and example.

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Essential Readings:

1. N. Jacobson, Basic Algebra, Vol. I, II & III Hindustan Publishing Company.
2. S. Lang, Algebra, Addision-Wisley.
3. I.S. Luther & IBS Passi, Algebra Vol. I, II & III Narosha Pub. House, New Delhi.
4. M. Artin, Algebra, Prentice- Hall of India, 1991.

Suggested Readings

1. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra, Cambridge University press.
2. I.N. Herstein, Topic in Algebra, Wiley Eastern, New Delhi.

Essential e-Recourse

1. https://www.cs.columbia.edu/~nadimpalli/data/AAL-Notes.pdf
2. https://archive.nptel.ac.in/courses/111/105/111105112/
3. https://nptel.ac.in/courses/111106113
4. https://www.youtube.com/watch?v=iobTKR4-19o
5. https://www.youtube.com/watch?v=MVojEjXdVgA

Dr. HARISINGH GOUR VISHWAVIDYALAYA, SAGAR

(A Central University)

Department of Mathematics and Statistics

M.Sc. I Semester (Statistics)

STAT-DSM-122	REAL ANALYSIS	L	T	P	C
		4	0	0	4
		Max.Marks-100			

Mid Sem-20
Internal Assessment-20
End Sem-60

Learning Objectives

To explain fundamentals of Riemann-Stieltjes integration and its uses.
To introduce the Rearrangement of series, Riemann's rearrangement theorem.
To explain sequence and series sequence of functions, uniform convergence.
To explain the derivation Inverse function and its applications.
To explain the concept of extremum in several variable and its applications.

Course Learning Outcomes: This course will enable the students to:

CO1: Learn R-S integrability and its relation with uniform convergence.
CO2: Understand rearrangement and Riemann rearrangement theorem.
CO3: To learn partial, directional derivative and derivative of functions from R^n to R^m.

Unit wise Learning Outcomes: After completion of this course students will be able to:

UO1: Evaluate the integral of a function with respect to an increasing function using the concept of R-S integration. Also students will able to test the convergence of improper integrals.
UO2: Interpret meaning of rearrangement of infinite series and its examples.

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UO3: Understand the concepts of uniform and point wise convergence and its consequences in preservation of limit, continuity, integration etc.

UO4: Understand the differentiability of functions of several variables and related theorems e. g. inverse function theorem, implicit function theorem.

UO5: Understand the proof of inverse function theorem and Lagrange multiplier method for extremum prblems.

Unit-I Definition and existence of Riemann-Stieltjes integral, Conditions for R-S integrability. Properties of the R-Sintegral, R-S integrability of functions of a function. Improper integrals and test for convergence.
Unit-II: Rearrangements of terms of a series, Riemann's theorem, Dirichlet's theorem. Sequences and series of functions, point wise and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence.
Unit-III: Uniform convergence and continuity, uniform convergence and R-S integration; uniform convergence and differentiation, Power series, uniqueness theorem for power series.
Unit-IV: Functions of several variables, derivatives in an open subset of R^n, derivative as linear transformations, directional derivative, chain rule; Partial derivatives, interchange of the order of differentiation, derivatives of higher orders.
Unit-V: Taylor's theorem, inverse function theorem, implicit function theorem, Jacobians, extremum problems with constraints, Lagrange's multiplier method.

Essential Readings:

1. T.M. Apostal: Mathematical analysis, Narosa, 1985.
2. H.L. Royden: Real Analysis, Macmillan (Indian Edition).

Suggested Readings:

1. Walter Rudin: Principles of Mathematical Analysis, McGraw Hill.
2. Terence Tao, Analysis I, Hindustan Book Agency (third edition), 2014.
3. Terence Tao, Analysis II, Springer and Hindustan Book Agency (third edition), 2015.

E- Resource :

1. https://nptel.ac.in/courses/111106053
2. https://nptel.ac.in/courses/111105098
3. https://ocw.mit.edu/courses/18-100a-real-analysis-fall-2020/#:~:text=Course%20Description,the%20interchange%20of%20limit%20operations.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
M.Sc.- I Semester (Statistics)

STAT-SEC- 121	Survey Sampling and Field work	L	T	P	C
		4	0	0	4
		Max. Marks : 100			

Mid Sem-20
Internal Assessment-20
End Sem-60

Learning Objectives: (1) To understand the concept population and drawing appropriate sample.
(2) To learn various methods of drawing good samples and conducting field work
(3) To learn procedure to get the best method of sample estimate.

Unit – I: Concept of Fixed population and super-population approaches. Concepts and distinct features of probability sampling and non – probability sampling schemes, sampling designs and sampling error. Review of some important results in SRSWOR and SRSWR related to the estimation of population mean/total and proportions. Questionnaire Preparation and field work.
Unit – II: Estimation of population mean/total in stratified populations, Allocation problem in stratified random sampling (i) for fixed cost and (ii) for specified precision and corresponding expressions for variance of stratified sample mean. Post stratification, Deep stratification
Unit – III: Unequal probability sampling: PPSWR/PPSWOR methods of sample selection (including cumulative total method and Lahiri's scheme). Comparison of SRSWR and PPSWR schemes. Ordered estimators of Des Raj and Murthy (for n=2). Construction of unordered estimators from ordered estimators. Horvitz Thompson's estimator of a finite population total/mean. Expressions for variance of Horvitz Thompson's estimator and their unbiased estimators. Issue of negativity of estimated variance and its resolution. πPS sampling scheme and some of its important results. Midzuno-Sen sampling scheme.
Unit – IV: Double sampling scheme: Ratio, regression and product estimators with double sampling and their comparison with estimators with known population mean of auxiliary variable. Some unbiased ratio type estimators for population mean. Successive Sampling.
Unit –V: Concept of cluster sampling, two stage sampling with unequal cluster sizes and interpenetrating subsampling. Kinds of non-sampling errors with special reference to non-response problems. Hansen and Hurwitz estimator for population mean. Concept of randomized response and some well-known randomized response techniques for sensitive characteristics.

Course Learning Outcomes: After completion of this course the students will be able to understand various types of sampling procedures and their mutual relative merits with adequate applications. Student will be capable enough to design a questionnaire and perform field work as survey for data collection.

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Essential Readings:

1. Cochran, W.G.: Sampling Techniques (3rd edition. 1977), Wiley.
2. P.V Sukahtme, B.V. Sukhatme, S. Sukhatme and C.Asok: Sampling Theory of Surveys with Applications, ISAS Publication, New Delhi

Suggested Readings and Links:

1. Singh D. and Chaudhary, F.S. (1986): Theory and Analysis of Sample Survey Designs, New Age International

2 M.N. Murthy, Theory and Methods, Statistical Publishing Society, Calcutta

E-Books: National Digital Library

DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
M.Sc.–I Semester (Statistics)

STAT-DSM- 123	Statistics Practical-I	L	T	P	C
		0	0	4	4
		Max. Marks : 100			

Mid Sem-20
Internal Assessment-20
End Sem-60

The practicals will be based on theory papers and will be decided by the course coordinators.

DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
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Department of Mathematics and Statistics
M.Sc..–I Semester (Statistics)

STAT-MDM-121	Statistical Computing using Software	L	T	P	C
		4	0	0	4
		Max. Marks : 100			

Mid Sem-20
Internal Assessment-20
End Sem-60

Learning Objectives:
(1) To develop the skill of programming.
(2) To learn idea of data analysis.
(3) To learn about making interpretation on the analysis outcome.

Unit – I:
Programming in a high level language such as C (preferred)
Unit – II:
Syntax ,basics of R programming and Python programming
Unit – III:
Topics include simple syntax, loops, pointers and arrays, functions, input/output, and linking to databases.
Unit – IV:
Numerical analysis and statistical applications using R and Python. Computation using software in probability, statistics and data analysis
Unit –V
Computing in numerical integration, root extraction, random number generation, Monte Carlo integration, and matrix operation computations using software.

Course Learning Outcomes: After completion of this course the students will be able to understand the basic concept of computing and practical applications of Statistical tools.

Essential Readings:
1. G.H. Givens and J.A. Hopping, Computational Statistics (2005), Wiley Publication.
2. W.J. Kindley and J.E.Gentle, Statistical Computing (1980), Tayler and Francis

Suggested Reading and Links:
1. J. Voss, Introduction to Statistical Computing-A simulation based approach, Wiley series
2. R.A. Thisted, Elements of Statistical Computing,
E-Books Link: National Digital Library

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
M.Sc.–I Semester (Statistics)

STAT-MDM- 122	Linear Models and Regression Analysis	L	T	P	C
		4	0	0	4
		Max. Marks : 100			

Mid Sem-20
Internal assessment-20
End Sem-60

Learning Objectives :(1) To understand the concept of linear models applicable in different fields.
(2) To learn about problems and issues while using linear models.
(3) To learn about hidden properties in linear models.

Unit
Gauuss-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,.
Unit - II:
Generalized inverse of a matrix and solution of normal equations, variances and covariances of least square estimators.
Unit - III: 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 - IV:
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 - V:
Multi co-linearity, ridge regression, sub-set selection of explanatory variables, Mallows Cp Statistics

Course Learning Outcomes: After completion of this course the students will be able to learn about concept, analysis and properties of linear models applicable in different fields.

Essential Readings:

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.

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Suggested Readings:

1. Graybill, I.A. (1961): An Introduction to Linear Statistical Models, Vol. 1, McGraw Hill Book Co. Inc

E-Books: National Digital Library

DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR

(A Central University)

Department of Mathematics and Statistics

M.Sc.- I–Semester (Statistics)

STAT-MDM-123	Mathematical Finance	L	T	P	C
		4	0	0	4
		Max.Marks-100			

Mid Sem-20

Internal assessment-20

End Sem-60

Learning Objectives: (1) To study random variable and its properties.

(2) To understand Trinomial processes & Brownian motion.

(3) To explain transition Wiener processes & Forward contracts.

(4) To study standard pricing models in the term of Black-Scholes options.

(5) To understand Arbitrage relationship for American options.

Unit-I:
Probability & conditional probability, Random variables, Expectation and conditional expectation, Variance & Covariance, correlation. Normal random variable and its properties. The central limit theorem.
Unit-II:
Stochastic processes in discrete time, Binomial processes, Trinomial processes, General random walks, Geometric random walks. Binomial models with state dependent increments. Brownian motion.
Unit - III:
Stochastic integration, Stochastic differential equations. The stock price as a stochastic process. Option pricing, Wiener processes. Derivatives, Forward contracts, spot price, forward price, future price, call & put options.
Unit - IV:
Ito's lemma, Black-Scholes options pricing model, Binomial model for European options, Cox-Ross Rubinstein approach.
Unit - V:
Pricing contract via arbitrage. The arbitrage theorem. Arbitrage relationship for American options.

Course Learning Outcomes: (1)After completion of this course the students will understand the basic concept of different models and use in daily life.

(2) To financial advisor in Mutual finance.

(3) To useful in stock trading company.

(4) To stock technical analysis for investor.

Essential Readings:

1. Stanley L. S. (2012): A Course on Statistics for Finance, Chapman and Hall/CRC.

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Suggested Readings:

1. Franke,J.,Hardle,W.K. And Hafner, C.M. (2011): Statistics of Financial Markets: An Introduction, 3rd Edition, Springer Publications.

E book links: National Digital Library

DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
M.Sc..–II Semester (Statistics)

STAT-DSM-221	Statistical Inference - I	L	T	P	C
		4	0	0	4
		Max. Marks : 100			

Mid Sem-20
Internal Assessment-20
End Sem-60

Learning Objectives:

(1) To understand inferential aspect of statistics.
(2) To understand about the best estimate.
(3) To know the basics of decision problems under different situations.

Unit I: Extension of Cramer-Rao inequality for multi-parameter case, Bhattacharya bounds, information in data about the parameters as variation in likelihood function..
Unit II: Ideas of sufficient and minimal complete-sufficient statistics, sufficiency when the range of variate depends on parameter, minimum variance unbiased estimators, Rao-Blackwell and Lehman-Scheffe theorems, examples based on some standard distributions.
Unit III: Asymptotic properties of maximum likelihood estimators, solution of likelihood equations, method of scoring, Newton-Raphson method.
Unit IV: General decision problems, loss function, risk function, estimation and testing viewed as general decision problems, minimax decision, Bayes decision, least favourable prior, Bayes estimation under squared error loss,
Unit V: some simple illustrations based on binomial, Poisson, and normal distributions, procedure for obtaining minimax estimators from Bayes estimators.

Course Learning Outcomes:

After completion of this course, student will be capable enough to draw inference under situation of uncertainty.

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Essential Readings:

1. Kale, B.K. (1999): A First Course on Parametric Inference, Narosa Publishing House.
2. Rohatgi, V.K. (1988): An Introduction to Probability and Mathematical Statistics, Wiley Eastern, New Delhi

Suggested Readings and links:

1. Lehmann, E.L. (1986): Theory of Point Estimation, Student Edition.
2. Lehmann, E.L.(1986): Testing Statistical Hypotheses, Student Editions.
3. Rao, C.R. (1973): Linear Statistical Inference and its Applications, Wiley Eastern.
4. Ferguson, T.S. (1967): Mathematical Statistics, Academic Press.
5. Zacks, S. (1971): Theory of Statistical Inference, Wiley, New York

E Books Link: National Digital Library

DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
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Department of Mathematics and Statistics
M.Sc.–II Semester (Statistics)

STAT-DSM-222	Stochastic Processes	L	T	P	C
		4	0	0	4
		Max. Marks : 100			

Mid Sem-20
Internal Assessment-20
End Sem-60

Learning Objectives: (1) To understand the concept of stochastic process.
(2) To learn about problems and issues in stochastic process.
(3) To learn about hidden properties in stochastic process.

Unit – I:
Introduction to stochastic processes (SPS): Classification of SPs according to state space and time domain. Countable state Markov chains (MC's), Chapman-Kolmogorov equations; calculation of n-step transition probability and its limit.
Unit – II:
Stationary distribution, classification of states; transient MC; random walk and gambler's ruin problem; Applications from social, biological and physical sciences.

Unit – III:
Discrete state space continuous time MC: Kolmogorov – Feller differential equations; Poisson process, birth and death process; Wiener process as a limit of random walk; first-passage time and other problems.
Unit – IV:
Renewal theory: Elementary renewal theorem and applications. Statement and uses of key renewal theorem; study of residual life time process. Stationary process; weakly stationary and strongly stationary processes;
Unit – V:
Branching process: Galton-Watson branching process, probability of ultimate extinction, distribution of population size. Martingale in discrete time, inequality, convergence and smoothing properties. Statistical inference in MC and Markov processes.

Course Learning Outcomes: After completion of this course the students will be able to understand the concepts, properties and applications of stochastic process.

Essential Readings:

1. Medhi, J. (1982): Stochastic Processes, Wiley Eastern.

Suggested Readings :

1 1. Adke, S.R. and Manjunath, S.M. (1984): An Introduction to Finite Markov Processes, Willey Eastern.
2. Bharat, B.R. (2000): Stochastic Models: Analysis and Applications, new Age International, India.

E-Books Link: National Digital Library

DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
M.Sc.–II Semester (Statistics)

STAT-SEC-221	**Multivariate Analysis using Software**	L	T	P	C
		4	0	0	4
		Max. Marks : 100			

Mid Sem-20
Internal Assessment-20
End Sem-60

Learning Objectives: (1) To understand the concept of mutual effect of many variables of others.
(2) To learn about problems and issues while dealing with many variables.
(3) To learn about hidden properties in a multivariate system.

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Unit–I: Multivariate normal distribution and its properties. Random sampling from multivariate normal distribution. Maximum likelihood estimators of parameters, distribution of sample mean vector. Analysis using software.
Unit–II: Wishart matrix – its distribution and properties, distribution of sample generalized variance, null and non-null distribution of multiple correlation coefficient.
Unit–III: Hotelling's T2 and its sampling distribution, application in test on mean vector for one and more multivariate normal population and also on equality of components of a mean vector in multivariate normal population
Unit–IV: Classification problem: Standards of good classification, procedure of classification based on multivariate normal distributions.
Unit–V Principal components, dimension reduction, canonical variates and canonical correlation— definition, use, estimation and computation. Analysis using software.

Course Learning Outcomes:
After completion of this course the students will be able to understand the basics of multivariate theory which is necessary to study the interaction effects of hidden factors in statistical analysis.

Essential Readings:

1. Anderson, T.W. (1983): An Introduction to Multivariate Statistical Analysis, 2nd Ed., Willey.
2. Giri, N.C. (1977): Multivariate Statistical Inference, Academic Press.

Suggested Readings and Link:

1. Kshirsagar, A.M. (1972): Multivariate Analysis, Marcel Dekker.
2. Morrison, D.F. (1976): Multivariate Statistical Methods, 2nd Ed. McGraw Hill.
3. Muirhead, R.J. (1982): Aspects of Multivariate Statistical Theory, J. Wiley.
4. Rao, C.R. (1973): Linear Statistical Inference and its Applications, 2nd Ed. Wiley.

E-Books Link: National Digital Library

DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
M.Sc.–II Semester (Statistics)

STAT-DSM- 223	Statistics Practical-II	L	T	P	C
		0	0	4	4
		Max. Marks : 100			

Mid Sem-20
Internal Assessment-20
End Sem-60

The practicals will be based on theory papers and will be decided by the course coordinators.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
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Department of Mathematics and Statistics
M.Sc.–II Semester (Statistics)

STAT-MDM-221	**Distribution Theory**	L	T	P	C
		4	0	0	4
		Max. Marks : 100			

Mid Sem-20
Internal Assessment-20
End Sem-60

Learning Objectives: (1) To understand the concept of probability distribution.
(2) To learn about problems and issues of specific distributions.
(3) To learn about hidden properties in linear models.

Unit – I: Brief review of basic distribution theory, joint, marginal conditional p.m.f.'s and p.d.f's, standard discrete and continuous distributions, bivariate normal, bivariate exponential, multivariate normal and multinomial distributions,
Unit – II: Functions of random variables and their distributions using Jacobian of transformation and other tools
Unit – III: Compound, truncated and mixture distributions, multiple and partial correlations, linear and multiple regressions. Markov, Holder, Jensen, Liapunov inequalities.
Unit – IV: Sampling distributions, non-central chi-square, t and F distributions and their properties. distributions of quadratic forms under normality and related distribution theory.
Unit – V: Order statistics, their distributions and properties, joint and marginal distributions of order statistics, extreme values and their asymptotic distributions (statement only) with applications. approximating distributions Delta method and its applications, approximating distributions of sample moments, transformations of statistics.

Course Learning Outcomes: After completion of this course the students will be able to understand the properties, applications and role, function, importance of Order Statistics.

Essential Readings:

1. Rohatagi, V.K. (1984): An introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.

Suggested Readings:

1.Rao, C.R. (1973); Linear Statistical Inference and its Applications, Wiley Eastern.
2. Pitman, J. (1993): Probability, Narosa Publishing House.
3. Jonson, S. and Kotz, S. (1972): Distribution in Statistics Vol. I-II & III, Houghton and Mifflin.

E-Books Link: National Digital Library

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
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Department of Mathematics and Statistics
M.Sc. –II Semester (Statistics)

STAT-MDM-222	**Design and Analysis of Experiments**	L	T	P	C
		4	0	0	4
		Max. Marks : 100			

Mid Sem-20
Internal Assessment-20
End Sem-60

Learning Objectives: (1) To understand the concept and importance designing an experiment.
(2) To learn to choose a best design for an experiment.
(3) To learn analytical aspect and error reduction procedure for a design.

Unit–I: Review of linear estimation and basic designs, missing plot technique:- General theory and applications, Analysis of Co-variance for CRD and RBD
Unit–II: Incomplete block design: Balanced incomplete block designs, simple lattice designs, Twoassociate partially balanced incomplete block designs: association scheme and intra block analysis, group divisible designs.
Unit–III: General factorial experiments, factorial effects; best estimates and testing the significance of factorial effects; study of 2n and 3r factorial experiments in randomized blocks; complete and partial confounding,
Unit–IV: Construction of symmetrical confounded factorial experiments, fractional replications for symmetrical factorials, split plot and strip-plot experiments..
Unit–V: Application areas: Response surface experiments; first order designs, and orthogonal designs; clinical trials, treatment-control designs; model variation and use of transformation; Tukey's test for additivity.

Course Learning Outcomes: After studying the syllabus the student will be able to understand the effectiveness of designing an experiment with merits and demerits of various

Essential Readings:

1. Alok Dey (1986): Theory of Block Designs, Wiley Eastern.
2. Das, M. and Giri, N. (1979): Design and Analysis of Experiments, Wiley Eastern.

Suggested Readings:

1. Montgomery, C.D. (1976): Design and Analysis of Experiment, Wiley, New York
2. Giri (1986): Analysis of Variance, South Asian Publishers.

E-Books Link : National Digital Library

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