Ph.D STATISTICS (COURSE WORK)-2018
STRUCTURE OF THE COURSE

SEMESTER – I (January-June)	Title of Paper	Credit Hours (Hrs Semester)
MPH 611	Probability Theory and Stochastic Processes	4 CH(40-48 Hrs)
MPH 612	(Theory Elective)	4 CH(40-48 Hrs)
MPH 613	Research Methodologies	4 CH(40-48 Hrs)
MPH 614	Field Studies	4 CH(40-48 Hrs)
MPH 615	Review of Research Paper published in referred Journals i) Review Report – 2CH ii) Seminar-2CH	4 CH
	Total	20 CH

The electives will be chosen from the schedule-A.

SCHEDULE-A

The Statistics students will choose any one elective from the following :

1. **STATISTICAL INFERENCE**
2. **ADVANCED THEORY OF SAMPLE SURVEYS**
3. **REGRESSION ANALYSIS AND BAYESIAN INFERENCE**
4. **STOCHASTIC INFERENCE.**

MPH 611

Probability Theory & Stochastic Processes :

I. Sigma field, Borel field, Measurable space, Product space, additive set function, Measure and Probability space, Induced measure and distribution function.

II. Independence of sequence of events and random variables, multiplication properties, random allocation of balls into cells, Borel-Cantelli theorem and characterization of independence, Tail sigma field, 0-1 law, Different types of convergence and its applications.

III. Random walk, Gambler's Ruin Problem,
Markov Chains :- Definition, Transition Problem, classification of states, Recurrence, Examples of Recurrence Markov Chain.

IV Birth and Death Process :
General birth and death process, Poisson Process, Differential equations of birth and death process
Martingales :- Definition and examples, upper Martingales,Super martingale and sub-Martingales, optimal sampling theorem, Martingale convergence theorem.

Books

1. Prob & Measure: P.Billingsley, Academic Press
2. A graduate course in prob : H.G.Tucker AP
3. Limit theorems for sums of independent random variable: B.V.Gnedenko & A.N.Kolmogorov, Addison Wesley.

MPH 612

STOCHASTIC INFERENCE

Unit-I :
introduction to stochastic process, Markov chain, Birth and Death process, martingale, Brownian motion.

Unit-2 :

Large sample theory for discrete parameter stochastic process, Estimation, Efficient test for simple hypothesis, large sample tests, optimal asymptotic test.

Unit-3 :

Large sample theory for continuous Stochastic process, Ito process, MLE for Ito-type process ,the linear case, least squares estimation, study of consistency and efficiency, testing of simple hypothesis.

Unit-4 : M/M/I, M/G/I and G/M/I queue, MLE in single server queue, large sample inference from single server queue. Rate of convergence. Estimation of traffic intensity.

Books:

1.Statistical Inference for Stochastic Processes. I.V. Basawa and BLS Prakasa Rao. AP.1980.

2.Statistical Inference for Markov Processes. P. Billingsley. The Chicago University Press, 1961.

3.Fundamentals of Queueing Theory. D. Gross and CM. Harris. Wiley. New York. 1985. Second edition.

4. A first course in stochastic process. S. Karlin and H.M Taylor

MPH 612 (A)

STATISTICAL INFERENCE

Unit-I

Experimental family of distribution, Sufficient statistics, Rao Blackwell Theorem and its applications, Convex Function, Complete Family of distribution, Bayes Theorem, Unbiased Estimation, Uniformly Minimum Variance, Unbiased Estimators, Information Inequalities of Chi-Parameter and Multiparameter Cases.

Unit-II : Large sample comparison of estimators, Consistent and Efficient Estimators, Asymptotic Efficiency.

Unit-Ill: Minimum Likelihood Estimators, Uniparameter and Multiparameter Cases, Bayes Estimaton, Minimum Estimation, Admissible Estimators.

Unit-IV: Neyman and Pearsonian Test, Sequential Probability Ratio Test and it's Properties, Likelihood Ratio Test and its Properties.

Books Recommended

1. Theory of Point Estimation: E.L.Lehman
2. Statistical Inference : S Zacks
3. Sequential Analysis: A Wald
4. Testing of Hypothesis: E.L.Lehman

MPH 612 (B)

Advanced Theory of Sample Surveys

Unit –I

Types of Sampling: Simple Random, Stratified Random and systematic sampling, Estimation in Ratio and Regression estimators, (For One and two variables), Double sampling for ration and regression estimators, double Sampling for stratification.

Unit-II

Sampling with varying probabilities, ordered and unordered estimators, Sampling Strategies due to Horvitz Thomson, Yales and Grundy Form Midzuno Sen, Brewerand Durbin Scheme (Sample size two only) Rao-Hartley, cochran Scheme for sample size n with random grouping and PPS systematic sampling, Double sampling for PPS estimation.

Unit-III

Single stage cluster sampling: multi-stage sampling, selection of PSU's with unequal probabilities, Selection of PSU with replacement, stratified multi-stage sampling, Estimation of ratios, choice of sampling and sdub-sampling fraction, Repetitive Surveys, sampling on more than two occasions.

Unit-IV

Non-sampling errors, response errors, response bias, the analysis of data, Estimation of variance components uncorrelated response error, response and sampling variance, the problem of non-response, some example of sources of error. Variance estimation, method Estimation of random groups sub population. The best linear estimator two way stratification with small sample, variance estimation in multistage sampling, sampling inspections.

Books suggested

1.	Chochran, W.G.	Sample Techniques
2	Desrjv and Chandok	Sampling Theory
3	Singh & Chaudhary F.S.	Theory and analysis of sample Survey designs.
4	Mukhopadhyay, Primal	Inter Problems in survey sampling

MPH 612 (C)

Regression Analysis and Bayesian Inference

Unit I

Simple Linear Regression, Estimation of parameters, Matrix Approach to Linear Regression, R^2 and adjusted R^2 , Weighted Least Squares. Model Adequacy Checking – Residual Analysis, methods of scaling residuals- Standardized and studentized residuals Press Residual, Residual Plots, PRESS Statistic

Unit II

Diagnostics for Leverage and Influence, Variable Selection and Model Building, Computational Techniques for Model Selection- Mallow's C_p , Stepwise Regression, Forward Selection, Backward Elimination. Elementary Ideas of Logistic and Poisson regression

Unit III

Mixture Distributions, Exponential Family of distributions, Prior and Posterior distributions, Baye's theorem and computation of posterior distribution, Natural conjugate family of priors for a model, Conjugate families for exponential family models

Unit IV

Non – Informative and Improper priors, Jeffrey's Prior, Asymptotically Locally invariant prior. Maximum entropy priors, Bayes estimation.

Books Recommended

Montgomery, D.C, Peck and Vining, G.G. (2002). Introduction to Linear Regression Analysis (John Wiley & Sons.)

Draper, N.R. and Smith, H. (1981) Applied Regression Analysis (John Wiley & Sons)

Robert, C.P. (2001): The Bayesian Choice: A Decision Theoretic Motivation (Springer Verlag New York)

Sinha , S.K. (2004) Bayesian Estimation

Berger, J.O. (1985) Statistical Decision Theory and Bayesian Analysis (Springer)

MPH 613

RESEARCH METHODOLOGY

Unit-I
Application of statistical concepts/procedures. Data, diagrammatic representation of data. Probability, Measure of Central tendency, Measure of dispersion, Skewness and Kurtosis, Normal distribution, Simple correlation, regression analysis, Sampling: Simple random sampling, Stratified random sampling, Systematic sampling.

Unit-2 :
Testing of Hypothesis tests, X (chi-square), F and T-tests: Analysis of variance, covariance, principal component analysis; Experimental design: completely randomized block design, randomized block design, Latin square design. One-way analysis of variance, Two-way analysis of variance, follow up tests: Non-parametric procedures; Writing of research report,

Unit-3 Programming fundamentals: basics of a high level programming language C: Editing, compiling and running a program-storing data: Elementary numerical methods (as per requirement of the subject). Plotting graph

Unit-4:
Preparation of Dissertation: Types and layout of Research, Precautions in preparing the research dissertation, Bibliography, reference and annexure, discussion of results, draurg conclusions given suggestions and recommendations to the concerned persons

MPH 613

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Books

1. Fundamentals of Mathematical Statistics by S.C. Gupta & V.K. Kapoor, Sultan Chand, 2013
2. Research Methodology: Methods and Techniques, C.R.Kothari
3. Fundamentals of Applied Statistics-S.C. Gupta and V.K. Kapoor, Sultan Chand, 2013.

MPH 612 (C)

Regression Analysis and Bayesian Inference

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Sinha , S.K. (2004) Bayesian Estimation

Berger, J.O. (1985) Statistical Decision Theory and Bayesian Analysis (Springer)