Syllabus for Two-year Master's Programme in Statistics
4th Semester for the year 2025 onwards under NEP 2020
(Board of Postgraduate studies held on 05-05-2025)

Course Title: Multivariate Analysis

Course Code: MSTSCMA425 **Total number of Credits: 04**

Total Contact Hours: 60 hrs. **Max. Marks:100**

Course Learning objectives:

- To introduce the elementary and advanced concepts of multivariate analysis tools.

Course Learning Outcomes (CLO's)

On successful completion of this course, the students will be able to

CLO1: describe the multivariate analysis tools in relation to univariate tools

CLO2: apply multivariate statistical methods in various applications.

CLO3: apply generalized statistics in real life data sets.

CLO4: apply principal component analysis in real life data sets.

UNIT-I

Multivariate Normal Distribution Theory: Marginal and conditional distribution, Joint distribution, Linear function of correlated normal variate. Characteristics function of multivariate normal distribution, Maximum likelihood estimation of the mean vector and co-variance matrix and their independence. Distribution of sample mean vector. Large sample behavior of mean vector and co-variance matrix. Distribution of non-central chi-square.

UNIT-II

Quadratic form and its distribution. Multiple and partial correlation co-efficient and their sampling distribution. Simple regression model, regression co-efficient and distribution of sample regression co-efficient. Test of linear hypothesis about regression co-efficient and interval estimation.

Distribution of sample co-variance matrix and the sample generalized variance; Wishart matrix and its distribution. Some important properties of the Wishart distribution. Characteristic function of Wishart distribution.

UNIT-III

Generalized T^2 statistics: The general T^2statistics, Derivation of the generalized T^2 statistics and its distribution. Some important properties of T^2 statistics and its uses. Two-sample problem with unequal co-variance matrices. Likelihood criterion for testing independence of set of variate and its moments. Walk's lambda criterion and its distribution. Mahalanobis D^2 statistics and its distribution.

UNIT-IV

Principal Component: Definition of principal components, uses, estimation and computation, Statistical inference on principal components.

Factor Analysis: Definition of factor analysis and uses, linear factor models, estimation of factor loading, Factor rotation, estimation of factor scores.

CLO-PLO Mapping Matrix for MSTSCMA425						
		PLO				**Average CLO**
CLO		PLO1	PLO2	PLO3	PLO4	
	CLO1	3	2	3	3	**2.75**
	CLO2	2	2	3	3	**2.5**
	CLO3	3	3	3	3	**2.75**
	CLO4	2	3	2	3	**2.5**
	Average PLO	**2.5**	**2.5**	**2.75**	**3**	**2.625**

Recommended Text Books & References:

- Anderson, T.W (1983): An Introduction to Multivariate Statistical analysis, 2nd ed., John Wiley Johnson,
- R.A. and Wichen, D.W. (1992): Applied Multivariate Statistical Analysis,2nd ed. Prentice Hall.
- Giri, N.C. (1977): Multivariate Statistical Inference, Academic press.
- Kshirsagar, A. M (1972): Multivariate Analysis, Marcel Decker.
- Morrison, D. F. (1976): Multivariate Statistical Methods, 2nd Ed, and Mc Graw Hill.
- Sharma, S. (1996): Applied multivariate technique, Wiley
- Muirhead, R. J. (1982): Aspects of multivariate statistical theory,
- John Wiley. Seber, G.A.F. (1984): Multivariate observations, Wiley.
- Srivastava, M.S. and Khatri, C.G. (1979): An introduction to multivariate statistics. North Holland. Carter and Srivastava: Multivariate Analysis, North Ho

Syllabus for Two-year Master's Programme in Statistics
4th - Semester for the year 2025 onwards under NEP 2020
(Board of Postgraduate studies held on 05-05-2025)

Course Title: Survey Project
Course Code: MSTSPSP425 **Total Number of Credits: 04**
Total Contact Hours: 120 hrs. **Max. Marks:100**

Course Learning objectives:

- Demonstrate knowledge of fundamental concepts in survey design, including population, sample, sampling methods, and questionnaire construction.
- Identify and define clear, measurable research objectives or hypotheses suitable for statistical investigation through surveys.

Course Learning Outcomes (CLO's)

CLO1: develop a survey plan including population definition, sampling strategy, and questionnaire design tailored to a specific research problem.

CLO2: apply suitable probability or non-probability sampling methods and justify their selection for a given study.

CLO3: Conduct data collection ethically and accurately using proper survey administration methods, and organize data for analysis.

CLO4: use appropriate descriptive and inferential statistical techniques to analyze and interpret the collected data using software tools (e.g., R, SPSS, Excel).

Note: The Project work will be based on Research Methodology followed by analyzing the real-life problems using statistical Techniques.

CLO-PLO Mapping Matrix for MSTSPSP425						
		PLO				**Average CLO**
		PLO1	PLO2	PLO3	PLO4	
CLO	CLO1	3	3	3	3	**3**
	CLO2	3	3	3	3	**3**
	CLO3	3	3	3	2	**2.75**
	CLO4	2	3	2	3	**2.5**
	Average PLO	**2.75**	**3**	**2.75**	**2.75**	**2.8125**

Syllabus for Two-year Master's Programme in Statistics
4th - Semester for the year 2025 onwards under NEP 2020
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Course Title: Practical Statistics-IV

Course Code: MSTSCPR425 **Total Number of Credits: 02**

Total Contact Hours: 60 hrs. **Max. Marks:50**

Practical based on MSTSCMA425

Course Learning objectives:

- To apply the elementary and advanced concepts of multivariate analysis tools in real life data sets.

Course Learning Outcomes (CLO's) :

On successful completion of this course, the students will be able to:

CLO1: apply, multivariate techniques in real life problem like medical science, psychological tests and agriculture etc.

CLO2: apply multiple and partial correlation co-efficient and simple regression model in real life data sets.

CLO3: apply generalized statistics in real life data sets.

CLO2: apply principal component analysis and factor analysis in real life data sets.

CLO-PLO Mapping Matrix for MSTSCPR425						
		PLO				**Average CLO**
CLO		PLO1	PLO2	PLO3	PLO4	
	CLO1	3	3	3	3	**3**
	CLO2	3	3	3	3	**3**
	CLO3	3	3	3	2	**2.75**
	CLO4	2	3	3	3	**2.75**
	Average PLO	3	3	3	3	**3**

Syllabus for Two-year Master's Programme in Statistics
4th - Semester for the year 2025 onwards under NEP 2020
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Course Title: Order Statistics

Course Code: MSTSCOS425 **Total Number of Credits: 02**

Total Contact Hours: 30 hrs. **Max. Marks: 50**

Course Learning Objective:

- To introduce the basic order statistics.
- Solve theoretical and applied problems involving order statistics using appropriate statistical techniques and reasoning.

Course Learning Outcomes (CLO's)

On successful completion of this course, the students will be able to

CLO1: understand the definition and significance of order statistics in statistical analysis.

CLO2: derive the probability density function (PDF) and cumulative distribution function (CDF) of the *k*th order statistic for various continuous and discrete distributions.

CLO3: understand the importance of correlation between extremes.

CLO4: understand the applications of order statistics in real data sets.

UNIT-I

Single Order Statistics: Cumulative distribution function, probability density function, structural properties and applications. Distribution of extremes. Distribution of median and range and their related examples. The expected value of a random variable between two consecutive order statistics is 1/(n+1).

UNIT-II

Joint order statistics: Joint probability density function of two order statistic, Marginal and conditional distribution of order statistics, extreme value laws and their properties. Correlation between extremes and related examples. Distribution of Range and other systematic statistics.

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CLO-PLO Mapping Matrix for MSTSCOS425						
		PLO				Average CLO
CLO		PLO1	PLO2	PLO3	PLO4	
	CLO1	3	2	3	3	**2.75**
	CLO2	3	3	3	3	**3**
	CLO3	3	2	3	2	**2.5**
	CLO4	2	3	2	3	**2.5**
	Average PLO	**2.75**	**2.5**	**2.75**	**2.75**	**2.6875**

Recommended Text Books & References:

- S.C. Gupta & V.K Kapoor (2012), Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
- Dudewicz, E.J. and Mishra, S.N. (1988): Modern Mathematical Statistics, Willy, Int'l Students edition.
- H.A. David, H.N. Nagaraja (2004): Order Statistics, Willy, Third Edition.
- B.C. Arnold, N. Balakrishnan, H. N. Nagaraja (2008): A First Course in Order Statistics, Society for Industrial and Applied Mathematics.

Syllabus for Two-year Master's Programme in Statistics
4th - Semester for the year 2025 onwards under NEP 2020
(Board of Postgraduate studies held on 05-05-2025)

Course Title: Stochastic Processes
Course Code: MSTSDSP425 **Total Number of Credits :04**
Total Contact Hours: 60 hrs. **Max. Marks: 100**

Course Learning Objective:

- To apprise the students about the existence of several stochastic processes in real life situations
- to equip them with the techniques to study their statistical behavior as a sequence of dependent random variables.

Course Outcomes:

CLO1: Understand the fundamental concepts of stochastic processes and their classifications.

CLO2: Analyze and model real-life systems using Markov chains and identify their long-term behavior.

CLO3: apply the Maximum likelihood estimation of transition probabilities in real data sets.

CLO4:Solve problems involving Brownian motion and Gaussian processes and interpret their applications in diverse fields.

UNIT I

Definition and classification of a stochastic process. Finite and countable Markov chains with stationary transition probabilities, classification of states, communicating classes, Irreducibility, Stationary distribution and its interpretation, random walk and gambler's ruin problems. Computing n-step transition probability matrix. Absorption probability and mean time to absorption.

Unit II

Markov processes, Kolmogorov forward and backward equations, Poisson process, compound Poisson process, Cramér-Lundberg model, Markov pure jump processes, birth-death processes. Yule process. Renewal processes, renewal function. Elementary renewal theorem and its applications.

Unit III

Sickness and marriage models in terms of Markov processes. Maximum likelihood estimation of transition probabilities. MLEs of transition intensities, Testing the order of a Markov chain. Simulation of a Markov chain and MCMC method.

Unit IV

Galton -Watson branching processes. Generating functions and their properties. Offspring mean and probability of extinction. Introduction to Brownian motion process and its basic properties. Forward and backward equations, Applications to insurance problems.

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CLO-PLO Mapping Matrix for MSTSDSP425						
		PLO				Average CLO
CLO		PLO1	PLO2	PLO3	PLO4	
	CLO1	3	2	2	3	**2.5**
	CLO2	3	3	3	3	**3**
	CLO3	3	3	3	2	**2.75**
	CLO4	2	3	2	3	**2.5**
	Average PLO	**2.75**	**2.75**	**2.5**	**2.75**	**2.6875**

Recommended Text Books & References:

- Ross, S.(2005) Introduction to Probability Models,6/e, Academic Press.
- Bhat, B.R. (2000). Stochastic Models: Analysis and Applications, 2/e, New Age International, India.
- Medhi, Jyotiprasad (1994): Stochastic Processes, Wiley Eastern Limited, 2/e.
- Adke, S.R. and Manjunath S.M. (1985). Finite Markov Processes. Wiley Eastern (New Age Publishing)
- Taylor and Karlin (1984). An Introduction to Stochastic Modeling, Academic Press.
- Feller, W. (1972) An Introduction to Probability Theory and its Applications,Vol. 3/e Wiley Eastern Ltd.

Syllabus for Two-year Master's Programme in Statistics
4th - Semester for the year 2025 onwards under NEP 2020
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Course Title: Industrial Statistics and Reliability Theory
Course Code: MSTSDIS425 **Total number of Credits: 04**
Total Contact Hours: 60 hrs. **Max. Marks: 100**

Course Learning Objectives:

- The aim of this course is to introduce the elementary and advanced concepts of statistical quality control and reliability theory.

Course Learning outcomes (CLO's)

After successful completion of this course, the students will be able to:

CLO1: sketch the techniques of statistical quality control.

CLO2: apply suitable SQC techniques and tools to improve the quality of production.

CLO3: exhibit the basic concepts of reliability and maintenance theory in real-life situations.

CLO4: reflect these tools in application areas like system reliability & maintenance analysis.

UNIT-I

Product Control: Basic concepts. Consumer and producer's risk, operating characteristic curve/function (OC). Corrective sampling plan (CSP). Average sample number (ASN), average out-going Quality (AOQ), graphical method of drawing AOQ, average out-going quality limit (AOQL).

UNIT-II

Single Sampling Plan. Methods of finding n and c for SSP. Double sampling inspection plan, evaluation and design. Sequential sampling plan. Plans for inspection by variables for one-sided specification.

UNIT-III

Capability indices: C_p, C_{pk} and C_{pm}, relation between C_p and $C_{pk.}$ Estimation, confidence intervals relating to capability indices for normally distributed characteristics. Reliability concepts, hazard rate, distribution of longevity and moments. Some important theorems based on reliability theory.

UNIT-III

Common life time distributions: exponential, Weibull, gamma, Gumbel and normal distributions. System: various classification of systems. Reliability and hazard rate of a system with independent units connected in (a) series and (b) Parallel systems. Type I and Type II censored samples.

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CLO-PLO Mapping Matrix for MSTSDIS425						
		PLO				Average CLO
CLO		PLO1	PLO2	PLO3	PLO4	
	CLO1	3	2	2	2	**2.25**
	CLO2	3	3	2	3	**2.75**
	CLO3	3	3	2	3	**2.75**
	CLO4	2	3	2	3	**2.5**
	Average PLO	**2.75**	**2.75**	**2**	**2.75**	**2.5625**

Recommended Text Books & References:

- Barlow, R.E. and Proschan, F. (1985). Statistical Theory of Reliability and Life Testing; Holt, Rinehart and Winston.
- Biswas, S.(1996). Statistical Quality Control, Sampling Inspection and Reliability; New Age International Publishers.
- Montgomery, D.C. (2019) Introduction to Statistical Quality Control; Johnson Wiley &sons
- Ott, E.R. (1975) Process Quality Control; McGraw hill
- Phadke, M.S. (1989) Quality Engineering through Robust Design; Prentice Hall
- Wetherill, G.B. (1977) Sampling Inspection and Quality Control; Halsted Press

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(Board of Postgraduate studies held on 05-05-2025)

Course Title: Survival Analysis
Course No.: MSTSDSA425 **Total number of Credits: 04**
Total Contact Hours: 60 hrs. **Max. Marks: 100**

Course Learning Objectives: To equip students with a strong theoretical and applied foundation in survival analysis.

Course Learning outcomes:

After successful completion of this course, the students will be able to:

CLO1: Apply non-parametric methods like Kaplan-Meier and Nelson-Aalen estimators to analyse censored survival data and compare survival distributions.

CLO2: Fit and interpret parametric survival models and assess their suitability.

CLO3: Use Cox proportional hazards and accelerated failure time models to evaluate the effect of covariates on survival, and interpret model diagnostics and selection criteria.

CLO4: Use Model selection criteria and comparison of nested models (-2logL and AIC) for real life data sets.

UNIT I

Survival function, hazard rate, cumulative hazard function, and mean residual life. Parametric models for study of event time data: Exponential, Weibull, extreme value, gamma, Pareto, logistic, loglogistic, normal, log–normal and mixture models -their survival characteristics. Longitudinal studies.

UNIT II

Censoring mechanisms- type I, type II and left right and interval censoring. Likelihood function under censoring. Fitting parametric models to survival data with right censoring. Large sample tests with censored data. The E–M algorithm.

UNIT III

Kaplan–Meier estimators. Treatment of ties. Self-consistency property and asymptotic properties of K–M estimator (statement). Pointwise confidence interval for S(t). Nelson-Aalen estimator of cumulative hazard function and estimation of S(t) based on it. Two–sample methods. Comparison of survival functions: Log rank and Tarone-Ware tests. Competing risks model; Kaplan-Meier estimator of survival function, Nelson-Aalen estimator.

UNIT IV

Explanatory variables- factors and variates. Cox proportional hazards model. The partial likelihood and estimation of regression coefficients and their standard errors. Breslow's estimator of the baseline hazard function; estimation of cumulative hazard rate and S(t). Statement of asymptotic properties of the estimator. Accelerated life model. Model selection criteria and comparison of nested models (-2logL and AIC). Using information on prognostic variables in a competing risks model.

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CLO-PLO Mapping Matrix for MSTSDSA425						
		PLO				Average CLO
		PLO1	PLO2	PLO3	PLO4	
CLO	CLO1	3	3	3	2	**2.75**
	CLO2	3	3	3	3	**3**
	CLO3	3	3	3	3	**3**
	CLO4	3	2	2	3	**2.5**
	Average PLO	**3**	**2.75**	**2.75**	**2.75**	**2.8125**

Recommended Text Books & References:

- Elandt-Johnson, Regina C; Johnson, Norman L.(1999). Survival models and data analysis. Classics Library ed. – John Wiley & Sons.
- Kalbfleisch, J.D. and Prentice, R. L (2002), The Statistical Analysis of Failure Time Data, 2nd edition, J. Wiley, New York.
- Klien, J.P. and Moeschberger, M.L. (2003). Survival Analysis: Techniques for censored and Trun-cated Data. 2/e. Springer
- Miller, J (1980), Survival Analysis, J. Wiley, New York.

Syllabus for Two-year Master's Programme in Statistics
4th - Semester for the year 2025 onwards under NEP 2020
(Board of Postgraduate studies held on 05-05-2025)

Course Title: Econometrics
Course No.: MSTSDEC425 **Total number of Credits: 04**
Total Contact Hours: 60 hrs. **Max. Marks: 100**

Course objectives:

- To introduce both elementary and advanced concepts of econometrics and provide students with the theoretical foundation and practical tools necessary for empirical economic data analysis using cross-sectional, time-series, and panel data models.

Course outcomes: On successful completion of this course, the students will be able to:
CLO 1: explain the scope and fundamental concepts of econometrics.
CLO 2: apply the classical linear regression model in real data sets.
CLO 3: apply econometric models such as Logit, Probit, and dynamic models economic data analysis.
CLO 4: fit the dynamic econometric models and Time Series for real data sets.

UNIT I

Introduction to Econometrics and Regression Models: Nature, scope, and meaning of Econometrics, Two-variable Linear Regression Model – Assumptions, Estimation of parameters using Ordinary Least Squares (OLS), Tests of significance: t-test, F-test, R^2 , Properties of estimators (BLUE), Functional Forms of Regression Models: Linear, Log-linear, Semi-log, Reciprocal, Choice of functional forms and interpretation.

UNIT II

Violations of Classical Assumptions: Serial Correlation, Causes, Consequences, Detection (Durbin-Watson, etc.) Heteroscedasticity, Causes, Consequences, Detection (Breusch-Pagan, White test), Remedies for serial correlation and heteroscedasticity. Model Specification: Types of specification errors and consequences. Specification Error Tests (RESET test, omitted variables), Model Selection Criteria: AIC, BIC, adjusted R^2, Errors in Variables – Concept and implications.

UNIT III

Qualitative Response Models and Model Extensions: Linear Probability Model (LPM): Introduction, advantages, limitations, Logit Model: Concept, estimation, and interpretation, Probit Model: Concept, estimation, and comparison with Logit, Use of Dummy Variables in regression models, Interaction terms and interpretation.

UNIT IV

Dynamic Econometric Models and Time Series: Dynamic Models: Autoregressive (AR), Distributed Lag (DL) models, Koyck transformation and estimation of DL models, Introduction to Time Series Data: Components and structure, Stationarity – Concept, importance, detection (ADF test overview), Forecasting using econometric models, Overview of Autocorrelation and model diagnostics in time series.

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CLO-PLO Mapping Matrix for MSTSDEC425						
		PLO				Average CLO
CLO		PLO1	PLO2	PLO3	PLO4	
	CLO1	3	3	2	2	**2.5**
	CLO2	3	3	2	3	**2.75**
	CLO3	3	3	2	3	**2.75**
	CLO4	3	2	3	3	**2.75**
	Average PLO	**3**	**2.75**	**2.25**	**2.75**	**2.6875**

Recommended Text Books & References:

- Gujarati, D. N. (2004). Basic Econometrics (4th Edition). Tata McGraw-Hill.
- Maddala, G. S. (2001). Introduction to Econometrics. Wiley.
- Wooldridge, J. M. (2016). Introductory Econometrics: A Modern Approach (6th Edition). Cengage Learning.
- Madnani, G. M. K. (2008). Introduction to Econometric Principles and Applications. Oxford & IBH Publishing Co. Pvt. Ltd.