PCL 105: 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.

Lecture Plan

Lecture number	Topics covered
1-1	Introduction to course, policies, plan and organization of lectures, course related resources, brief introduction to probability
2-3	Axioms of probability, concept of probability distributions for continuous and discrete case, introduction to conditional probability, Bayes' theorem, laws of total probability and expectation, examples and practical application of conditional probability, some popular discrete and continuous probability distributions
4-5	Examples of discrete and continuous distributions, joint and marginal distributions, moment generating function, kurtosis, skewness
6-6	Law of large numbers, Central Limit theorem, Convergence in probability and distribution, examples
7-8	Introduction to discrete time Markov chains, Multi-step transition probabilities, examples, Chapman Kolmogorov equation, long time distribution of states in Markov processes
9-11	Hitting probabilities, return and exit times, examples
12-14	Mean number of returns to a state, classification of states, periodicity of Markov chains
15-16	Stationary distributions, Detailed Balance, examples
17-18	Introduction to Poisson process, examples

19-24	Continuous time Markov chains, Kolmogorov backward and forward equations, Limiting behavior, birth and death processes (including pure birth and pure death), examples from queueing theory
25-25	Introduction to formulation of hypothesis, statistical analysis and design of experiments
26-28	Sampling distributions, chi-square, t and F distributions, introduction to hypothesis testing
29-32	ANOVA (1 way tests, 2 way tests)
33-38	Time series analysis and forecasting: Moving average and Auto-regressive models, ARMA models, introduction to concepts on auto-correlation and stationarity, white noise processes, examples
39-42	Overview of multi-variate statistics and data analysis

Total lecture hours: 42
Total tutorial hours: 0
Total lab hours: 28

Total credit hours: 70

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).

** Lectures will be based on notes that will be provided to students on weekly basis.

Signature of Course Co-ordinator

Signature of Head of Department
(Mathematics)