Course basics: This course is an introduction to probability done from its basics on up. This area is of intrinsic mathematical interest, and is also a foundation for more advanced work in statistics, probability, neural network theory, engineering, management, finance, and many areas of applied mathematics. Many current papers in mainstream engineering, neural network, and computer science journals have applications of probability theory as their central themes.

This course is an introduction to the field - we will survey the fundamentals, together with some standard applications.

Topics covered will include probability measures, random variables, independence, expected value, zero-one laws, laws of large numbers, central limit theorem, gambling systems, Markov chains, conditional probability and expectation, characteristic functions, and the foundations for martingales and Brownian motion. Other applications of these topics will be discussed.

The course will cover these topics from the context of mathematical analysis, and some experience and competence in analysis is required. We will focus on a rigorous exposition of probability theory from its foundations, in order to enable students to do research and applications of the theory with a capability for using its full scope.

Grading: Grades will be computed as follows. There will a midterm and a take-home final. The midterm will count 25%, and the final, 35% of the final grade. Homework scores will contribute to 30% of the final grade. An additional 10% of the grade is for coming to and participating in class, a very important part of the course.

Homework: Homework will generally be assigned out of the text, with an assignment due on Thursday of each week.

Importance of exposition in homeworks: In a course like this, it is natural to emphasize the notion of rigorous exposition. This is reflected in the need for rigor and care in written problem solutions. I will emphasize the need for good written communication of ideas in the homework assignments, and the ability to formalize intuitive mathematical notions clearly.
This will include the requirement of well written and thought-out problem solutions. Feel free to consult with me on what will be expected of you here.

**Textbook:** We will use Billingsley’s book *Probability and Measure*, third edition.

**Problem suggestions:** Please note that suggestions for problems are given at the end of the textbook.