

DEPARTMENT OF STATISTICS
SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR



SYLLABUS EFFECTIVE FROM: 2017-18
MASTER OF SCIENCE (STATISTICS)

M. Sc (Statistics) SECOND SEMESTER

CODE AND SUBJECT	Credit	Number of Hours of Teaching	Nature of the Course
PS02CSTA21 Stochastic Processes	4	4	C
PS02CSTA22 Linear Models and Regression Analysis.	4	4	C
PS02CSTA23 Statistical Inference II	4	4	C
PS02CSTA24 Theory of Sample Surveys	4	4	C
PS02ESTA21 Official Statistics	4	4	EL
PS02ESTA22 Operations Research	4	4	EL
PS02CSTA25 Practicals	4	6	P
PS02CSTA26 Viva-Voce	1	4	CVV

PS02CSTA21: STOCHASTIC PROCESSES

UNIT 1	Introduction to Stochastic Processes: Classification of stochastic processes, Chapman-Kolmogorov equations, calculation of n-step transition probability, classification of states. Absorbing Markov chain, Ergodic Markov chain, Stationary distribution, various random walk models, Time reversible Markov chain, Applications from social, biological and physical sciences.	12L
UNIT 2	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	12L
UNIT 3	Birth and death process: Special cases of birth and death process such as queues, simple trunk line process. Stationary processes: weakly and strongly stationary processes. Moving average and auto regressive processes.	12L
UNIT 4	Continuous time and continuous state space Markov process: Kolmogorov-Feller differential equations, Diffusion processes with Wiener process and Ornstein-Uhlenbeck process as particular cases. First passage time and other problems	12L

Books Recommended:

1. Adke, S.R. and Manjunath, S.M. (1984). An Introduction to Finite Markov Processes. Wiley Eastern.
2. Bhat, B.R. (2000) Stochastic Models: Analysis and Applications. New Age International Publications, New Delhi.
3. Feller, W. (1971). An Introduction to Probability Theory and its applications. Vol II.
4. Karlin, S. and Taylor, H.M. (1975). A first course in Stochastic Processes, Vol.1, Academic Press.
5. Prakash Rao, B.L.S. and Bhat, B.R. (1996). Stochastic Processes and Statistical Inference, New Age International Publications, New Delhi.
6. Ross, S.M. (1983). Stochastic Processes, Wiley.
7. V.G. Kulkarni (2015). Modeling and Analysis of Stochastic Systems, CRC Press (Indian Ed.)
8. J. Medhi (1994). Introduction to Stochastic Processes. Second ed. New Age International
9. A.K. Basu (2002). Introduction to Stochastic Processes. Alpha Science International Ltd.

PS02CSTA22: LINEAR MODELS AND REGRESSION ANALYSIS

UNIT 1	Introduction of models based on nature of data; preliminary of matrix algebra; need of estimation of linear parametric functions; Gauss-Markov set-up, Normal Equations and Least Square Estimates, Error and estimation spaces, variances and covariance of least square estimates, estimation of error variance, distribution of sum of square due to regressors, errors estimation with correlated observations, least square with correlated observations, least square estimates with (a) restriction on parameters (b) specification error, simultaneous estimates of linear parametric functions.	12L
UNIT 2	Tests of hypotheses for one and more than one linear parametric functions, confidence intervals and regions, Analysis of Variance, Power of F-test, Multiple comparison tests due to Tukey and Scheffe, simultaneous estimates of linear parametric functions.	12L
UNIT 3	Introduction to one-way random effects linear models and estimation variance components. Simple linear Regression, multiple regressions, fit of polynomials and use of orthogonal polynomials.	12L
UNIT 4	Residual and their plots as test for departure from assumptions such as fitness of the model, normality, homogeneity of variances and detection of outliers, Remedies. Multicollinearity, Ridge regression and principle component regression, subset selection of explanatory variables, Mallows's C_p Statistic. Introduction to non-linear models.	12L

Books Recommended:

1. Weisberg, S.(2005). Residual and Influence in Regression. Wiley Series in Probability and Statistics, Wiley
2. Draper, N.R. and Smith, H.(1998).Applied Regression Analysis. Third Edition, Wiley India Ltd.
3. Gunst,R.F. and Mason, R.L.(1980). Regression Analysis and its Applications –A Data Oriented Approach. Macel and Dekker.
4. Rao, C.R. (2001) Linear Statistical Inference and its Applications. Ed. II, Wiley Eastern.
5. Weisberg's.(1985). Applied Linear Regression. Wiley Series in Probability and Statistics, Wiley

6. Gujarathi, D.N. and Sangeetha (2007). Basic Econometrics, Ed. IV , Tata MacGraw Hill
7. Montgomery, D.C., Peck, E.A and Vinning, G.G. (2010). Introduction to Linear Regression Analysis, Ed.III, Wiley
8. Freund, J. R, Wilson, W.J, and Sa, P. (2006). Regression Analysis: Statistical Modeling of Response Variable, Ed.II, Academic Press
9. Kshirsagar, A.(1983). A Course in Linear Models, Statistics : Textbook and Monographs, Vol. 45, Marcel Dekker, Inc.
10. Hey-Jahans, C.(2012) .An R Companion to Linear Statistical Models ,CRC Press

PS02CSTA23: STATISTICAL INFERENCE II

- UNIT 1 Randomized test, randomized version of Neyman-Pearson lemma and its generalization. Uniformly most powerful tests for one sided alternative for one parameter exponential class of densities and extension to the distributions having monotone likelihood ratio property. **12L**
- UNIT 2 Unbiased tests, its applications to one-parameter exponential family of distribution, Similar tests, UMP similar tests, test with Neyman structure, UMP unbiased tests for parameters of normal distribution, Confidence bounds: Neyman's principal of confidence bounds, uniformly most accurate and uniformly most accurate unbiased confidence bounds. **12L**
- UNIT 3 Likelihood Ratio Test (LRT), large sample properties: consistency of tests, asymptotic distribution of LRT, Chi-square goodness of fit test. **12L**
- Sequential Probability Ratio Test (SPRT), properties of SPRT, the fundamental identity of SPRT and its use in derivation of OC and ASN functions.
- UNIT 4 U-statistics, properties and asymptotic distributions (in one and two samples cases). One sample problem : Kolmogorov-Smiirnov test, Location problem. Wilcoxon signed-rank test. Two sample problem: Wilcoxon-Mann-Whitney test. **12L**

Books Recommended:

1. Kale, B.K. (1999) A First Course on Parametric Inference (Narosa)
2. Dudewicz, E. J. and Mishra, S.N.(1988) Modern Mathematical Statistics
3. Ferguson, T. S. (1967): Mathematical statistics (A decision theoretic approach), Academic Press.
4. Kendall, M. G. and Stuart, A. (1979) : The Advanced Theory of Statistics, Vol. 2, (IV edition), Griffin, London.
5. Lehmann, E. L. (1986) Testing of Statistical hypothesis (John Wiley)
6. Rohatgi, V. K. (1976) Introduction to theory of probability and Mathematical Statistics
7. Sahu, P. K., Pal, S.R. and Das, A. K. (2015) Estimation and Inferential Statistics, Springer India
8. Gibbons, J. D. and Chakraborti, S. (2003) Nonparametric statistical Inference (Third Edition) Marcel Dekker, New York, 4th Edition
9. Mood, A. M., Graybill, F. A. and Boes, D. C. (1974). Introduction to the Theory of Statistics, McGraw-Hill

PS02CSTA24: THEORY OF SAMPLE SURVEYS

UNIT 1	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	12L
UNIT 2	Use of univariate and multivariate auxiliary information for estimation: Ratio, Product, Difference and Regression methods of estimation with their properties. Unbiased and almost unbiased ratio estimators.	12L
UNIT 3	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 with equal and unequal first stage units. Optimum values of sample size and sub-sample size. SRSWOR (SRSWR) used at both stages.	12L
UNIT 4	Double sampling for PPS estimation, ratio and regression estimators and for stratification. Non-sampling errors, response and non-response errors and their treatments, randomized response techniques.	12L

Books Recommended:

1. Cochran, W.G. (2007) Sampling Techniques, 3rd Edition, (Wiley)
2. DesRaj and Chandhok, P. (1998) Sample Survey Theory (Narosa)
3. Mukhopadhyay, P. (2008). Theory and Methods of Survey Sampling, 2nd Edition, PHI
4. Murthy, M.N.(1967) Sampling Theory and Methods
5. Sampath, S. (2001). Sampling Theory and Method, Narosa Publishing House
5. Singh S. (2003). Advanced Sampling Theory with Applications: How Michael 'selected' Amy, Vol. 1 & 2, Springer
6. Sukhatme P.V, Sukhatme, B.V., Sukhatme S. and Asok C. (1984) Sampling Theory of Surveys with Applications (Indian Soc. for Agricultural Statistics, New Delhi).

PS02ESTA21: OFFICIAL STATISTICS

- Unit 1** Introduction to Indian and International statistical systems. Role, function and activities of Central and State statistical organizations. Organization of large scale sample surveys. Role of National Sample Survey Organization. General and special data dissemination systems. **12L`**
- Unit 2** Population growth in developed and developing countries, evaluation of performance of family welfare programmes, projections of labour force and manpower. Scope and content of population census of India. **12L**
- Unit 3** System of collection of Agricultural Statistics. Crop forecasting and estimation, productivity, fragmentation of holdings, support prices, buffer stocks, impact of irrigation projects. **12L**
- Unit 4** Statistics related to industries, foreign trade, balance of payment, cost of living, inflation, educational and other social statistics. **12L**

Books Recommended:

- 1 Basic Statistics Relating to the Indian Economy (CSO) 1990.
- 2 Guide to Official Statistics (CSO) 1999.
- 3 Statistical System in India (CSO) 1995.
- 4 Principles and accommodation of National Population Censuses, UNESCO
- 5 Panse, V. G., Estimation of Crop Yields (FAO)
- 6 Family Welfare Yearbook. Annual Publication of D/o Family Welfare
- 7 Monthly Statistics of Foreign Trade in India, DGCIS, Calcutta and other Govt. Publications

PS02ESTA22: OPERATIONS RESEARCH

UNIT 1	Linear Programming: Convex sets, supporting and separating hyperplanes, standard linear programming problem, basic feasible solutions, simplex algorithm and simplex method, geometry of simplex method. Duality in linear programming, duality theorems,	12L
UNIT 2	Dual simplex method with justification, post optimality analysis, sensitivity analysis and parametric linear programming. Integer Linear Programming: Introduction, Gomory Cut Method, Branch and Bound Method.	12L
UNIT 3	Network Analysis: Definition and formulation, critical path method, Project Evaluation and Review Technique(PERT), Optimal allocation of resources (men-power) through time schedule.	12L
UNIT 4	Queueing Theory: Introduction, steady state solution of M/M/c/∞/FIFO and M/M/C/N/FIFO with associated distributions of queue length and waiting time.(c=1 as particular case).	12L

Non-linear Programming: Quadratic Programming, Kuhn-Tucker Conditions.

Books Recommended:

1. Hadley,G. (1961).linear Programming. Addison-Wesley.
2. Hiller,F.S. and Liberman, G.J.(1995).Introduction to Operations Research. (6th Edition)Mcgraw-Hill Int.Ed.
3. Hiller,F.S. and Liberman, G.J.(1995).Introduction to Mathematical Programming(2nd Edition)McGraw Hill Int. Ed.
4. Murty,K.G.(1983).Linear Programming (2nd Edition)John-Wiley.
5. Taha, H.A.(1997).Operations Research(6th Edition) Prentice-Hall India Ltd.
6. Ravindran,A. Phillips, D.T., Solberge, J.J.(1987).Operations Research(2nd Edition) John-Wiley.