Syllabus for Pre-PhD Course-work in Statistics
(Effective from the Academic Year 2021-22 Onwards)

Department of Statistics
Tripura University

(A Central University)
Suryamaninagar-799022, Tripura (W), India

PHD-9001: Research Methodology I (Common for All Science Departments)

PHD-9002: Research Methodology II

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research.

Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, an Illustration.

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Design of Sample Surveys: Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement, Techniques of Developing Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale.

Data Collection: Introduction, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. Chi-square Test, Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, and Cautions in Using Chi Square Tests.

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Suggested Books:
1. Singh, Y. K.(2006). Fundamental of Research Methodology and Statistics. New Age International.
2. C.R. Kothari and Gaurav Garg (2018). Research Methodology: Methods and Techniques. New Age International.

Course Outcomes:

After successful completion of this course, student will be able to:

• To give an overview of the research methodology and explain the technique of defining a research problem
• To explain the functions of the literature review in research.
• To explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
• To explain various research designs and their characteristics.
• To explain the details of sampling designs, measurement and scaling techniques and also different methods of data collections.
• To explain several parametric and non-parametric tests of hypotheses.
• To explain the art of interpretation and the art of writing research reports.

PHD-9003: Advanced Statistics

Theory of Estimation: Methods of estimation. Properties of estimators. Confidence intervals. Tests of hypotheses, most powerful and uniformly most powerful tests, Likelihood ratio tests. Simple nonparametric tests for one and two sample problems, rank correlation and test for independence.

Linear Models: Gauss-Markov models, estimability of parameters, Best linear unbiased estimators, tests for linear hypotheses and confidence intervals. Analysis of variance and covariance. Fixed, random and mixed effects models. Simple and multiple linear regression. Elementary regression diagnostics. Logistic regression.

Multivariate Analysis: Multivariate normal distribution, Wishart distribution and their properties. Distribution of quadratic forms. Inference for parameters, partial and multiple correlation coefficients and related tests. Data reduction techniques, Principle component analysis, Discriminant analysis, Cluster analysis, Canonical correlation.

Survey Techniques: Simple random sampling, stratified sampling and systematic sampling. Probability proportional to size sampling. Ratio and regression methods.

Experimental Designs: Connectedness and orthogonal block designs, BIBD, PBIBD, Optimal design of experiments, 2^K factorial experiments: confounding and construction.

Stochastic Processes: Markov chains with finite and countable state space, classification of states, limiting behaviour of n-step transition probabilities, stationary distribution.
Elementary Bayesian inference.

Course Outcomes:

After successful completion of this course, student will be able to:

➢ Apply various parametric, non-parametric and sequential estimation techniques to deal with real life problems.
➢ Understand the concept of linear model and the underlying assumptions to obtain least squares estimate of regression coefficients.

- ➢ Test the significance of single mean vector, difference in the two mean vectors and MANOVA based on normal assumption.
- ➢ Perform various data reduction techniques and analysis.
- ➢ .Analysis and compare efficiency of the different experimental designs.
- ➢ Understand the distinctive features of sampling schemes and its related estimation problems.
- ➢ Understand the concept of Markov chain and its basic properties using some theorems.

Suggested Books:
1. Cochran, W. G: Sampling Techniques. Wiley Eastern.
2. Sampath, S: Sampling Theory and Methods. Narosa Publising House.
3. Rao, C.R: Linear Statistical Inference and its Applications. Wiley Eastern, New Delhi.
4. Mukhopadhaya, P: Mathematical Statistics. Books and Allied (P) Ltd.
5. Kshirsagar, A M: A Course in Linear Models. Marcel Dekker, N. Y.
6. Joshi, D D: Linear Estimation and Design of Experiments. New Age International Publication.
7. Mukhopadhyay, P: Applied Statistics. Books and Allied (P) Ltd.
8. Chakrabarti, M.C: Mathematics of Design and Analysis of Experiments. Asia Publishing House, Bombay.
9. Anderson, T.W: An introduction to Multivariate Statistical Analysis. John Wiley.
10. Bhuyan, K. C: Multivariate Analysis and Its Applications. New Central Book Agency (P) Ltd.
11. Medhi, J: Stochastic Process. Wiley Eastern.

PHD-9004: Project Work and Seminar Presentation.

The paper PHD-9004 on a special topic (taken by the candidate) is to be submitted for the project. The candidate has to present a public seminar on his/her project.

Course Outcomes:

After successful completion of this course, student will be able to:
- ➢ To demonstrate the technique of defining a research problem in project work.
- ➢ To explicate carrying out a literature review, developing theoretical as well as mathematical frameworks.
- ➢ To construct the details of sampling designs, measurement and scaling techniques and also different methods of data collections.
- ➢ To elaborate the art of interpretation and the art of writing project reports.

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