

DSC 06: Probability for Computing

Guidelines

Unit	Topic	Reference	
		Table of Content	Book
1.	Basic Probability: Introduction to the notion of probability, Random experiment, Sample space and Events, Probability defined on events, Algebra of events. Conditional probabilities, independent events, Bayes' theorem.	1.1 1.2 1.3 1.4 1.5 1.6	[1]
2.	Random Variables: Introduction to Random Variables, Probability mass/density functions, Cumulative distribution functions. Discrete Random Variables (Bernoulli, Binomial, Poisson, Multinomial and Geometric). Continuous Random Variables (Uniform, Exponential and Normal). Expectation of a Random Variable, Expectation of Function of a Random Variable and Variance. Markov inequality, Chebyshev's inequality, Central Limit Theorem, Weak and Strong Laws of Large Numbers.	2.1 2.2 2.3 (Excluding 2.3.3) 2.4 2.8	[1]
3.	Joint Distributions: Jointly distributed Random Variables, Joint distribution functions, Independent Random Variables, Covariance of Random Variables, Correlation Coefficients, Conditional Expectation.	2.5.1 2.5.2 2.5.3 3.1 3.2 3.3 3.4	
4.	Markov Chain and Information Theory: Introduction to Stochastic Processes, Chapman–Kolmogorov equations, Classification of states, Limiting and Stationary Probabilities. Random Number Generation, Pseudo Random Numbers, Inverse Transformation Method, Rejection Method, Uncertainty, Information and Entropy, Mutual Information, KL Divergence.	4.1 4.2 4.3 (Till example 4.17) 4.4 (Till example 4.22)	

References

[1] Sheldon M. Ross Introduction to Probability Models, 10th Edition, Elsevier, 2019.

[2] Trivedi, K.S. Probability and Statistics with Reliability, Queuing and Computer Science Applications, 2nd edition, Wiley, 2015.

[3] Marc Peter Deisenroth, A. Aldo Faisal and Cheng Soon Ong, Mathematics for Machine Learning, 1st edition, Cambridge University Press, 2020.

[4] Ian F. Blake, An Introduction to Applied Probability, John Wiley.

Additional References

- i. James L. Johnson, Probability and Statistics for Computer Science, 6th edition, Wiley, 2004.
- ii. David Forsyth, Probability and Statistics for Computer Science, 1st edition, Springer, 2019.
- iii. Freund J.E., Mathematical Statistics with Applications, 8th edition, Pearson Education, 2013.
- iv. Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 9th edition, Cengage Learning, 2020.

Practical List

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 the internet for the following exercises.

1. Plotting and fitting of Binomial distribution and graphical representation of probabilities.
2. Plotting and fitting of Multinomial distribution and graphical representation of probabilities.
3. Plotting and fitting of Poisson distribution and graphical representation of probabilities.
4. Plotting and fitting of Geometric distribution and graphical representation of probabilities.
5. Plotting and fitting of Uniform distribution and graphical representation of probabilities.
6. Plotting and fitting of Exponential distribution and graphical representation of probabilities.
7. Plotting and fitting of Normal distribution and graphical representation of probabilities.
8. Calculation of cumulative distribution functions for Exponential and Normal distribution.
9. Given data from two distributions, find the distance between the distributions.
10. Application problems based on the Binomial distribution.
11. Application problems based on the Poisson distribution.
12. Application problems based on the Normal distribution.
13. Presentation of bivariate data through scatter-plot diagrams and calculations of covariance.
14. Calculation of Karl Pearson's correlation coefficients.
15. To find the correlation coefficient for a bivariate frequency distribution.
16. Generating Random numbers from discrete (Bernoulli, Binomial, Poisson) distributions.
17. Generating Random numbers from continuous (Uniform, Normal) distributions.

18. Find the entropy from the given data set.