# Ma 351 Theory of Probability (Fall 2011)

**Time and Place.** M,W,F 12:30-1:50, E382

**Instructor.** Dr. Gabriela Sanchis, 384 G Esbenshade Hall, Office Phone: 361-1339

**E-mail.** sanchisgr@etown.edu

**Office Hours.** M, W: 2-3:20; T, Th: 11:00-12:00; and by appointment.

**Textbook.** Fundamentals of Probability with Stochastic Processes (3rd Edition) by Saeed Ghahramani

**Prerequisites.** Ma 222 and Ma 235.

**Course Objectives.** To provide an elementary introduction to the mathematical theory of probability and the many diverse possible applications of the subject.

**Learning Outcomes.** Students will be able to:

- Define various probabilistic concepts.
- Apply combinatorial methods to compute probabilities of events where the sample space is finite or countably infinite.
- Compute conditional probabilities.
- Solve problems involving discrete and continuous random variables.
- Solve problems involving jointly distributed random variables.
- Compute moment-generating functions of random variables and use them to solve problems.
- Apply the Central Limit Theorem to solve problems.

**Attendance.** You are expected to attend all classes. Excessive amounts of absenteeism may result in a lower grade. If you do miss a class, it is your responsibility to obtain from a classmate any notes, assignments, handouts, or anything else you may have missed.

**Homework.** There will be weekly homework assignments which will be collected and graded. You may work together on these assignments, but you must write up and hand in your own solutions. To receive full credit on a problem, your solution must be complete, accurate, clearly written, and easy to follow. Homework must be turned in at the beginning of class on the due date. Your lowest homework grade will be dropped.

**Exams.** There will be three in-class exams, tentatively scheduled for Wednesdays September 28 and November 2, and Friday December 2. Your comprehensive final exam is scheduled for Thursday, December 15, 2:30 to 5:30 p.m.

**Academic Integrity.** All work must be one's own and must comply with the Standards of Academic Integrity defined in the Elizabethtown College Catalog (see http://catalog.etown.edu/ and then click on **Academic Policies** in the menu on the left, and then on **Academic Judicial System**). More specifically, no collaboration is allowed on exams. Collaboration on homework is allowed as described above in the section on homework.

**Grading.** 94-100 A; 90-93 A-; 87-89 B+; 83-86 B; 80-82 B-; 77-79 C+; 73-76 C; 70-72 C-; 67-69 D+; 63-66 D; 60-62 D-; below 60 F

Course grades will be calculated according to the following weighting:
Homework: 20% In-Class Exams: 55% Final Exam: 25%
(The lowest of your four exam grades will count 11% and the two others will count 22% each.)

**Disability.** Elizabethtown College welcomes otherwise qualified students with disabilities to participate in all of its courses, programs, and activities. If you have a documented disability and require accommodations to access course material, activities, or requirements, you must:

(1) Contact the Director of Disability Services, Lynne Davies, in the Center for Student Success, BSC 228, by phone (361-1227) or email daviesl@etown.edu.
(2) Meet with me, the instructor, within two weeks of receiving a copy of the accommodation letter from Disability Services to discuss your accommodation needs and their implementation.

# Tentative List of Topics

**Chapter 1: Axioms of Probability**
1.1 Introduction
1.2 Sample Space and Events
1.3 Axioms of Probability
1.4 Basic Theorems

**Chapter 2: Combinatorial Methods**
2.1 Introduction
2.2 Counting Principle
2.3 Permutations
2.4 Combinations

**Chapter 3: Conditional Probability and Independence**
3.1 Conditional Probability
3.2 Law of Multiplication
3.3 Law of Total Probability
3.4 Bayes' Formula
3.5 Independence

**Chapter 4: Distribution Functions and Discrete Random Variables**
4.1 Random Variables
4.2 Distribution Functions
4.3 Discrete Random Variables
4.4 Expectations of Discrete Random Variables
4.5 Variances and Moments of Discrete Random Variables

**Chapter 5: Special Discrete Distributions**
5.1 Bernoulli and Binomial Random Variables
5.2 Poisson Random Variable
5.3 Other Discrete Random Variables

**Chapter 6: Continuous Random Variables**
6.1 Probability Density Functions
6.2 Density Function of a Function of a Random Variable
6.3 Expectations and Variances

**Chapter 7: Special Continuous Random Variables**
7.1 Uniform Random Variable
7.2 Normal Random Variable
7.3 Exponential Random Variable
7.4 Gamma Distribution

**Chapter 8: Bivariate Distributions**
8.1 Joint Distribution of Two Random Variables
8.2 Independent Random Variables
8.3 Conditional Distributions

**Chapter 9: Multivariate Distributions**
9.1 Joint Distribution of $n > 2$ Random Variables
9.2 Order Statistics

**Chapter 10: More Expectations and Variances**
10.1 Expected Values of Sums of Random Variables
10.2 Covariance
10.3 Correlation
10.4 Conditioning on Random Variables

**Chapter 11: Sums of Independent Random Variables and Limit Theorems**
11.1 Moment-Generating Functions
11.2 Sums of Independent Random Variables
11.3 Markov and Chebyshev Inequalities
11.4 Law of Large Numbers
11.5 Central Limit Theorem