SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR

SYLLABUS EFFECTIVE FROM: 2018-19
(પીજી બોર્ડ તા. ૦૩/૦૫/૨૦૧૭)
MASTER OF SCIENCE (STATISTICS)
SEMESTER – IV

CODE AND SUBJECT		Credit	Number of Hours of Teaching	Nature of the Courrse
PS04CSTA21	Computer Oriented Statistical Methods	4	4	C
PS04CSTA22	Statistical Quality Control Techniques	4	4	C
Financial Statistics				
PS04ESTA21	Econometrics	4	4	EL
PS04ESTA22	Actuarial Statistics	4	4	EL
Biostatistics				
PS04ESTA23	Bioassays	4	4	EL
PS04ESTA24	Clinical Trials	4	4	EL
PS04CSTA23	Practicals	4	6	P
PS04CSTA24	Project	4	6	PR
PS04CSTA25	Viva-Voce	1	2	CVV

PS04CSTA21: COMPUTER ORIENTED STATISTICAL METHODS

Unit 1 **Generation of random numbers from** UNIFORM, BINOMOIAL, POISSON, EXPONENTIAL, WEIBULL, NORMAL, GAMMA, t, F, MULTIVARIATE NORMAL DISTRIBUTION and different Stochastic Processes using pseudo random number generation algorithms like linear congruential method (LCG), Inverse method, rejection method etc.   **12 L**

Unit 2 **Simulation Principles:** Rejection method; variance reduction; importance sampling. **Simulation** of probability distribution of different statistics using Monte Carlo and similar techniques. Estimation of Bias, MSE and other statistics using bootstrap and similar techniques. **MCMC algorithms:** Metropolis-Hastings algorithm; Gibbs sampling   **12L**

Unit 3 **Logistic Regression Models**: Introduction; The multiple logistic regression model; Fitting the logistic regression model; testing for the significance of the model. Application of logistic regression in study of Matched case control data.   **12L**

Cox's regression model: Proportional Hazard Model. Estimation and tests of parameters of the proportional hazard model. Use of this in comparison of two more life distributions.

Discriminate Analysis

Unit 4 **Multivariate techniques**: (i) Principal component analysis (ii) Factor Analysis (iii) Canonical Correlation (iv) Cluster Analysis.   **12L**

Books Recommended:

1   Fishman, G.S. (1996) Monte Carlo: Concepts, Algorithms, and Applications.(Springer).

2   Rubinstein, R.Y. (1981); Simulation and the Monte Carlo Method. (Wiley).

3   Tanner, M.A. (1996); Tools for Statistical Inference, Third edition. (Springer.)

4   Efron, B. and Tibshirani. R.J. (1993); An Introduction to the Bootstrap. (Chapman and Hall).

5   Shao J. and Tu, D. (1995); The Jackknife and the Bootstrap. Springer Verlag.

6   McLachlan, G.J. and Krishnan, T. (1997) The EM Algorithms and Extensions.(Wiley.)

7   Simonoff J.S. (1996) Smoothing Methods in Statistics. (Springer).

8   William J., Kennedy, Jr. James E. Gentle (1980). Statistical Computing. Marcel Decker

9   J.S. Liu (2001). Monte Carlo Strategies in Scientific Computing, Springer,

Kshirsagar**,** A. M. (1972). Multivariate Analysis, Marcel Dekker, NY

10

PS04CSTA22: STATISTICAL QUALITY CONTROL TECHNIQUES

Unit 1 Basic Concepts of quality control**.** Process control and process capability. Relation between theory of testing hypotheses and charts. choice of control limits, rational subgroup principle, allocating sampling effort, average run length. Purpose of capability Indices. Determining the process capability using, $\bar{X} - R$, $\bar{X} - S$ charts. The role of normality in determining defective parts per million. One sided specification, non-normal distributions.   **12 L**

Unit 2 Process capability analysis: potential capability, actual capability, definitive analysis. Testing of potential capability, confidence interval of potential capability and actual capability. Gage and measurement system capability study. Setting specification limits on discret components (linear and non linear combination). Estimation of natural tolerance limit of a process.   **12L**

Unit 3 CUSUM charts, EWMA chart –Use of these charts for prediction. CUSUM, EWMA for controlling process variability. Comparison of these charts with Shewart charts. Acceptance control charts Acceptance sampling plan, chain sampling, continuous sampling plans, Skip –lot sampling plans. Fundamental of experimental design, one factor, two factor, blocking. Concept of interaction.   **12L**

Unit 4 Process Design and Iimprovement with designed experiments. Use of Design of 2^k-factorial design with k≥1. 2^{k-p} fractional factorial design in SPC. Taguchi's contribution to Quality Engineering. Elements and principle of quality engineering. Steps in robust design; signal to noise ratio.   **12L**

Books Recommended:

1. Montgomery, D. C. (1985) Introduction to Statistical Quality Control.(Wiley)

2. Montgomery, D.C. (1985) Design and Analysis of Experiments; Wiley

3. Rayon,T.P(1989) Statistical Methods for quality improvement.John Wiley and sons

4. Ott, E.R. (1975) Process Quality Control; McGraw Hill

5. Wetherill, G.B. (1977) Sampling Inspection and Quality Control; Halsted Press.

6. Wetherill, G.B. and Brown, D.W. (1991) Statistical Process Control, Theory and Practice; Chapman and Hall

7. Phadke, M.S. (1989) Quality Engineering through Robust Design; Prentice Hall

PS04ESTA21: ECONOMETRICS

6 Econometrics: Definition, Methodology, Examples, Nature and Source of Data, Classical Linear Regression Model (CLRM): Assumptions, estimation of parameters through Maximum Likelihood Method and Ordinary Least Square Method, Properties of Estimator, Model Selection Criterion; RSquare, Adjusted RSquare, Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC) Mallow's C_p Criterion, Forecast Chi-Square, Significance Test and Confidence Interval, Testing of Subset of Regressors, Point Predictor, Cobb-Douglas Production function, Constraint Least Square, Dummy Variable: Nature, introduction, examples, Chow Test, Seasonal Adjustment **12 L**

Unit 2 Hetroscedasticity: Reason of Hetroscedasticity; Detection: Informal Method, Formal Test; Park Test, Goldfield-Quant Test, White General Hetroscedasticity Test, The Breusch-Pagan Test; Remedial Measures, OLS Assumptions in presence of Hetroscedasticity; Method of Generalized Least Squares (GLS), Consequences of using OLS in presence of Hetroscedasticity; **12L**

Autocorrelation: Nature of the Problem, OLS Estimation in the presence of Autocorrelation, Consequences of Autocorrelation, Detection: Graphical Method, The Run Test, Durbin-Watson d Test, A General Test of Autocorrelation, The Breusch-Goldfrey (BG) Test; GLS when correlation coefficient is known as well as unknown; Auto Regressive Conditional Hetroscedasticity (ARCH) and Generalized Autoregressive Conditional Hetroscedasticity (GARH) Model; Analysis of Residuals: Outliers, Leverage, Influence; Chow Prediction Failure Test

Unit 3 Multicolinearity Problem, Its implications and tools for handling the problem; Detection of Multicolinearity; Remedial Measures; Ridge Regression; Use of Principle Component Analysis; **12L**

Linear Regression with Stochastic Regressors, Types of Specification Errors, Errors of Measurement, Instrumental (Proxy) Variable

Unit 4 Simultaneous Equation Models: Nature, Examples, Identification Problems: Rules of Identification: The Order Condition of Identifiablity, The Rank Condition of Identifiability. **12L**

Estimation in Simultaneous Equation Models, Recursive System, Indirect Least Square (ILS) Method, Two Stage Least Square Method (2SLS)

Books Recommended:

1 Doran, H.E.(1989). Applied Regression Analysis in Econometrics, Marcel Dekker Inc.

2 Freud, R.J., Wilson,W.J. and Sa,P.(2006). Regression Analysis: Statistical Modeling of a Response Variable, Ed. II Elsevier Inc.

3 Gujarathi, D.N. and Sangeetha (2007). Basic Econometrics, Ed. IV , Tata MacGraw Hill

4	Greene, W.G. (2003) Econometric Analysis. Ed. V, Pearson Education
5	Intriligator,M.D., Bodkin, R.G., Hsiao, C.(1996). Econometric Models, Techniques and Applications, Pearson Publisher
6	Johnston, J. (1984) : Econometric methods, Third edition, McGraw Hill.
7	Ruppert, D.(2004). Statistics and Finance: An Introduction , Springer (India) Pvt. Ltd.
8	Theil, H. (1982) : Introduction to the theory and practice of Econometrics, John Wiley.
9	Walters, A (1970) : An introduction to Econometrics, McMillan & Co
10	Wasington, S.P., Karlftis, M.G. and Mannering, F.L. (2011). Statistical and Econometric Methods for Transportation Data Analysis, Ed. II, CRC Press, Chapman & Hall Books

PS04ESTA22: ACTUARIAL STATISTICS

Unit 1 Utility theory, insurance and utility theory, models for individual claims and their sums, survival function, curtate future lifetime, force of mortality **12 L**

Life table and its relation with survival function, examples, assumptions for fractional ages, some analytical laws of mortality, select and ultimate tables.

Multiple life functions, joint life and last survivor status, insurance and annuity benefits through multiple life functions evaluation for special mortality laws.

Unit 2 Multiple decrement models, deterministic and random survivorship groups, associated single decrement tables, central rates of multiple decrement, net single **12 L** premiums and their numerical evaluations.

Distribution of aggregate claims, compound Poisson distribution and its applications. Distribution of aggregate claims, compound Poisson distribution and its applications.

Unit 3 **Principles of compound interest**: Nominal and effective rates of interest and discount, force of interest and discount, compound interest, accumulation factor, **12L** continuous compounding.

Life insurance: Insurance payable at the moment's of death and at the end of the year of death-level benefit insurance, endowment insurance, differed insurance and varying benefit insurance, recursions, commutation functions.

Life annuities: Single payment, continuous life annuities, discrete life annuities, life annuities with monthly payments, commutation functions, varying annuities, recursions, complete annuities-immediate and apportion able annuities-due.

Unit 4 **Net Premiums:** Continuous and discrete premiums, true monthly payment premiums, apportionable premiums, commutation functions, accumulation type **12 L** benefits.

Payment premiums, apportionable premiums, commutation functions accumulation type benefits.

Net premium reserves: Continuous and discrete net premium reserve, reserves on a semi continuous basis, reserves based on true monthly premiums, reserves on an apportion able or discounted continuous basis, reserves at fractional durations, allocations of loss to policy years, recursive formulas and differential equations for reserves, commutation functions.

Some practical considerations: Premiums that include expenses-general expenses types of expenses, per policy expenses.

Claim amount distributions, approximating the individual model, stop-loss insurance

Books Recommended:

1. Shailaja R Deshmukh(2009) Actuarial Statistics:An Introduction using R. University Press Pvt.Ltd Hyderabad(Text Book)

2. N. L. Bowers, H. U. Gerber, J. C. Hickman, D. A. Jones and C. J. Nesbitt, (1986), Actuarial Mathematics', Society of Actuaries, Itasca, IIIinois, U. S. A. Second Edition (1997)

   Section I – Chapters: 1, 2, 3, 8, 9, and 11

   Section II – Chapters: 4, 5, 6, 7, 13, and 14

   Books for Additional References:

3. Spurgeon E. T. (1972), Life Contingencies, Cambridge University Press

4. Neill, A. (1977). Life Contingencies, Heinemann

PS04ESTA23: BIOASSAYS

Unit 1   Principles of planning an assay.

12 L

Types of biological assays: Direct assays; Ratio estimators, asymptotic distributions; Fieller's theorem .

Quantitative dose response relations: Indirect Assays; the dose response regressions; similarity; Assay validity; Monotony; Linearizing transformations; Essential non-linear relation; a response curve for vitamin B12; Homoscedasticity of variance.

Unit 2   Parallel line Assays: Unsymmetric designs; Complete Analysis;

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Symmetric dose structure for parallel assays; complete analysis

Unit 3   Slope ratio Assays

12L

Quantal responses; The use of quantal responses; minimal effective dose; median effective dose; Methods of estimation of parameters; Estimation of extreme quantiles; Doseallocation schemes; Polychotomous quantal response;Estimation of points on the quantal response function.

Unit 4   Estimation of safe doses

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Bayesian approach to bioassay

Books Recommended:

1   **Z. Govindarajulu (2000). Statistical Techniques in Bioassay, S. Kargar**

D. J. Finney (1971). Statistical Method in Bioassay, Griffin.
2

D. J. Finney (1971). Probit Analysis (3rd Ed.), Griffin.
3

G. B. Weatherile (1966). Sequential Methodsin Statistics, Methuen.
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PS04ESTA24: CLINICAL TRIALS

Unit 1 **Introduction** to clinical trials, the need, ethics, protocol of clinical trials, Overview of phase 1 – IV and DF, SE, CTE trials, data management and case studies. bias and random error in clinical studies, Endpoints of clinical trials and sample size estimation in SE and CTE trials.   **12 L**

Unit 2 **Design of clinical trials** parallel vs. cross over designs, cross sectional vs. longitudinal designs, review of factorial designs. Randomization techniques for group allocation.   **12L**

Unit 3 **Analysis** of outcomes from Phase I- III trials, analysis of survival data from clinical trials, techniques for Interim analysis, intent to treat analysis.   **12L**

Unit 4 **Application areas** Meta analysis, Multi-center trials, Bioequivalence trials

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Books Recommended:

1   David Machin, Simon Day. Text Book Of Clinical Trials

2   Ton Cleophs, Aeilko Zwinderman. Statistics Applied To Clinical Trials.

3   Stephen Senn. Cross – Over Trials In Clinical Research.

4   Annpey Pong & Shein- Chung Chow. Hand Book Of Adaptive Designs In Pharmaceutical And Clinical Development

5   Effron and Marubini. Analyzing data from CT and Obs studies

6   Karl E. Peace. Design And Analysis Of Clinical Trials With Time-To-Event Endpoints

7   Geert Molenberghs & Michael G. Kenward. Missing Data In Clinical Studies

8   Annpey Pong , Shein- Chung Chow. Handbook Of Adaptive Designs In Pharmaceutical And Clinical Development

9   Shein-Chung Chow, Mark Chang. Adaptive Design Methods In Clinical Trials.

10   Umakanta Sahoo, Dipti Sawant. Clinical Trial Monitoring A Professional Hand Book

11   Diane Fairclough. Design And Analysis Of Quality Of Life Studies In Clinical Trials.