ANNAMALAI UNIVERSITY

DEPARTMENT OF STATISTICS

Ph.D - STATISTICS (COURSE WORK)

COURSE CODE SSTA81

REGULATIONS AND SYLLABI

(FROM 2019-2020 ONWARDS)

Ph.D (STATISTICS)

(STUDENTS JOINING WITH M.PHIL DEGREE NEED NOT TAKE COUSE-I AND COURSE-II)

Ph.D (STATISTICS) – SEMESTER-I
PAPER – I : RESEARCH METHODOLOGY-I
(COMMON TO ALL)
STATISTICAL INFERENCE

UNIT-I

Unbiasedness and consistency – Point estimation; Highest concentration Criterion; minimum MSE criterion; Unbiased estimators; Quenoulli's Method of reducing the bias in stages; Consistent estimator; BAN estimator; Case of several parameters; Sufficiency and Completeness - Sufficient Statistics; Fisher Information measure; Neyman-Fisher Factorization Theorem; minimal sufficient statistics; Complete Statistics; exponential family of distributions; Pitman's family of distributions.
(Contents as in Chapter -2 and 3 of Book-1)

UNIT-II

Minimum Variance Unbiased Estimators-Case of a single parameter; Lower bounds for variance of Unbiased estimators (Cramar-Rao Inequality) UMVUE; Bhattacharya Inequality; Chapman-Robin's Inequality; Rao-Blackwell theorem; Lehman- Sheffee Theorem; Use of sufficient and complete statistics; case of several parameters; Method of Estimation - Method of moments; method of maximum likelihood; Fisher's iteration technique of MLE; Properties of MLE.
(Contents as in Chapter -4 and 5 of Book-1)

UNIT-III

Tests of Hypotheses – Concepts; Non-randomized and randomized tests; Critical region; Two types of errors; level of significance ; size and power of the test; Neyman Pearson Theory and Lemma; Test functions; MP tests when H and K are simple; UMP tests; monotone likelihood ratio property; Generalized NP lemma; Tests for one parameter exponential family of distributions.
(Contents as in Chapter -7 and 8of Book-1)

UNIT-IV

Locally most powerful tests UMPU tests for Multi-parameter exponential family of distribution; Tests with Neyman's structure; Likelihood ratio (LR) tests; Asymptotic distribution of the LR test criterion; LR test for testing the mean and variance of the Normal distribution based on K-samples($K \geq 1$); LR test for categorized data.
(Contents as in Chapter -8 and 9 of Book-1)

UNIT-V

Bayesian Approach - Prior and posterior distributions; non-informative priors; point estimation, interval estimation; hypothesis testing; decision theory approach; application to point estimation problems.
(Contents as in Chapter -11 of Book-1)

Books for Study and Reference:-

1. **Rajagopalan,M and P.Dhanavanthan., Statistical inference, PHI Learning Private Limited, New Delhi,2012).**
2. **Gibbons, J.D. and S.Chakraborty, Nonparametric Statistical Inference, 3rd ed., Marcel Dekker,2010.**
3. **Lehman, E.L. and J.P. Romano, Testing Statistical Hypotheses, 3rd ed., Springer 2005.**
4. **Lehman, E.L. and G.Casella, Theory of Point Estimation, 2nd ed., Springer – Verlag, 1998.**

5. Rao, C.R., Linear Statistical Inference and Its Applications, 2nd ed., Wiley, New York, 1973.
6. Zack, S., Parametric Statistical Inference: Basic Theory and Modern Approach, Pergamon Press 1981.
7. Zacks, S., The Theory of Statistical inference, John Wiley, New York, 1971.
8. Santhakumaran, A (2004), Probability Models and Their Parametric Estimation, K.P.Jam Publication, Chennai.

Ph.D (STATISTICS) – SEMESTER-I

PAPER – II : RESEARCH METHODOLOGY-II

(COMMON TO ALL)

STOCHASTIC MODELLING

UNIT – I

Stochastic Processes - Definition and examples; Classification of stochastic processes with illustrations; Gambler's ruin problem Markov Chains ; Definition and examples; One and two dimensional random walk; Transition probabilities; Classification of States; Recurrent Markov chains; Necessary and sufficient condition for a state to be recurrent ; Basic limit theorems on recurrence; Statistical inference for Markov chains. (Section 1.2, 1.3, and 1.4 of chapters 1 and 2 of Book No.4).

UNIT – II

Basic limit thermos of Markov chains; Theorem establishing the stationery probability distribution of a positive recurrent; a periodic class of states; Absorption probabilities; Criteria for recurrence; examples. (Section 3.1, 3.3, 3.4, 3.5 and 3.7 of chapter -3 of Book No.4).

UNIT – III

Continuous time Markov chains; Examples; General pure birth process; Poisson process; its definition and properties; Birth and death processes with absorbing states; Finite state continuous time Markov Chains. (Chapter 4 of Book No.4).

UNIT – IV

Branching process; Discrete time branching process; Generating function relation; mean and variance generations ; Extinction probabilities and theorems; Renewal processes; renewal function ; renewal equation; renewal theorems.
(Section 8.1, 8.2, 8.3, of Chapter 8),
(Section5.1,5.2,5.3,5.4,5.5of Chapter 8 of Book No. 4).

UNIT V

Concept of reliability; components and systems; coherent systems; reliability of coherent systems; Life distributions; reliability function; hazard rate; common life distribution; Exponential; Weibull; Gamma distributions. Estimation of parameters; IFR and DFR distributions; Reliability of system with independent components; Basic idea of maintainability.

Books for Study and Reference:-

1) Medhi , J. (2002). Stochastic processes, Wiley Eastern, New York
2) Sheldon M.Ross (2004). Stochastic processes, John Wiley & sons
3) Bhat, B.R (2002). Stochastic models: Analysis and applications
4) Karlin, S. and H.W. Taylor, (1975), A First course in Stachastic processes, Academic Press, 2nd edn, London.
5) Karlin.S and H.M.Taylor (1979), A second course in Stochastic processes, Academic Press, London.
6) Chung, K.L.(1967) Markov chains with stationary transition probabilities, Springer Verlages NY, 2nd edition.
7) Prabhu.N.U, (1965) Stochastic Processes McMillan , New York.

8) Bharucha Reid, A.T.(1960) Markov chain with applications, John Wiley, New York.
9) Pandey, B.N(2007) Statistical Techniques in Life Testing, Reliability, Sampling Theory and Quality Control, Narosa Publishing House Pte. Ltd.

Ph.D (STATISTICS) – SEMESTER-II
PAPER – III : AREA OF SPECIALIZATION – I
(COMMON TO ALL Ph.D Scholars)
APPLIED REGRESSION ANALYSIS

UNIT: I

Simple Linear Regression - Simple Linear Regression Model; Least- Squares Estimation of the Parameter; Estimation of β_0 and β_1 ; Properties of the least-square Estimators and the fitted Regression Model; Estimation of σ^2 ; Hypothesis Testing on the slope and intercept- Use of t-Tests; Testing Significance of Regression; The Analysis of Variance. Interval Estimation in Simple Linear Regression; Confidence Interval on β_0 , β_1 and σ^2 ; Interval Estimation of the Mean Response. Coefficient of Determination; Estimation by Maximum Likelihood.
(Contents as in Chapter- 2 of Book-1)

UNIT: II

Multiple Linear Regression : Multiple Regression Models; Estimation of Model Parameters; Least Square Estimation of the Regression Coefficient; Properties of the Least Squares Estimators; Maximum Likelihood Estimation; Hypothesis Testing in Multiple Linear Regression; Test for Significance of Regression; Test on Individual Regression Co-efficient; Testing the General Linear hypothesis; Confidence Intervals in Multiple Regression; Prediction of New observation; Hidden Extrapolation in Multiple Regression; Standardized Regression Coefficients; Multicolinearity.
(Contents as in Chapter- 3 of Book-1)

UNIT: III

Model Adequacy Checking - Introduction Residual Analysis; Definition of Residuals; Residual Plots; Partial Regression and Partial regression Plots; The PRESS Statistic; Detection and treatment of outliers. Lack of fit of the Regression Model; A Format Test for Lack of fit; Estimation of Pure Error.
(Contents as in Chapter- 4 of Book-1)

UNIT: IV

Variable Selection and Model Building - The Model – Building Problem; Consequences of Model Misspecification; Criteria for Evaluating subject Regression Models. Computational Techniques for Variable selection: All Possible Regressions; Stepwise Regression Methods.
(Contents as in Chapter- 9 of Book-1)

UNIT: V

Uses of Regression Analysis; Regression Models with Autocorrelation; Detecting the Presence of Autocorrelation; Parameter Estimation Methods; Effects of Measurement Errors in Repressors; Simple Linear Regression; The Berkson Model; Inverse Estimation; The Calibration Problem; Bootstrapping in Regression; Bootstrap Confidence interval; Neural Networks.
(Contents as in Chapter- 14 of Book-1)

Book for Study and Reference:-

1. **Douglas C.Montgomery, Elizabeth A.Peck, G.Geoffrey Vining. Introduction to Linear Regression Analysis. 3rd ed. Wiley India Pvt.Ltd.**
2. **Draper, N.R and Smith H; Applied regression analysis 2nd Edition, John Wiley and Sons 1981.**
3. **Draper, N.R and Smith H(1998); Applied regression analysis 3rd Edition, Wiley, New York.**
4. **Graybill, F.A. (1961), An Introduction to Linear Statistical Models, Vol. 1, McGraw-Hill, New York.**
5. **Johnston, J. (1972), Econometric Methods, Mc Graw- Hill, New York.**
6. **Fox J. Linear Statistical Models and Related methods, John Wiley and Sons 1984.**
7. **Searle SR, Linear Models, Wiley, New York 1971.**
8. **Searle G.A.F.(1977), Linear Regression Analysis, Wiley, New York.**

Ph.D (STATISTICS) – SEMESTER-II

PAPER – IV : AREA OF SPECIALIZATION – II

(The Syllabus will be given by the Guide depends upon their Research area)