# CS-501: Probability Theory and Statistical Computing

- Introduction to the notion of probability, Random experiment, Sample space & Events, Probability defined on events, Algebra of events, Conditional probabilities, Independent events, Bayes' theorem. 5L

  [1]: [chap 1: 1.1 - 1.6]

- Random Variables, cumulative distribution functions, probability mass/density functions, Discrete Random Variables (Binomial, Poisson and Geometric). 4L

  [1]: [chap 2: 2.1, 2.2]

- Continuous Random Variables (Normal, Exponential, Uniform and Gamma). 2L

  [1]: [chap 2: 2.3]

- Expectation of a Random Variable (Discrete & Continuous cases). Expectation of Function of a Random Variable. Variance of a Random Variable. 2L

  [1]: [chap 2: 2.4]

- Jointly distributed Random Variables, Joint distribution functions, Independent Random Variables, Co-variance of Random Variables. Joint probability Distribution of Function of Random Variables, Moment Generating Functions. 8 L

  [1]: [chap 2: 2.5, 2.6]

- Introduction to Conditional Probability – Discrete and Continuous, Conditional Expectation, Matching Rounds Problem, Quicksort 5L

  [1]: [chap 3: 3.1 - 3.4 upto pg117]

- Conditional Variance, Variance in Matching Rounds Problem, Best Prize Problem 2L

  [1]: [chap 3: 3.4.1, 3.5]

- Some more Applications: List Model, Random Graphs, Left Skip free random walks 4L

  [1]: [chap 3: 3.6.1, 3.6.2, 3.6.6]

**Limits and bounds :** Markov inequality, Chebyshev's inequality, Chernoff's bound, Central Limit Theorem, Strong Law of Large Numbers. 3L

[1]: [chap 2: 2.8]

**Markov Chains:** Introduction to stochastic processes, Chapman–Kolmogrov equations, classification of states, Limiting and Stationery probabilities. 7L

[1]: [chap 4: 4.1-4.5.2]

**Statistical Analysis**: Simple Linear Regression Model, Linear Probabilistic Model, Estimating Model Parameters, Sample Correlation Coefficient, Inferences about the Population Correlation Coefficient. 6L

[2]: [chap 12: 12.1, 12.2, 12.5]

## Recommended Reading Material

### Text Books

**1.** Sheldon Ross, *Introduction to Probability Models*, Tenth Edition, Academic Press/Elsevier, 2012.

2. Jay L. Devore, *Probability and Statistics for Engineering and the Sciences*, Eighth Edition, Cengage Learning,2012.

### Reference Books

3. K.S. Trivedi, *Probability and Statistics with Reliability, Queuing and Computer Science Applications,* Second Edition, Wiley, 2013.

4. James L. Johnson, *Probability and Statistics for Computer Science*, Wiley, 2008.

5. Jane Horgan, *Probability with R: An Introduction with Computer Science Applications*, Wiley, 2008.

### Online Reading/Supporting Material

1. www.**openintro**.org/stat/down/**OpenIntroS**tatFirst.**pdf**

# LIST OF PRACTICALS OF PAPER NO -CS-501: Probability Theory and Statistical Computing

**The goal of this lab is to develop data interpretation skills. Following exercises are designed to enable students to understand data characteristics either by visualization or by interpreting computed measures. All the exercises are to be completed using MS Excel functions and graphs. At the end of each exercise, the student should be able to draw a conclusion and state in a concise manner.**

**Teachers are expected to guide students to obtain real data available through internet for the following exercises. Some suggested sites are:**

**http://www.censusindia.gov.in/**
**http://www.visualizing.org/data/browse**
**http://www.who.int/gho/publications/world_health_statistics/2012/en/index.html**

| S.No. | Practicals |
|---|---|
| 1. | Fitting of binomial distribution and graphical representation of probabilities. |
| 2. | Fitting of Poisson distribution and graphical representation of probabilities. |
| 3. | Calculation of cumulative distribution functions for normal distribution. |
| 4. | Application problems based on the Binomial distribution. |
| 5. | Application problems based on the Poisson distribution. |
| 6. | Application problems based on the Normal distribution. |
| 7. | Presentation of bivariate data through scatter-plot diagram and calculations of covariance. |
| 08. | Calculation of Karl Pearson's correlation coefficients. |
| 09. | To find the correlation coefficient for a bivariate frequency distribution. |
| 10. | Calculation of Spearman's rank correlation coefficients. |
| 11. | Fitting of simple linear regression. |