Syllabus

PCL105 Statistical Methods and Algorithms

Semester: Autumn, 2018
Course Co-ordinator: Amrik Sen (Instructor)
Course website: https://amriksen.wixsite.com/amriksen/pcl105-autumn2018
L T P Credit
3 0 2 4

Course Objective: The course aims to introduce to the students, fundamental principles as well as advanced topics in statistics and sampling techniques. This course underscores the importance of statistical methods to perform scientific and engineering research.

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Introduction: Nature and objectives of research, Study and formulation of research problem. Scope and formulation of hypothesis. Preparation and presentation of research proposal using statistical package.

Review of Probability: Appraisal of axiomatic approach of probability, Conditional probability, Bayes' rule, Conditional distributions, and conditional expectations.

Markov chains: Basics of Markov chains, Finite state space, Markov chains, Transition and stationary Markov chains. Continuous time Markov process, Kolmogorov, Forward and backward equations, Pure birth, Pure death, Birth and death process.

Analysis of variance: One Way Classification: ANOVA for fixed effect model, ANOVA for Two-way Classification (one observation per cell): ANOVA for fixed effect model.

Design of Experiments: Completely Randomized Design, Randomized Block Design, Latin Square Design, their statistical analysis and variance of estimates, Analysis of Covariance.

Multivariate Data Analysis: Introduction, multivariate normal distributions, Mean vector, Variance-covariance matrix, Correlation matrix and their estimation for multivariate data., Step wise regression, Selection of best set of variables, Classification and discrimination problems. Factor analysis and principal component analysis. Illustrative examples and Multivariate data analysis using statistical package.

Time Series and forecasting: Components of time series, Analysis of time series, Measurement of trend, Measurement of seasonal variations , Measurement of cyclic variations , Auto-Regression Analysis, Auto-correlation , Random component in time series.

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Laboratory Work: Implementation of statistical techniques using statistical packages viz. SPSS, Mathematica including evaluation of statistical parameters and data interpretation, Regression Analysis, covariance, Analysis of variance, multivariate data analysis and problems based on time series and forecasting.

Course Learning Outcomes (CLO): Upon the completion of this course, the students will attain the following skills.

1. Compute probabilities of composite events along with an understanding of random variables.
2. Design statistical experiments using different statistical software and interpret data based on statistical principles like ANOVA.
3. Perform time-series analysis.
4. Obtain foundational understanding of stochastic (Markov) processes.
5. Perform multivariate data analysis for different engineering and scientific applications.

Recommended Books:

1. Medhi, J., Stochastic Processes, New Age International (2005).
2. Populis,A., Random Variables and Stochastic Processes, Tata McGraw Hill (2002).
3. Montgomery, Introduction to Statistical Quality Control, John Wiley and Sons (2005).
4. Durrett, R., Essentials of Stochastic Processes, Springer (2016).
5. Ross, Sheldon, Stochastic Processes, John Wiley and Sons (1996).
6. Hogg, McKean and Craig, Introduction to Mathematical Statistics, Pearson (2013).
7. Bhuyan,K.C., Multivariate Analysis and Its Applications, New Central Book Agency (2002).
8. Anderson,T.W., An Introduction to Multivariate Statistical Analysis, John Wiley and Sons (2003).
9. Goon, Das, Gupta, Fundamental of Statistics Vol.-II, World Press (1999).