MATH-263 Probability Theory

Credit Hours: 3-0

Prerequisites: None

Course Objectives: An understanding of random phenomena is becoming increasingly important in today's world within social and political sciences, finance, life sciences and many other fields. The aim of this course is to develop the concept of chance in a mathematical framework. A prime objective of the course is to introduce the students to the fundamentals of probability theory and present techniques and basic results of the theory and illustrate these concepts with applications. This course will also present the basic principles of random variables and random processes needed in applications.

Core Contents: Counting Techniques, Axioms of Probability, Conditional Probability and Independence, Discrete and Continuous Random Variables, Jointly Distributed Random Variables.

Detailed Course Contents: Introduction to Descriptive Statistics: Collection and Presentation ofSample Data, Some Important Features of Sample Data.

Counting Techniques. Axioms of Probability: Sample Space and Events, Axioms of Probability, Some Simple Propositions, Sample Spaces having Equally Likely Outcomes, Probability as a Continuous Set Function, and Probability as a Measure of Belief, Conditional Probability and Independence: Conditional Probability, Bayes's Formula, Independent Events. Discrete Random Variables: Random Variables, Discrete Random Variables, Expected Value, Expectation of a Function of a Random Variable, Variance, The Bernoulli and Binomial Random Variables, Properties of Binomial Random Variables, Computing the Binomial Distribution Function, The Poisson Random Variable, Computing the Poisson Distribution Function, Other Discrete Probability Distributions: The Geometric Random Variable, The Negative Binomial Random Variable, The Hypergeometric Random Variable, Expected Value of Sums of Random Variables, Properties of the Cumulative Distribution Function.

Continuous Random Variables: Expectation and Variance of Continuous Random Variables, The Uniform Random Variable, Normal Random Variable, The Normal Approximation to the Binomial Distribution, Exponential Random Variable, The Distribution Function of a Random Variable.

Jointly Distributed Random Variables: Joint Distribution, Independent Random Variables, Sums of Independent Random Variables, Identically Distributed Uniform Random Variables, Normal Random Variables, Poisson and Binomial Random Variables, Conditional Distributions: Discrete Case, Conditional Distributions: Continuous Case, Joint Probability Distribution of Functions of Random Variables, Exchangeable Random Variables.

Properties of Expectation: Expectation of Sums of Random Variables, Obtaining Bounds from Expectations via the Probabilistic Method, The Maximum–Minimums Identity, Moments of the Number of Events that Occur, Covariance, Variance of Sums and Correlations, Conditional Expectation, Computing Expectations by

Conditioning, Computing Probabilities by Conditioning, Conditional Variance, Conditional Expectation and Prediction, Moment Generating Functions, Joint Moment Generating Functions.

Students will be introduced by SPSS

Course Outcomes: Students who successfully complete this course should be able todemonstrate understanding of:

- basic probability axioms and rules
- Discrete and continuous random variables
- Marginal and conditional distributions of bivariate random variables.
- Expectation and moment generating functions.

Text Book:

1. Sheldon M. Ross (B1), A First Course in Probability (8th Ed.) Pearson Education, 2010
2. Sheldon M. Ross (B2), Introductory Statistics (3th Edition) Elsevier, 2010.

Reference Books

- M. H. DeGroot and M. J. Schervish: Probability and Statistics (3rd Edition), Addison-Wesley, 2002.
- Papoulis, Probability, Random Variables, and Stochastic Processes, (3rd Edition),McGraw Hill, 1991.
- Robert B. Ash, Basic Probability Theory, Dover. 2008.
- R. E. Walpole, R. H. Myers, S. L. Myers and Keying Ye, Probability and Statistics forEngineers and Scientists (7th Edition), Prentice Hall, 2002

Students will be required to implement the contents in SPSS

Weekly Breakdown		
Week	***Section***	***Topics***
1	**(B2)** 1.2, 2.2, 3.2-3.5	Introduction to Descriptive Statistics: Collection and Presentation of SampleData. Some Important Features of Sample Data.
2	**(B1)**1.1-1.5	Counting techniques: Permutations, Combinations.
3	2.1-2.3	Sample Space and Events, Axioms of Probability.
4	2.4-2.7	Some Simple Propositions, Sample Spaces having Equally Likely Outcomes, Probability as a Continuous Set Function, Probability as a Measure of Belief.
5	3.1-3.4	Conditional Probabilities, Bayes's Formula, Independent Events.
6	4.1-4.4	Random Variables, Discrete Random Variables, Expected Value, Expectationof a Function of a Random Variable.
7	4.5, 4.6	Variance, The Bernoulli and Binomial Random Variables, Properties of Binomial Random Variables, Computing the Binomial Distribution Function.
8	4.7, 4.8	The Poisson Random Variable, Computing the Poisson Distribution Function,Other Discrete Probability Distributions: The Geometric Random Variable, The Negative Binomial Random Variable, The Hypergeometric Random Variable.
9	**Mid Semester Exam**	

10	4.9,4.10, 5.1-5.3	Expected Value of Sums of Random Variables, Properties of the CumulativeDistribution Function, Expectation and Variance of Continuous Random, Variables, The Uniform Random Variables.
11	5.4, 5.5	Normal Random Variables, The Normal Approximation to the BinomialDistribution, Exponential Random Variable.
12	5.7, 6.1	The Distribution of a Function of a Random Variable, Joint Distribution.
13	6.2-6.3	Independent Random Variables, Sums of Independent Random Variables,Identically Distributed Uniform Random Variables, Normal Random Variables, Poisson and Binomial Random Variables.
14	6.4-6.7	Conditional Distributions: Discrete Case, Conditional Distributions: Continuous Case, Joint Probability Distribution of Functions of Random Variables, Exchangeable Random variables.
15	7.1-7.3	Expectation of Sums of Random Variables, Obtaining Bounds from Expectations via the Probabilistic Method, The Maximum–Minimums Identity, Moments of the Number of Events that occur.
16	7.4-7.6	Covariance, Variance of Sums, and Correlations, Conditional, Expectation, Computing Expectations by Conditioning, Computing Probabilities by Conditioning, Conditional Variance, Conditional Expectation and Prediction,
17	7.7	Moment Generating Functions, Joint Moment Generating Functions.
18	**End Semester Exam**	