SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

Master of Science Statistics Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme L-P-T	Total Notional Hours	Course credits
DSC	**P2S02NCSTA01**	Statistical Inference-II	4-0-0	120	04

- **Course Learning Outcomes (CLOs)**

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

CLO1: Explain the principles of Bayesian inference, including prior selection (conjugate vs. non-informative), likelihood construction, and the derivation of posterior mean.

CLO2: Develop, apply, and diagnose convergence of MCMC methods (e.g., Gibbs sampling, Metropolis-Hastings) to estimate posterior distributions for complex, multi-parameter models.

CLO3: Apply advanced techniques for the Multiple Testing Problem (Bonferroni correction), and control for false positives when conducting multiple hypothesis tests, compute False Discovery Rate (FDR).

CLO4: Evaluate and implement non-parametric statistical tests (e.g., Wilcoxon, Mann-Whitney, Kruskal-Wallis) when parametric assumptions are invalid.

CLO5: Use software (e.g., R, Excel) to implement MCMC methods, perform Bayesian analysis, and conduct non-parametric analyses.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Bayesian Estimation • Introduction to Decision Theory: Set of decisions; loss function; risk function; Baye's theorem, prior and posterior distributions; principles of Minimax and Bayes risk, Bayes • Baye's estimation: Baye's estimator of parameters and parametric functions for squared error, absolute error loss functions.	CL PBL	1 2 5
II	Markov Chain Monte Carlo Methods • Metropolis-Hastings and Gibbs sampling for posterior computation. • M-Estimators: Estimating equations, asymptotic theory of M-estimators, and sandwich variance.	CL PBL ICT EL	2 5
III	Multiple Testing and Modern Inference • Multiple Comparisons Problem: Family-wise error rate (FWER), false discovery rate (FDR), and multiplicity. • Bonferroni and Related Procedures: Bonferroni, Holm, Hochberg, and Hommel step-wise procedures. • Benjamini-Hochberg FDR Procedure: FDR control in multiple testing and applications in genomics.	CL ICT EL	3 5
IV	Non-Parametric Tests • Two Sample Tests: Wilcoxon Rank Sum Test, Wilcoxon-Mann-Whitney Test • Several Sample Tests: Kruskal-Wallis Test, Friedman Test, Kendall-Babington Smith, Durbin Test, Skillings-Mack	CL PBL ICT-EL	4 5

Master of Science Statistics Semester-II

- **Learning Pedagogies/Methods**
  (a) Classroom Lecture (CL)
  (b) Problem-Based Learning (PBL)
  (c) ICT-Enabled Learning through Digital Resources/ Virtual Labs/Webinars (ICT EL)
- **Assessment Methodologies**

(A) Internal Assessment

a. Internal Formative assessment

i. MCQ and Objective question Quiz: Students select or give the correct answer from the list of options four /none for a given questions.
ii. Assignment: A practical task or setup questions given to measure a student's knowledge, skill and ability in subject or field.
iii. Seminar: A student-led academic activity designed to evaluate student's ability to research, understand, and present a specific topic.
iv. Group Discussion: An interactive method to asses a student's personality and inter- personal skills in team setting. It typically involves 5 to 15 participants discussing a topic for 15 to 30 minutes in presence of an observer.

b. Internal Summative Assessment

i. Mid-term tests
A test conducted roughly halfway through an academic term or semester.

(B) Weightage of Learning Efforts for External Assessment

Unit	Aligned CLOs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	1, 2, 5	30	4	5	3	12
II	2, 5	30	4	5	4	13
III	3, 5	30	4	5	4	13
IV	4, 5	30	3	5	4	12
		120	**15**	**20**	**15**	**50**

- **Assessment and Evaluation**

Sr.No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	FA: Seminars, Assignments, Quizzes, Group Discussion	25%
		SA: Mid Term Test	25%
2	End-Semester Examination	Written Exam	50%

(C) CLOs – PLOs Matrix

CLO	PLO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO1	2	-	2	3	3	1	-	3	-	1	-	-	2	3	1
CLO2	2	-	2	2	3	3	-	3	2	-	1	-	3	3	-
CLO3	3	-	2	3	2	1	-	3	-	1	-	3	3	3	-
CLO4	1	-	2	3	2	1	-	3	-	-	1	-	2	3	1
CLO5	3	-	2	1	3	3	-	2	3	-	1	1	2	3	-

Master of Science Statistics Semester-II

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- **Suggested Learning Materials Books:**

Sr.No.	Title	Author(s)	Edition/Year	Publisher
1	Computer Age Statistical Inference	Efron, B., & Hastie, T.	First/2016	Cambridge University Press
2	Modern Mathematical Statistics	Dudewicz, E. J., and Mishra, S. N.	Third/1988	John Wiley & Sons
3	Nonparametric Statistical Inference	Gibbons, J. D. and Subhabrata Chakraborti	Fifth/2009	Chapman and Hall/CRC
4	Probability and Statistical Inference	Mukhopadhyay, N.	First/2000	CRC Press
5	Mathematical Statistics	Mukhopadhyay P.	Third/ 2006	Books and Allied Pvt. Ltd.

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NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

Master of Science Statistics Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme L-P-T	Total Notional Hours	Course credits
DSE	**P2S02NESTA01**	Regression Modelling	4-0-0	120	04

- **Course Learning Outcomes (CLOs)**

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

CLO1: Demonstrate understanding and apply fundamental concepts of simple and multiple linear regression models

CLO2: Analyze regression models using appropriate estimation methods and interpret model coefficients effectively.

CLO3: Evaluate regression models through diagnostic techniques and apply suitable remedial measures.

CLO4: Build generalized linear models to analyze categorical and count data using appropriate link functions, estimation methods, and inferential techniques.

CLO5: Evaluate and implement advanced generalized linear models including Poisson, Gamma, and Loglinear models for real-world data analysis and decision-making.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Fundamentals of Linear Regression Models • Simple and Multiple Linear Regression Models: Review of Linear Statistical Models, Simple Linear Regression (OLS estimation, assumptions, inference, prediction), Measures of Goodness-of-Fit (R^2, Adjusted R^2) • Diagnostic Analysis and Remedial Measures: Residual Analysis (Residual plots, Q-Q plots, scale-location), Outliers and Influence (Cook's Distance, DFFITS, DFBETAS, Hat Matrix),	CL CBL ICT EL	1 2
II	Model Building and Diagnostic Techniques in Regression • Model Building and Selection Methods: Best Subset Selection, Forward and Backward Stepwise Regression, Model Selection Criteria (AIC, BIC, Mallows' C_p) • Multicollinearity and heteroscedasticity: Detection and Remedial Measures	CL PBL ICT EL	2 3
III	Introduction to Generalise linear models • Exponential Family and Link Functions, linear predictors, IRLS method of estimation, Deviance for testing, residual analysis • Binary and categorical Models: Logistics, Multinomial, and Cumulative logit models estimation and applications	CBL MP PBL ICT EL	4
IV	Models for counts, non-normal response and non-parametric models • Discreate and rate models: Poisson Regression with count and rates, models with constant CV, models for time to event data	CL PBL CBL MP ICT EL	5

	• Non-Parametric Regression: Lass Regression, L1 Regularization, Coefficient Shrinkage • Quantile Regression: Minimizing the pinball loss, inference, and applications in heteroscedastic data		

- **Learning Pedagogies/Methods**
  (d) Classroom Lecture (CL)
  (e) Case-Based Learning (CBL)
  (f) Micro-Projects (MP)
  (g) Problem-Based Learning (PBL)
  (h) ICT-Enabled Learning through Digital Resources/ Virtual Labs/Webinars (ICT EL)
- **Assessment Methodologies**

(D) Internal Assessment

a. Internal Formative assessment (25 Marks)

v. MCQ and Objective question Quiz: Students select or give the correct answer from the list of options four /none for a given questions.

vi. Assignment: A practical task or setup questions given to measure a student's knowledge, skill and ability in subject or field.

vii. Seminar: A student-led academic activity designed to evaluate student's ability to research, understand, and present a specific topic.

viii. Group Discussion: An interactive method to asses a student's personality and inter- personal skills in team setting. It typically involves 5 to 15 participants discussing a topic for 15 to 30 minutes in presence of an observer.

b. Internal Summative Assessment (25 Marks)

i Mid-term tests
A test conducted roughly halfway through an academic term or semester.

ii. Laboratory performance
Students demonstrate their laboratory hands-on performance skills, knowledge and ability to apply concepts in subjects.

iii. Viva-voce
An oral examination conducted to evaluate a student's in-depth knowledge, understanding, and critical thinking regarding a subject or project.

(E) Weightage of Learning Efforts for External Assessment

Unit	Aligned CLOs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	1,2	30	4	5	3	12
II	2,3	30	4	5	4	13
III	4	30	4	5	4	13
IV	5	30	3	5	4	12
		120	**15**	**20**	**15**	**50**

- **Assessment and Evaluation**

Sr.No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	FA: Seminars, Assignments, Quizzes, Group Discussion	25%
		SA: Mid Term Test	25%
2	End-Semester Examination	Written Exam	50%

(F) CLOs – PLOs Matrix

CLO	PLO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO1	3	2	3	2	3	-	-	1	2	1	-	-	-	-	-
CLO2	3	3	2	3	3	-	-	2	2	1	-	-	-	-	-
CLO3	3	2	2	3	3	-	-	3	2	2	-	-	-	-	-
CLO4	3	2	2	3	3	2	-	3	3	2	-	-	-	-	-
CLO5	3	2	2	3	3	3	-	3	3	3	1	1	1	-	2

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- **Suggested Learning Materials Books:**

Sr.No.	Title	Author(s)	Edition/Year	Publisher
1	Applied Regression Analysis	Draper, N. R. and Smith, H.	Third Edition / 1998	Wiley India Ltd.
2	Regression Analysis and its Applications -A Data Oriented Approach.	Gunst, R. F. and Mason, R. L.	Third/1980	Macel and Dekker
3	Linear Statistical Inference and its Applications	Rao, C. R.	Edition II/2001	Wiley Eastern
4	Applied Linear Regression	Weisberg's	1985	Wiley Series in Probability and Statistics, Wiley
5	Introduction to Linear Regression Analysis	Montgomery, D. C., Peck, E. A and Vinning, G. G.	Edition III/ 2010	Wiley
6	Generalized linear models.	McCullagh, P.	First/1983	Chapman and Hall

- **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	Regression analysis By Prof. Soumen Maity | IISER PUNE	https://onlinecourses.nptel.ac.in/noc19_ma32/preview

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NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

Master of Science Statistics Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme L-P-T	Total Notional Hours	Course credits
DSE	**P2S02NESTA02**	Market Research	4-0-0	120	04

- **Course Learning Outcomes (CLOs)**

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

CLO1: Demonstrate comprehensive understanding of marketing research concepts, processes and their role in managerial decision-making.

CLO2: Analyze marketing research problems and apply appropriate research designs, methodologies and approaches in different business contexts.

CLO3: Apply measurement, scaling, questionnaire design, and sampling techniques for accurate and reliable primary data collection.

CLO4: Analyze and evaluate data using appropriate statistical and multivariate techniques for effective interpretation and decision-making.

CLO5: Evaluate and present structured research reports with clear interpretation, visual presentation and ethical considerations.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Fundamentals of Marketing Research and Problem Definition • Introduction to Marketing Research (MR): Definition and classification of MR, The MR process, The Role MR in Decision Making, Management Information System and Decision Support System, A case Study. • Defining MR problem and Developing an Approach: Importance of Defining MR problem, the process of defining the problem and developing an approach, Tasks involved, Environmental context of the problem-Buyers Behaviour, Legal and Economic Environment. Marketing and Technological Skills.	CL PBL ICT EL	1 2
II	Research Design in Marketing Research • Research Designs: Exploratory research design using secondary data, comparison of primary and secondary data. Advantages, uses and disadvantage of secondary data. Classification and sources of secondary data. Qualitative Research using (a) Focus Group interview (b) Depth interviews (c) Projective Techniques. • Descriptive Research Design: Descriptive research through survey and observations –Telephone Methods, Personal Methods, Mail Methods, Electronic Methods and Observational Method. Causal research – Basic experimental designs – internal and external validity of experiments.	CL PBL ICT EL CBL	2 3

III	Primary Data Collection, Measurement, Sampling Techniques and Report Writing: • Primary Data Collection, Measurement Scaling and Sampling Design: Primary Data Collection Methods Comparative and Non comparative Scaling Techniques, Questionnaire and Form Design, Sampling Designs- Probability and non-probability, Initial and Final Sample size determination. • Data Collection, Preparation, Analysis and Reporting: Field Work, Data Preparation, Review of data compilation, data presentation and data analysis	CL ICT EL PBL CBL	3 4
IV	Applications of Multivariate Techniques and Research Reporting • Applications of Multivariate Techniques: Brief Discussion on uses of multivariate techniques, multiple regression, discriminant and Logit Analysis, Factor Analysis, Cluster Analysis, Multidimensional scaling and conjoint analysis, structural equations and Path Analysis. • Report Preparation and Presentation: Structure of a Research Report, Data Interpretation and Presentation, Use of Tables, Charts, and Graphs, Report Writing Techniques, Oral Presentation Skills, Ethical Considerations in Reporting	CL CBL MP ICT EL	4 5

- **Learning Pedagogies/Methods**
  (i) Classroom Lecture (CL)
  (j) Case-Based Learning (CBL)
  (k) Micro-Projects (MP)
  (l) Problem-Based Learning (PBL)
  (m) ICT-Enabled Learning through Digital Resources/ Virtual Labs/Webinars (ICT EL)
- **Assessment Methodologies**

(G) Internal Assessment

a. Internal Formative assessment (25 Marks)

ix. MCQ and Objective question Quiz: Students select or give the correct answer from the list of options four /none for a given questions.

x. Assignment: A practical task or setup questions given to measure a student's knowledge, skill and ability in subject or field.

xi. Seminar: A student-led academic activity designed to evaluate student's ability to research, understand, and present a specific topic.

xii. Group Discussion: An interactive method to asses a student's personality and inter- personal skills in team setting. It typically involves 5 to 15 participants discussing a topic for 15 to 30 minutes in presence of an observer.

b. Internal Summative Assessment (25 marks)

iv. Mid-term tests
A test conducted roughly halfway through an academic term or semester.

v. Laboratory performance
Students demonstrate their laboratory hands-on performance skills, knowledge and ability to apply concepts in subjects.

vi. Viva-voce
An oral examination conducted to evaluate a student's in-depth knowledge, understanding, and critical thinking regarding a subject or project.

(H) Weightage of Learning Efforts for External Assessment

Unit	Aligned CLOs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	1, 2	30	4	5	3	12
II	2, 3	30	4	5	4	13
III	3, 4	30	4	5	4	13
IV	4, 5	30	3	5	4	12
		120	**15**	**20**	**15**	**50**

- **Assessment and Evaluation**

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	FA: Seminars, Assignments, Quizzes, Group Discussion	25%
		SA: Mid Term Test	25%
2	End-Semester Examination	Written Exam	50%

(I) CLOs – PLOs Matrix

CLO	PLO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO1	**2**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**
CLO2	**2**	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**-**
CLO3	**2**	**3**	**2**	**2**	**3**	**1**	**3**	**-**	**2**	**-**	**1**	**-**	**-**	**-**	**-**
CLO4	**3**	**3**	**2**	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**1**	**1**	**-**	**-**	**-**
CLO5	**2**	**2**	**1**	**-**	**2**	**-**	**-**	**-**	**2**	**3**	**3**	**2**	**-**	**1**	**1**

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- **Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Research for Marketing Decisions	Paul Green, Donald Tull, Gerald Albaurn	Fifth Edition/1988	PHI

2	Marketing Research	Rajendra Nargundkar	2003	Tata McGraw-Hill Education.
3	Marketing Research: An Applied Orientation	Malhotra Naresh K	Sixth Edition/2010	Pearson Education India.
4	Marketing Research – Measurement & Methods	Donald S. Tull, Del I. Hawkins	1990	McMillan
5	Marketing Research	Beri G. C.	Fourth Edition/ 2008	Tata McGraw Hill

- **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	Marketing Research and Analysis By Prof. J. K. Nayak | IIT Roorkee	https://onlinecourses.nptel.ac.in/noc25_mg89/preview

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NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

Master of Science Statistics Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme L-P-T	Total Notional Hours	Course credits
DSE	**P2S02NESTA03**	Stochastic Model Theory	4-0-0	120	04

- **Course Learning Outcomes (CLOs)**

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

CLO1: Identify and distinguish between discrete/continuous time and state spaces, and apply stochastic models to solve practical problems in fields such as engineering, finance, biology, and queuing theory

CLO2: Explain the Markov property, how changes in birth/death rates or drift/diffusion parameters affect system performance.

CLO3: Apply Formulate and solve problems involving Poisson processes, compound processes, and related renewal processes.

CLO4: Model population dynamics, queuing systems, telecommunication system and disease spread using birth-death processes, including determining stability.

CLO5: Derive the general diffusion processes, including drift and diffusion coefficients (Wiener and Ornstein Uhlenbeck process) of Brownian motion.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Markov Chain Modelling of Time – Indexed Events and Data • Classification of stochastic processes: Four types of stochastic processes and its applications • Markov Chains: Classification of state space, Chapman-Kolmogorov equations, calculation of n-step transition probability. Random walk model, Absorbing Markov chain, Ergodic Markov chain, Stationary distribution, various random walk models, Time reversible Markov chain, Applications in various domains.	CL PBL ICT EL	1 2 4
II	Counting Process Modelling of Time – Indexed Events and Data • Discrete Branching process: Galton-Watson branching process, probability of ultimate extinction, distribution of population size. • Discrete state space continuous time stochastic processes: Counting process, Poisson process, Generalization of Poisson process. Introduction to Renewal process	CL PBL ICT EL	1 4
III	Counting processes of Bivariate Events and Data • Birth and death process: Special cases of birth and death process such as linear population growth process, queues, simple trunk line process. • Stationary processes: weakly and strongly stationary processes. Moving average and auto regressive processes.	CL PBL ICT EL	3 4

IV	Diffusion Processes Modelling of • Continuous time and continuous state space Brownian Motion Processes: Kolmogorov-Feller differential equations, Infinitesimal conditional mean and variance • Two Special Diffusion Processes: Wiener Process and Ornstein-Uhlenbeck Process Modelling and applications. First passage time and other problems	CL CBL ICT EL	3 4 5

- **Learning Pedagogies/Methods**
  (n) Classroom Lecture (CL)
  (o) Case-Based Learning (CBL)
  (p) Problem-Based Learning (PBL)
  (q) ICT-Enabled Learning through Digital Resources/ Virtual Labs/Webinars (ICT EL)

- **Assessment Methodologies**

(J) Internal Assessment

a. Internal Formative assessment

xiii. MCQ and Objective question Quiz: Students select or give the correct answer from the list of options four /none for a given questions.

xiv. Assignment: A practical task or setup questions given to measure a student's knowledge, skill and ability in subject or field.

xv. Seminar: A student-led academic activity designed to evaluate student's ability to research, understand, and present a specific topic.

xvi. Group Discussion: An interactive method to asses a student's personality and inter- personal skills in team setting. It typically involves 5 to 15 participants discussing a topic for 15 to 30 minutes in presence of an observer.

b. Internal Summative Assessment

vii. Mid-term tests
A test conducted roughly halfway through an academic term or semester.

viii. Laboratory performance
Students demonstrate their laboratory hands-on performance skills, knowledge and ability to apply concepts in subjects.

ix. Viva-voce
An oral examination conducted to evaluate a student's in-depth knowledge, understanding, and critical thinking regarding a subject or project.

(K) Weightage of Learning Efforts for External Assessment

Unit	Aligned CLOs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	1, 2, 4	30	4	5	3	12
II	1, 2, 5	30	4	5	4	13
III	1, 3, 4	30	4	5	4	13
IV	1, 2, 5	30	3	5	4	12
		120	**15**	**20**	**15**	**50**

Master of Science Statistics Semester-II

- **Assessment and Evaluation**

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	FA: Seminars, Assignments, Quizzes, Group Discussion	25
		SA: Mid Term Test	25
2	End-Semester Examination	Written Exam	50

(L) CLOs – PLOs Matrix

CLO	PLO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO1	-	-	3	2	1	1	1	2	1	1	-	-	2	3	1
CLO2	1	-	-	2	1	-	-	1	1	-	1	-	2	3	-
CLO3	1	-	2	-	1	1	-	1	-	3	-	-	2	3	-
CLO4	-	-	1	2	1	1	-	2	1	-	1	-	2	3	-
CLO5	1	1	2	3	1	3	2	2	1	-	1	-	2	3	-

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- **Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Stochastic Processes	J. Medhi	Third/2009	Wiley Estern Ltd.
2	Stochastic Models, Analysis and Applications	Bhat, B. R.	Third/2004	New Age International (P) Ltd, India
3	Introduction to Stochastic Processes	A. K. Basu	First/2003	Narosa Publishing House
4	An Introduction to Stochastic Processes with Applications to Biology	Linda, J. S. Allen	First/2011	CRC Press
5	Modeling and Analysis of Stochastic Systems	V. G. Kulkarni	Third/2015	CRC Press

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Master of Science Statistics Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme L-P-T	Total Notional Hours	Course credits
DSE	**P2S02NESTA04**	Sample Survey Techniques	4-0-0	120	04

- **Course Learning Outcomes (CLOs)**

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

CLO1: **Analyze** the fundamental principles of sample surveys and estimation procedures based on probability sampling methods.

CLO2: **Apply** varying probability sampling techniques including PPS sampling and related estimators such as Horvitz-Thompson and other PPS schemes.

CLO3: **Demonstrate** the use of auxiliary information in estimation using ratio, product, difference and regression methods and examine their properties.

CLO4: **Evaluate** cluster sampling and two-stage sampling designs including determination of optimum sample and cluster sizes.

CLO5: **Analyze and evaluate** two-phase sampling methods, non-sampling errors and randomized response techniques for sensitive survey data.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Principles of Sample Surveys and Probability Sampling Methods • General principles of sample surveys: Basic ideas in estimation from probability sampling. • Varying probability sampling: PPS sampling with replacement and without replacement, Horvitz-Thompson estimator, Random group method, PPS systematic sampling, Midzuno-sen sampling, Lahiri's sampling scheme.	CL PBL ICT EL CBL	1 2
II	Auxiliary Information in Survey Sampling and Estimation Methods • Use of Auxiliary Information in Estimation: Use of univariate and multivariate auxiliary information for estimation • Methods of Estimation Using Auxiliary Information: Ratio, Product, Difference and Regression methods of estimation with their properties. Unbiased and almost unbiased ratio estimators.	CL PBL ICT EL MP	3
III	Cluster Sampling and Two-Stage Sampling Techniques • Cluster Sampling: Cluster sampling with equal and unequal cluster sizes, optimum values of sample size and cluster size, PPS estimation for cluster sampling, cluster sampling for estimation of population proportion. • Two Stage Sampling: Two-stage sampling with equal and unequal first stage units. Optimum values of sample size and subsamples size. SRSWOR (SRSWR) used at both stages.	PBL CL CBL MP	4

IV	Two-Phase Sampling, Non-Sampling Errors and Randomized Response Techniques • Two-Phase Sampling and Estimation Methods: Two-phase (Double) sampling for PPS estimation, ratio and regression estimators and stratified sampling. • Non-Sampling Errors and Randomized Response Techniques: Non-sampling errors, response and non-response errors and their treatments, randomized response techniques: Warner model, unrelated question model for sensitive survey questions.	CL CBL ICTEL PBL	5

Learning Pedagogies/Methods

(r) Classroom Lecture (CL)
(s) Case-Based Learning (CBL)
(t) Micro-Projects (MP)
(u) Problem-Based Learning (PBL)
(v) ICT-Enabled Learning through Digital Resources/ Virtual Labs/Webinars (ICT EL)

- **Assessment Methodologies**

(M) Internal Assessment

a. Internal Formative assessment (25 Marks)

xvii. **MCQ and Objective question Quiz:** Students select or give the correct answer from the list of options four /none for a given questions.

xviii. **Assignment:** A practical task or setup questions given to measure a student's knowledge, skill and ability in subject or field.

xix. **Seminar:** A student-led academic activity designed to evaluate student's ability to research, understand, and present a specific topic.

xx. **Group Discussion:** An interactive method to asses a student's personality and inter- personal skills in team setting. It typically involves 5 to 15 participants discussing a topic for 15 to 30 minutes in presence of an observer.

b. Internal Summative Assessment (25 Marks)

i. Mid-term tests
A test conducted roughly halfway through an academic term or semester.

ii. Laboratory performance
Students demonstrate their laboratory hands-on performance skills, knowledge and ability to apply concepts in subjects.

iii. Viva-voce
An oral examination conducted to evaluate a student's in-depth knowledge, understanding, and critical thinking regarding a subject or project.

(N) Weightage of Learning Efforts for External Assessment

Unit	Aligned CLOs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	1, 2	30	4	5	3	12
II	3	30	4	5	4	13
III	4	30	4	5	4	13
IV	5	30	3	5	4	12
		120	**15**	**20**	**15**	**50**

- **Assessment and Evaluation**

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	FA: Seminars, Assignments, Quizzes, Group Discussion	25%
		SA: Mid Term Test	25%
2	End-Semester Examination	Written Exam	50%

(O) CLOs – PLOs Matrix

CLO	PLO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO1	**3**	**2**	**3**	**2**	**2**	**-**	**3**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**-**
CLO2	**3**	**3**	**3**	**2**	**2**	**-**	**3**	**-**	**2**	**1**	**1**	**-**	**-**	**-**	**-**
CLO3	**3**	**2**	**3**	**3**	**3**	**-**	**2**	**1**	**2**	**1**	**1**	**-**	**-**	**-**	**-**
CLO4	**3**	**3**	**3**	**2**	**3**	**-**	**3**	**-**	**2**	**1**	**1**	**-**	**-**	**-**	**-**
CLO5	**3**	**2**	**3**	**3**	**3**	**-**	**2**	**1**	**2**	**2**	**2**	**1**	**-**	**-**	**-**

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- **Suggested Learning Materials Books:**

Sr.No.	Title	Author(s)	Edition/Year	Publisher
1	Theory and Methods of Survey Sampling	Mukhopadhyay, P.	2nd Edition/2008	PHI
2	Sampling Techniques	Cochran, W.G.	Third Edition/2007	Wiley
3	Sampling Theory and Methods	Murthy, M.N.	First/1967	Statistical Publishing Society in Calcutta, India

4	Sampling Theory of Surveys with Applications	Sukhatme P.V, Sukhatme, B.V., Sukhatme S. and Ashok C.	3rd Edition/1984	Indian Soc. for Agricultural Statistics, New Delhi
5	Advanced Sampling Theory with Applications: How Michael 'selected' Amy, Vol. 1 & 2	Singh S.	2003	Springer

- **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	Shalabh, Indian Institute of Technology, Kanpur	https://home.iitk.ac.in/~shalab/course1.htm

Master of Science Statistics Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	**P2S02NCSTA02**	Practical (RM, SM) through Python	0-4-0	120	04

- **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:
CLO1: Develop proficiency in modeling big and small data from various fields.
CLO2: Write models' interpretation and report in user friendly terminology.
CLO3: Perform diagnostic tests and make decisions about section of model.
CLO4: Apply Stochastics Theory to produce Stochastic models.
CLO5: Competency to handle biostatistics and finance data.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Practice of Regression Modelling • Simple Linear Regression Analysis • Multiple Linear Regression Analysis • Residual Analysis in Regression Models • Goodness of Fit Tests and Model Evaluation	CL CBL	1 2 3 5
II	Practice of Generalised Regression Modelling • Logistics Regression • Multinomial Regression • Cumulative logit Regression • Poisson Regression: Modeling Count Data • Lasso and Quantile Regression	CL CBL	1 2 3 5
III	Practice of Stochastic Models • Markov chain modelling • Homogeneous Poisson Process Modelling • Compound Poisson Process Modelling	CL CBL	4 5
IV	Practice of Advanced Stochastic Models • Non-Homogeneous Poisson Process Modelling • Wiener Process Modelling • Ornstein-Uhlenbeck Process Modelling	CL CBL	4 5

- **Learning Pedagogies/Methods**
  (w) Classroom Lecture (CL)
  (x) Case-Based Learning (CBL)
- **Assessment Methodologies**
  (P) Internal Assessment
    a. Internal Formative assessment
      i. Group Discussion: An interactive method to asses a student's personality and inter- personal skills in team setting. It typically involves 5 to 15 participants discussing a topic for 15 to 30 minutes in presence of an observer.

b. Internal Summative Assessment

x. Mid-term tests
A test conducted roughly halfway through an academic term or semester.

xi. Laboratory performance
Students demonstrate their laboratory hands-on performance skills, knowledge and ability to apply concepts in subjects.

(Q) Weightage of Learning Efforts for External Assessment

Unit	Aligned CLOs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	1,2, 3, 5	30	1	5	6	12
II	1,2, 3, 5	30	1	5	6	13
III	4, 5	30	1	5	6	13
IV	4, 5	30	1	5	6	12
		120	**4**	**20**	**24**	**50**

- **Assessment and Evaluation**

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	FA: Seminars, Assignments, Quizzes, Group Discussion	25%
		SA: Mid Term Test	25%
2	End-Semester Examination	Written Exam	50%

(R) CLOs – PLOs Matrix

CLO	PLO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO1	**1**	**-**	**3**	**-**	**3**	**2**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**2**	**1**
CLO2	**1**	**-**	**3**	**-**	**3**	**2**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**2**	**1**
CLO3	**1**	**-**	**3**	**3**	**3**	**2**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**2**	**1**
CLO4	**1**	**-**	**3**	**-**	**3**	**2**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**2**	**1**
CLO5	**1**	**-**	**3**	**-**	**3**	**2**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**2**	**1**

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- **Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Introduction to Stochastics Process	A.K. Basu	First/2003	Narosa Publishing House
2.	Stochastics Models: Analysis and Applications	B.R. Bhat	First/2000	New Age International Publishers
3	Introduction to Linear Regression Analysis	Montgomery, D. C., Peck, E. A and Vinning, G. G.	Edition III/ 2010	Wiley
4	Generalized linear models.	McCullagh, P.	First/1983	Chapman and Hall

Master of Science Statistics Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	**P2S02NCSTA03**	Practical (SS, MR) through R and Excel	0-4-0	120	04

- **Course Learning Outcomes (CLOs)**

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

CLO1: Design and implement survey sampling methods and perform corresponding estimation procedures.

CLO2: Compute and interpret ratio and regression estimators, and evaluate their efficiency in practical survey data contexts.

CLO3: Build and analyze logistic, multinomial, ordinal, and cumulative logit regression models for categorical data and interpret the results meaningfully.

CLO4: Simulate Likert-scale data, assess reliability using Cronbach's Alpha, visualize item responses, and determine appropriate sample sizes using relevant R packages.

CLO5: Design questionnaires with validation features, perform descriptive statistical analysis, create visual summaries such as radar charts, and estimate sample sizes using Excel functions.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Practice of Survey Sampling • Simple Random Sampling: Methodology and Estimation • Stratified Random Sampling: Design and Analysis • Probability Proportional to Size (PPS) Sampling with Replacement • Probability Proportional to Size (PPS) Sampling without Replacement • Ratio Method of Estimation in Sample Surveys • Regression Method of Estimation in Sample Surveys • Two-Stage Sampling: Design and Estimation Procedures	CL CBL	1 2
II	Practice of Generalised Regression Modelling • Logistics Regression • Multinomial Regression • Ordinal Regression • Cumulative logit Regression	CL CBL	3
III	Practice of Questionnaire Design and analysis using R • Simulate Likert-scale data (5-point) for 100 respondents • Compute Cronbach's Alpha with psych::alpha() • Generate reliability analysis output • Plot item-response distributions with ggplot2 • Determine sample size using pwr package	CL CBL	4
IV	Practice of Questionnaire Design and analysis using Excel • Build a questionnaire with Likert scale columns	CL CBL	5

	• Use Data Validation for drop-down scale options • Calculate mean, SD, and variance per item • Create spider/radar chart for scale comparisons • Use NORM.INV to compute sample size estimate		

- **Learning Pedagogies/Methods**
  (y) Classroom Lecture (CL)
  (z) Case-Based Learning (CBL)

- **Assessment Methodologies**

(S) Internal Assessment

a. Internal Formative assessment

xxi. Group Discussion: An interactive method to asses a student's personality and inter- personal skills in team setting. It typically involves 5 to 15 participants discussing a topic for 15 to 30 minutes in presence of an observer.

b. Internal Summative Assessment

xii. Mid-term tests
A test conducted roughly halfway through an academic term or semester.

xiii. Laboratory performance
Students demonstrate their laboratory hands-on performance skills, knowledge and ability to apply concepts in subjects.

(T) Weightage of Learning Efforts for External Assessment

Unit	Aligned CLOs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	1,2	30	1	5	6	12
II	3	30	1	5	6	13
III	4	30	1	5	6	13
IV	5	30	1	5	6	12
		120	**4**	**20**	**24**	**50**

- **Assessment and Evaluation**

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	FA: Seminars, Assignments, Quizzes, Group Discussion	25%
		SA: Mid Term Test	25%
2	End-Semester Examination	Written Exam	50%

Master of Science Statistics Semester-II

(U) CLOs – PLOs Matrix

CLO	PLO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO1	1	-	3	-	2	-	3	-	3	-	-	-	-	2	1
CLO2	1	-	3	-	2	-	3	-	3	-	-	-	-	2	1
CLO3	1	-	3	-	2	-	3	-	3	-	-	-	-	2	1
CLO4	1	-	3	-	2	-	3	-	3	-	3	2	3	2	1
CLO5	1	-	3	-	2	-	3	-	3	-	3	2	3	2	1

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- **Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Marketing Research	Rajendra Nargundkar	2003	Tata McGraw-Hill Education.
2	Marketing Research: An Applied Orientation	Malhotra Naresh K	Sixth Edition/2010	Pearson Education India.
3	Sampling Theory of Surveys with Applications	Sukhatme P.V, Sukhatme, B.V., Sukhatme S. and Ashok C.	3rd Edition/1984	Indian Soc. for Agricultural Statistics, New Delhi

Master of Science Statistics Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	**P2S02NCSTA04**	Lean Six Sigma Tools	0-2-0	60	02

- **Course Learning Outcomes (CLOs)**

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

CLO1: Create SIPOC (Supplier, Input, Process, Output, Customer) diagrams and Process Flowcharts to visualize and improve workflow efficiency.

CLO2: Apply techniques such as Fishbone Diagrams (Ishikawa), 5 Whys, and Failure Mode and Effects Analysis (FMEA) to identify the true source of problems.

CLO3: Ability to identify and eliminate the "8 Wastes" (TIMWOODS) using tools like 5S, Kanban, Value Stream Mapping (VSM), and Poka-Yoke.

CLO4: Utilize statistical tools (e.g., Minitab, SPC charts, Regression) to analyze data, measure process capability, and reduce defects.

CLO5: Proficiency in navigating Define, Measure, Analyze, Improve, and Control phases to execute process improvement projects.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Overview of Lean and Six Sigma Principles • Introduction of Methodologies: SCORE, DMAIC, DMADV. • Lean Philosophy and Wastes (Muda): Eight wastes of lean, flow thinking, and pull-based production. • Value Stream Mapping (VSM): Current and future state maps, cycle time, lead time, and takt.	CBL ICT EL	1 2 3
II	Six Sigma Roles and Responsibilities • Kaizen and 5S Methodology: Sort, set in order, shine, standardise, sustain — practical implementation.5S, Gemba walk. • Just-in-Time and Kanban Systems: Pull production, kanban signals, and WIP limits. • DMAIC Tools: Tools used in Define-Measure-Analyze-Improve/Design-Control Phase.	CBL ICT EL MP	1 2 3 4 5

- **Learning Pedagogies/Methods**
  - (aa) Case-Based Learning (CBL)
  - (bb) Micro-Projects (MP)
  - (cc) ICT-Enabled Learning through Digital Resources/ Virtual Labs/Webinars (ICT EL)

- **Assessment Methodologies**

(V) Internal Assessment

a. Internal Formative assessment (15 Marks)

xxii. MCQ and Objective question Quiz: Students select or give the correct answer from the list of options four /none for a given question.

xxiii. Seminar: A student-led academic activity designed to evaluate student's ability to research, understand, and present a specific topic.

xxiv. Group Discussion: An interactive method to asses a student's personality and inter- personal skills in team setting. It typically involves 5 to 15 participants discussing a topic for 15 to 30 minutes in presence of an observer.

b. Internal Summative Assessment (10 Marks)

xiv. Mid-term tests
A test conducted roughly halfway through an academic term or semester.

xv. Laboratory performance
Students demonstrate their laboratory hands-on performance skills, knowledge and ability to apply concepts in subjects.

(W) Weightage of Learning Efforts for External Assessment

Unit	Aligned CLOs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	1, 2, 3	30	4	5	6	15
II	1- 5	30	8	11	16	10
		60	**12**	**16**	**22**	**25**

- **Assessment and Evaluation**

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	FA: Quizzes, Group Discussion	15
		SA: Mid Term Test	10

(X) CLOs – PLOs Matrix

CLO	PLO														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO1	-	-	1	1	1	1	-	-	-	-	2	2	3	-	1
CLO2	1	1	1	-	2	-	-	-	-	-	1	1	2	-	1
CLO3	1	-	-	-	1	3	-	2	-	3	-	-	2	3	-
CLO4	-	-	1	-	1	1	-	-	3	-	1	-	2	3	-
CLO5	1	1	1	-	1	-	2	-	3	1	1	2	2	-	3

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- **Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Introduction to Statistical Quality Control	Montgomery, D. C.	Eighth/2019	Wiley
2	The Six Sigma Handbook	Pyzdek, T., & Keller, P.	Fifth/2018	McGraw-Hill
3	Lean Six Sigma: Combining Six Sigma Quality with Lean Production Speed	George, M. L.	First/2002	McGraw-Hill

- **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	ASQ Six Sigma Body of Knowledge	https://asq.org