Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati
Autonomous

Course Structure for M.Sc. Statistics (2022 Pattern)
(With effect from Academic Year 2022-2023)

Name of the Programme : M.Sc. Statistics

Program Code : PSST

Class : M.Sc. Part – I

Semester : I

Paper Code	Title of Paper	No. of Credits
PSST111	Mathematical Analysis	4
PSST112	Linear Algebra	4
PSST113	Probability Distributions	4
PSST114	Sampling Theory	4
PSST115	Statistics Practical – I	4
PSST116	Statistics Practical – II	4

Name of the Programme : M.Sc. Statistics

Program Code : PSST

Class : M.Sc. Part – I

Semester : II

Paper Code	Title of Paper	No. of Credits
PSST121	Modern Probability Theory	4
PSST122	Statistical Inference	4
PSST123	Applied Multivariate Analysis	4
PSST124	Regression Models	4
PSST125	Statistics Practical – III	4
PSST126	Statistics Practical – IV	4

SYLLABUS (CBCS) FOR M.Sc. Statistics
(2022 Pattern)
(With effect from Academic Year 2022-2023)

Name of the Programme : M.Sc. Statistics
Program Code : PSST
Class : M.Sc. Part – I
Semester : II
Course Name : Modern Probability Theory
Course Code : PSST121
No. of lectures : 60
Credit : 4 credits

A) COURSE OBJECTIVES:

1. To apply learned theoretical concepts in solving problems, modeling real-world scenarios, and understanding statistical and probabilistic phenomena.
2. To develop analytical skills to critically evaluate and solve problems related to probability theory and stochastic processes.
3. To recognize the relevance and application of probability theory and stochastic processes in various fields such as finance, engineering, and sciences.

B) Course Outcomes:

Students will be able to

CO1 understand the concepts of random variables, sigma-fields generated by random variables
CO2 solve the problems based on probability measure, distribution function and expectation
CO3 understand the concepts of independence of events, random variables
CO4 understand different modes of convergences and their interrelationships
CO5 understand interrelationships between different modes of convergences.
CO6 apply WLLN related to sequence of random variables.
CO7 apply CLT related to sequence of random variables.

TOPICS/CONTENTS:

Unit-1

Review of algebra of sets, sequence of sets, limsup, liminf and limit of a sequence of sets, Classes of sets, field, sigma field, minimal sigma field, Borel fields, measurable space, monotone classes,

Measurable function, Real and Vector valued random variables, simple r.v., r.v. as a limit of sequence of simple r.v.s, Probability measure on a measurable space, probability space, properties of probability measure: continuity, mixture of probability measures. **(18L)**

Unit 2

Distribution function, decomposition of a distribution function, discrete and continuous type r.v., Expectation of simple r.v, non-negative r.v. and arbitrary r.v., properties of expectation, moments, moment inequalities **(12L)**

Unit 3

Convergence of a sequence of r.v.s, convergence in probability, convergence in distribution, convergence in r^{th} mean, almost sure convergence, their inter-relations, Slutsky's theorem, convergence theorem for expectations, characteristic function and properties, conjugate pairs of distributions, **(15L)**

Unit 4

Independence of events, class of independent events, independence of classes, independence of r.v's, expectation of the product of independent r.v.'s, equivalent definitions of independence, Kolmogorov 0-1 Law, Borel 0-1 criterion, Borel Cantelli Lemma, Khintchin's WLLN, Strong Law of Large Numbers (SLLN) (Statement only), Central Limit Theorem (CLT), Levy continuity theorem, CLT for i.i.d. r.v.s, Liaponove's form, Lindeberg Feller form and their applications. **(15L)**

References:

1) Bhat, B.R. (2007) Modern Probability Theory, Third Edition. New Age Inter-national
2) Billingsley, P. (1995) Probability and Measure, Wiley Publication.
3) Chung, K. L. (2001) A Course in Probability Theory, Third Edition, Academic Press, London
4) Basu, A. K. (1999) Measure Theory and Probability (Prentice Hall of India)
5) Ash, Robert. (1972) Real Analysis and Probability, (Academic Press)
6) Feller, W. (1969) Introduction to Probability and its applications Vol.II, (Wiley Easter Ltd.)
7) Gut A. (2005), Probability: A Graduate Course, Spinger-Verlag, New York.
8) Dasgupta A. (2008), Asymptotic Theory of Statistics and Probability, Spinger-Verlag, New York.

Programme Outcomes and Course Outcomes Mapping:

Course Outcomes	Programme Outcomes (POs)								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	3	1	3	1	1	1	1	3
CO2		3	1	3	1	1	1	1	3
CO3		3	1	3	1	1	1	1	3
CO4		3	1	3	1	1	1	1	3
CO5		3	1	3	1	1	1	1	3
CO6		3	1	3	1	1	1	1	3
CO7		3	1	3	1	1	1	1	3

Weight: 1 - Partially related 2 - Moderately Related 3 - Strongly related

PO1. Disciplinary Knowledge

CO1. Understand the concepts of random variables, sigma-fields generated by random variables. (Weightage: 3 - Strongly Related)

Justification: Understanding the concepts of random variables is fundamental to building disciplinary knowledge in probability theory.

PO2. Critical Thinking and Problem Solving

All COs (Weightage: 3 - Strongly Related)

Justification: All outcomes involve critical thinking and problem-solving skills related to probability measures, distribution functions, and expectations.

PO3. Social Competence

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes are more technical and focused on probability theory, with less direct relevance to social competence.

PO4. Research-related Skills and Scientific Temper

All COs (Weightage: 3 - Strongly Related)

Justification: The outcomes align closely with research-related skills and the development of a scientific temper in the context of probability theory.

PO5. Trans-disciplinary Knowledge

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes are specific to probability theory and have limited trans-disciplinary connections.

PO6. Personal and Professional Competence

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes contribute more to technical competence in probability theory, with limited direct connections to personal and professional aspects.

PO7. Effective Citizenship and Ethics

All COs (Weightage: 1 - Partially Related)

Justification: The content is more technical and less directly related to effective citizenship and ethics.

PO8. Environment and Sustainability

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes are more focused on probability theory and less on environmental or sustainability aspects.

PO9. Self-directed and Life-long Learning

All COs (Weightage: 3 - Strongly Related)

Justification: Probability theory is dynamic, and mastering its principles requires ongoing self-directed learning and adaptation.

SYLLABUS (CBCS) FOR M.Sc. Statistics
(2022 Pattern)
(With effect from Academic Year 2022-2023)

Name of the Programme	**:** M.Sc. Statistics
Program Code	**:** PSST
Class	**:** M.Sc. Part – I
Semester	**:** II
Course Name	**:** Statistical Inference
Course Code	**:** PSST122
No. of lectures	**:** 60
Credit	**:** 4 credits

A) Course Objectives:

To guide students towards a comprehensive understanding of advanced statistical concepts and their practical applications in estimation, hypothesis testing, confidence intervals, and Bayesian inference.

B) Course Outcomes:

Students will be able to understand the concept of

CO1 estimation and testing procedures to deal with real life problems.

CO2 Fisher Information matrix, Lower bounds to variance of estimators, MVUE.

CO3 prior and posterior data based modeling and analysis.

CO4 data reduction and different family of distributions

CO5 most powerful test, Neyman-Pearson fundamental lemma, UMP test, UMPU test.

CO6 Apply the factorization theorem to determine sufficient statistics and construct minimal sufficient statistics for given probability distributions, especially within the exponential family and Pitman family.

CO7 Understand UMP tests for one-sided alternatives within the Exponential class of densities and extensions to distributions having Monotone Likelihood Ratio property.

TOPICS/CONTENTS:

Unit 1

Sufficiency, Fisher's concept of sufficiency, Sufficient statistic, Factorization theorem, Joint Sufficiency, Likelihood Equivalence, Minimal Sufficiency, construction of Minimal Sufficient Statistic, Completeness, Exponential family and Pitman family admitting Minimal Sufficient Statistic.

(15L)

Unit 2

Fisher information and information matrix, Estimable function, Best Linear Unbiased Estimator, Gauss-Markov theorem, Cramer Rao inequality and its application, Rao-Blackwell theorem, Lehman-Scheffee theorem and its application, necessary sufficient condition of MVUE,necessary and sufficient condition for MVUE and their applications, Ancillary statistic. **(15L)**

Unit 3

Critical region and test function, Neyman Pearson lemma and most powerful test, Uniformly Most Powerful (UMP) test for one sided alternative for one parameter exponential family and Pitman family, Monotone Likelihood Ratio property, statement of UMPU test, nonexistence of UMP tests. **(15L)**

Unit 4

Confidence Interval (C.I.), Shortest Expected Length C.I. Uniformly Most Accurate C.I., introduction to Bayesian estimation: Prior and Posterior distribution, Loss function, Bayes estimation under squared error and absolute error loss functions, Conjugate family of Prior distribution and its example, Principal of Minimum Expected Posterior Loss. **(15L)**

References:

1. Casella G. and Beregar R.L. (2002) Statistical Inference, 2nd Edition (Duxbury Advanced Series)
2. Dudewitz E.J. & Mishra S.N.(1988) Modern Mathematical Statistics (John Wiley)
3. Kale B.K. (1999) A First course on Parametric Inference (Narosa)
4. Lehman E.L (1988) Theory of point estimation (John Wiley)
5. Lehman E.L(1986) Testing of Statistical hypotheses (John Wiley)
6. Rohatagi V.K. (1976) Introduction to theory of probability & mathematical statistics

(John Wiley & sons)

7. Dasgupta A. (2008), Asymptotic Theory of Statistics and Probability, Spinger-Verlag, New York.
8. Ulhas Jayram Dixit (2016) ISBN 978-981-10-0888-7 Examples in Parametric Inference with R.

Programme Outcomes and Course Outcomes Mapping:

Course Outcomes	Programme Outcomes (POs)								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	3		3	1	1	1	1	3
CO2	3	3		3	1	1	1	1	3
CO3	3	3		3	1	1	1	1	3
CO4	3	3		3	1	1	1	1	3
CO5	3	3		3	1	1	1	1	3
CO6	3	3		3	1	1	1	1	3
CO7	3	3	2	3	1	1	1	1	3

Weight: 1 - Partially related 2 - Moderately Related 3 - Strongly related

PO1. Disciplinary Knowledge

CO1. Estimation and testing procedures to deal with real-life problems. (Weightage: 3 - Strongly Related)

Justification: The application of estimation and testing procedures directly contributes to building disciplinary knowledge in statistical theory.

PO2. Critical Thinking and Problem Solving

All COs (Weightage: 3 - Strongly Related)

Justification: All outcomes involve critical thinking and problem-solving skills, especially in the context of statistical inference and testing.

PO3. Social Competence

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes are more technical and focused on statistical theory, with less direct relevance to social competence.

PO4. Research-related Skills and Scientific Temper

All COs (Weightage: 3 - Strongly Related)

Justification: The outcomes align closely with research-related skills and the development of a scientific temper in the context of statistical modeling and analysis.

PO5. Trans-disciplinary Knowledge

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes are specific to statistical theory and have limited trans-disciplinary connections.

PO6. Personal and Professional Competence

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes contribute more to technical competence in statistical theory, with limited direct connections to personal and professional aspects.

PO7. Effective Citizenship and Ethics

All COs (Weightage: 1 - Partially Related)

Justification: The content is more technical and less directly related to effective citizenship and ethics.

PO8. Environment and Sustainability

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes are more focused on statistical theory and less on environmental or sustainability aspects.

PO9. Self-directed and Life-long Learning

All COs (Weightage: 3 - Strongly Related)

Justification: Statistical theory is dynamic, and mastering its principles requires ongoing self-directed learning and adaptation.

SYLLABUS (CBCS) FOR M.Sc. Statistics
(2022 Pattern)
(With effect from Academic Year 2022-2023)

Name of the Programme **:** M.Sc. Statistics
Program Code **:** PSST
Class **:** M.Sc. Part – I
Semester **:** II
Course Name **:** Applied Multivariate Analysis
Course Code : PSST123
No. of lectures **:** 60
Credit **:** 4 credits

Course Outcomes:

After completion of this course the students will be able to

CO1 carry out an extensive exploratory multivariate analysis for a given multivariate data

CO2 carry out cluster analysis of given multivariate data

CO3 solve problems involving multivariate normal distribution Evaluate

CO4 carry out statistical inference procedures using the data from a multivariate normal distribution.

CO5 carry out classification of given multivariate data

CO6 solve problems involving multivariate normal distribution evaluate.

CO7 carry out statistical inference procedures using the data from a multivariate normal distribution.

TOPICS/CONTENTS:

Unit-1

Exploratory multivariate data analysis, sample mean vector, sample dispersion matrix, correlation matrix, graphical representation, linear transformation and its mean, variance covariance, correlation between linear transformations, principal component analysis, factor analysis, canonical correlation with applications, cluster analysis with applications. **(20L)**

Unit- 2

Multivariate normal distribution, singular and non-singular normal distribution. m.g.f., characteristic function, moments, distribution of a linear form and quadratic form of normal variables, Cochran theorem, marginal and conditional distribution. Test for multivariate normality. **(12L)**

Unit- 3

M.L.E's of parameters of multivariate normal distribution and their sampling distribution, Wishart matrix, Wishart distribution and its properties, Tests of hypothesis about mean vector of a multivariate normal population, Hotelling T2 statistic and its distribution, its applications. Likelihood ratio test, confidence region for mean vector of multivariate normal distribution. **(15L)**

Unit- 4

Test for equality of dispersion matrices, discriminant analysis, Mahalanobis D2 statistic, test for significance of the coefficients in discriminant function, misclassification error, methods and applications of MANOVA (without derivation of the distribution of Wilk's lambda). **(13L)**

REFERENCES

1) Anderson T.W. (1984) Introduction to multivariate analysis (John Wiley)
2) C. R. Rao (1985) Linear Statistical inference and its applications (Wiley Eastern Ltd)
3) Hardle, W. K. & Simar, L. (2012), Applied Multivariate Statistical analysis (Springer, New York)
4) Johnson R.A. and Wichern D.W. (1988) Applied multivariate statistical analysis (Prentice Hall Inc.)
5) Johnson R.A. & Wichern, D.W. (1988). Applied Multivariate Statistical analysis (Prentice Hall Inc.)
6) Kshirsagar A.M. (1983) Multivariate Analysis (Marcel Dekker.)
7) K.C. Bhuyan (2005) Multivariate Analysis and its application, New Central book agency, LTD. Kolkatta
8) Morrison, D.F. (1990). Multivariate Statistical Methods (McGraw Hill Co.) (3rd ed.)
9) Bryan F. J., Manly, Jorge A. Navarro Alberto, Multivariate Statistical Methods, Fourth Edition, A Primer.

Programme Outcomes and Course Outcomes Mapping:

Course Outcomes	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	1	3	1	1	1	1	3
CO2		3	1	3	1	1	1	1	3
CO3		3	1	3	1	1	1	1	3
CO4		3	1	3	1	1	1	1	3
CO5		3	1	3	1	1	1	1	3
CO6		3	1	3	1	1	1	1	3
CO7		3	1	3	1	1	1	1	3

Weight: 1 - Partially related 2 - Moderately Related 3 - Strongly related

PO1. Disciplinary Knowledge

CO1. Carry out an extensive exploratory multivariate analysis for a given multivariate data. (Weightage: 3 - Strongly Related)

Justification: Performing extensive exploratory multivariate analysis contributes directly to building disciplinary knowledge in multivariate statistics.

PO2. Critical Thinking and Problem Solving

All COs (Weightage: 3 - Strongly Related)

Justification: All outcomes involve critical thinking and problem-solving skills, especially in the context of multivariate data analysis.

PO3. Social Competence

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes are more technical and focused on statistical analysis, with less direct relevance to social competence.

PO4. Research-related Skills and Scientific Temper

All COs (Weightage: 3 - Strongly Related)

Justification: The outcomes align closely with research-related skills and the development of a scientific temper in the context of multivariate statistical analysis.

PO5. Trans-disciplinary Knowledge

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes are specific to multivariate statistics and have limited trans-disciplinary connections.

PO6. Personal and Professional Competence

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes contribute more to technical competence in multivariate statistics, with limited direct connections to personal and professional aspects.

PO7. Effective Citizenship and Ethics

All COs (Weightage: 1 - Partially Related)

Justification: The content is more technical and less directly related to effective citizenship and ethics.

PO8. Environment and Sustainability

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes are more focused on statistical analysis and less on environmental or sustainability aspects.

PO9. Self-directed and Life-long Learning

All COs (Weightage: 3 - Strongly Related)

Justification: Multivariate statistics is dynamic, and mastering its principles requires ongoing self-directed learning and adaptation.

SYLLABUS (CBCS) FOR M.Sc. Statistics
(2022 Pattern)
(With effect from Academic Year 2022-2023)

Name of the Programme : M.Sc. Statistics
Program Code : PSST
Class : M.Sc. Part – I
Semester : II
Course Name : Regression Models
Course Code : PSST124
No. of lectures : 60
Credit : 4 credits

Course Outcomes:

Students will be able to

CO1 Excellent familiarity with both linear and nonlinear regression models.

CO2 Understanding of model selection and regression modelling techniques should be demonstrated.

CO3 The relation between dependent and independent variables should be examined.

CO4 Estimate the parameters and fit a model.

CO5 Investigate possible diagnostics in regression modeling and analysis.

CO6 Use confidence intervals and hypothesis testing to validate the model.

CO7 Utilize multinomial and ordinal regression models to analyze and interpret categorical response variables.

TOPICS/CONTENTS:

Unit-1

Simple linear regression, assumptions, least square (LS) estimators of parameters, standard error of estimators, testing of hypothesis for coefficient of regression, S.E. of prediction, testing of hypothesis about parallelism (slopes), equality of intercepts, generalized and weighted least squares, congruence, extrapolation, optimal choice of independent variables diagnostics checks and correction: graphical technique, tests for normality, uncorrelatedness, homoscedasticity, lack of fit, transformation on of dependent or independent variables. **(15L)**

Unit 2

Multiple regression: Standard Gauss-Markov setup, least square estimation, error and estimation spaces, variance and covariance of LS estimators, properties of LS estimators, estimation of error variance, case with correlated observation, LS estimation with restriction on parameters, simultaneous estimation of linear parametric functions, testing of hypothesis for one and more than one linear parametric functions, confidence intervals and regions, generalized and weighted least squares, Mallows Cp, stepwise regression methods – forward, backward, stepwise. **(15L)**

Unit 3

a) Multicollinearity: consequences, detection and remedies: (Principal component regression, ridge regression), autocorrelation consequences, Durbin Watson test, estimation of parameters in autocorrelation. **(10L)**

b) Test for significance of simple, multiple and partial correlation coefficients. Residual and residual diagnostics, transformation of variables: Box-Cox power Transformation. **(5L)**

Unit 4

a) Polynomial regression, inverse regression, Non-linear regression: Non-linear least squares transformation to a linear model, their uses and limitations, examination of non-linearity, initial estimates, iterative procedure, and Newton-Raphson method. **(5L)**

b) Generalized linear model: Link function: normal, binomial, Poisson, exponential, gamma. Logit transform, ML estimation of Logistic regression, tests of hypothesis, Wald test, LR test, score test, test for overall regression. **(10L)**

References

1) Draper, N. R. and Smith H. (1998) Applied regression analysis 3rd edition (John Wiley)
2) Hosmer, D. W. and Lemeshow, S. (1989) Applied logistic regression (John Wiley)
3) Mc Cullagh, P. and Nelder, J. A.(1989) Generalized linear models (Chapman and Hall)
4) Montogomery D.C., Elizabeth a. Peck, G. Geoffrey.(2003) Introduction to linear regression analysis (Wiley Eastern)
5) Neter, J.; Wasserman, W. and Kutner, M.H.(1985) Applied linear statistical models
6) Ratkowsky, D. A. (1983) Nonlinear regression modeling (Marcel Dekker)

Programme Outcomes and Course Outcomes Mapping:

Course Outcomes	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	1	3	1	1	1	1	3
CO2		3	1	3	1	1	1	1	3
CO3		3	1	3	1	1	1	1	3
CO4		3	1	3	1	1	1	1	3
CO5		3	1	3	1	1	1	1	3
CO6		3	1	3	1	1	1	1	3
CO7		3	1	3	1	1	1	1	3

Weight: 1 - Partially related 2 - Moderately Related 3 - Strongly related

PO1. Disciplinary Knowledge

CO1. Excellent familiarity with both linear and nonlinear regression models. (Weightage: 3 - Strongly Related)

Justification: Demonstrating excellent familiarity with regression models contributes directly to building disciplinary knowledge in statistical modeling.

PO2. Critical Thinking and Problem Solving

All COs (Weightage: 3 - Strongly Related)

Justification: All outcomes involve critical thinking and problem-solving skills, especially in the context of regression modeling and analysis techniques.

PO3. Social Competence

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes are more technical and focused on statistical analysis, with less direct relevance to social competence.

PO4. Research-related Skills and Scientific Temper

All COs (Weightage: 3 - Strongly Related)

Justification: The outcomes align closely with research-related skills and the development of a scientific temper in the context of regression analysis.

PO5. Trans-disciplinary Knowledge

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes are specific to regression modeling and have limited trans-disciplinary connections.

PO6. Personal and Professional Competence

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes contribute more to technical competence in regression analysis, with limited direct connections to personal and professional aspects.

PO7. Effective Citizenship and Ethics

All COs (Weightage: 1 - Partially Related)

Justification: The content is more technical and less directly related to effective citizenship and ethics.

PO8. Environment and Sustainability

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes are more focused on statistical analysis and less on environmental or sustainability aspects.

PO9. Self-directed and Life-long Learning

All COs (Weightage: 3 - Strongly Related)

Justification: Regression modeling is dynamic, and mastering its principles requires ongoing self-directed learning and adaptation.

SYLLABUS (CBCS) FOR M.Sc. Statistics
(2022 Pattern)
(With effect from Academic Year 2022-2023)

Name of the Programme **:** M.Sc. Statistics
Program Code **:** PSST
Class **:** M.Sc. Part – I
Semester **:** II
Course Name **:** Statistics Practical – III
Course Code **:** PSST125
No. of lectures **:** 60
Credit **:** 4 credits

Course Outcomes:

Students should be able to:

CO1 understand the link between multivariate techniques and corresponding univariate techniques,

CO2 analyze multivariate data and the dependence structure of variates to extract the useful information from a massive dataset,

CO3 apply suitable tools for exploratory data analysis, dimension reduction, and classification to formulate and solve real-life problems,

CO4 analyze multivariate data using data reduction techniques like principal component analysis, factor analysis.

CO5 Apply multivariate statistical methods to real-world datasets, interpreting and communicating the results effectively.

CO6 Calculate the confidence coefficient associated with a given confidence interval and interpret its meaning in the context of statistical estimation.

CO7 Develop skills in using statistical software/tools to perform computations and analyses related to likelihood ratio tests, discriminant analysis, MANOVA, power calculations, and confidence intervals.

Sr. No.	Title of Experiments
1.	Exploratory multivariate data analysis
2.	Testing Multivariate Normality
3.	Model sampling from multivariate normal distribution and computation of M.L.E.'s of parameters
4.	Principal component analysis
5.	Factor Analysis
6.	Cluster Analysis
7.	Canonical correlation analysis
8.	Application of Hotelling T^2 statistics- I
9.	Application of Hotelling T^2 statistics- II
10.	Likelihood ratio tests (Multivariate Test)
11.	Discriminant analysis
12.	Multivariate Analysis of Variance

Programme Outcomes and Course Outcomes Mapping:

Course Outcomes	Programme Outcomes (POs)								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	3	1	3		1	1	1	3
CO2		3	1	3		1	1	1	3
CO3		3	1	3	2	1	1	1	3
CO4		3	1	3		1	1	1	3
CO5		3	1	3		1	1	1	3
CO6		3	1	3		1	1	1	3
CO7		3	1	3		1	1	1	3

Weight: 1 - Partially related 2 - Moderately Related 3 - Strongly related

PO1. Disciplinary Knowledge

CO1. Understand the link between multivariate techniques and corresponding univariate techniques. (Weightage: 3 - Strongly Related)

Justification: Understanding the link between multivariate and univariate techniques is fundamental to disciplinary knowledge in statistics.

PO2. Critical Thinking and Problem Solving

All COs (Weightage: 3 - Strongly Related)

Justification: All outcomes involve critical thinking and problem-solving skills, especially in the context of analyzing and interpreting multivariate data.

PO3. Social Competence

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes are more technical and focused on statistical analysis, with less direct relevance to social competence.

PO4. Research-related Skills and Scientific Temper

All COs (Weightage: 3 - Strongly Related)

Justification: The outcomes align closely with research-related skills and the development of a scientific temper in the context of multivariate statistical analysis.

PO5. Trans-disciplinary Knowledge

CO3. Apply suitable tools for exploratory data analysis, dimension reduction, and classification to formulate and solve real-life problems. (Weightage: 2 - Moderately Related)

Justification: The application of tools for real-life problem-solving introduces a moderate level of trans-disciplinary knowledge.

PO6. Personal and Professional Competence

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes contribute more to technical competence in multivariate statistical analysis, with limited direct connections to personal and professional aspects.

PO7. Effective Citizenship and Ethics

All COs (Weightage: 1 - Partially Related)

Justification: The content is more technical and less directly related to effective citizenship and ethics.

PO8. Environment and Sustainability

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes are more focused on statistical analysis and less on environmental or sustainability aspects.

PO9. Self-directed and Life-long Learning

All COs (Weightage: 3 - Strongly Related)

Justification: Multivariate statistical analysis is dynamic, and mastering its principles requires ongoing self-directed learning and adaptation.

SYLLABUS (CBCS) FOR M.Sc. Statistics
(2022 Pattern)
(With effect from Academic Year 2022-2023)

Name of the Programme : M.Sc. Statistics
Program Code : PSST
Class : M.Sc. Part – I
Semester : II
Course Name : Statistics Practical – IV
Course Code : PSST126
No. of lectures : 60
Credit : 4 credits

Course Outcomes:

Students should be able to:

CO1 Excellent familiarity with both linear and nonlinear regression models.

CO2 Understanding of model selection and regression modelling techniques should be demonstrated.

CO3 Estimate the parameters and fit a model.

CO4 Investigate possible diagnostics in regression modeling and analysis.

CO5 Use confidence intervals and hypothesis testing to validate the model.

CO6 Apply polynomial regression and other nonlinear regression techniques.

CO7 Utilize multinomial and ordinal regression models to analyze and interpret categorical response variables.

CO8 Apply the Central Limit Theorem to demonstrate how the distribution of sample means or sums approximates a normal distribution regardless of the underlying distribution.

Sr. No.	Title of Experiments
1.	Simple regression and regression diagnostic
2.	Multiple regression
3.	Lack of fit of the regression model
4.	Multiple regression (selection of variable)
5.	Multicollinearity and diagnosis I
6.	Multicollinearity and diagnosis II
7.	Polynomial regression
8.	Nonlinear regression
9.	Poisson regression
10.	Logistic regression

11.	Computation of confidence coefficient for given confidence interval.
12.	Comparison of lengths of CI

Programme Outcomes and Course Outcomes Mapping:

Course Outcomes	Programme Outcomes (POs)								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3	3	1	3		1	1	1	3
CO2		3	1	3		1	1	1	3
CO3		3	1	3		1	1	1	3
CO4		3	1	3		1	1	1	3
CO5		3	1	3		1	1	1	3
CO6		3	1	3		1	1	1	3
CO7		3	1	3	2	1	1	1	3

Weight: 1 - Partially related 2 - Moderately Related 3 - Strongly related

PO1. Disciplinary Knowledge

CO1. Excellent familiarity with both linear and nonlinear regression models. (Weightage: 3 - Strongly Related)

Justification: Demonstrating excellent familiarity with regression models directly contributes to disciplinary knowledge in statistics and data analysis.

PO2. Critical Thinking and Problem Solving

All COs (Weightage: 3 - Strongly Related)

Justification: All outcomes involve critical thinking and problem-solving skills, especially in the context of regression modeling and analysis.

PO3. Social Competence

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes are more technical and focused on statistical analysis, with less direct relevance to social competence.

PO4. Research-related Skills and Scientific Temper

All COs (Weightage: 3 - Strongly Related)

Justification: The outcomes align closely with research-related skills and the development of a scientific temper in the context of regression analysis.

PO5. Trans-disciplinary Knowledge

CO7. Utilize multinomial and ordinal regression models to analyze and interpret categorical response variables. (Weightage: 2 - Moderately Related)

Justification: Utilizing regression models for categorical response variables introduces a moderate level of trans-disciplinary knowledge.

PO6. Personal and Professional Competence

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes contribute more to technical competence in regression analysis, with limited direct connections to personal and professional aspects.

PO7. Effective Citizenship and Ethics

All COs (Weightage: 1 - Partially Related)

Justification: The content is more technical and less directly related to effective citizenship and ethics.

PO8. Environment and Sustainability

All COs (Weightage: 1 - Partially Related)

Justification: The outcomes are more focused on statistical analysis and less on environmental or sustainability aspects.

PO9. Self-directed and Life-long Learning

All COs (Weightage: 3 - Strongly Related)

Justification: Mastering regression analysis and modeling requires ongoing self-directed learning and adaptation, aligning well with the lifelong learning goal.