Statistics 530 (Fall Term 2002)

Probability
Professor J. Michael Steele

Prerequisites: This course is designed to serve as a first graduate course in probability theory, and the only formal prerequisites are a knowledge of undergraduate probability (at the level of Statistics 430) and a knowledge of real analysis (at the level of a solid course in advanced calculus). Nevertheless, the course will move quickly and even students with a much stronger mathematical background will find room for personal challenges.

Course Objectives: This course hopes to provide students with a solid foundation in probability theory that can serve as the basics for doctoral studies in statistics, econometrics, finance, and related fields. The first two thirds of the course is based on the development of all of the tools that are needed for a thoroughly professional (industrial strength!) mastery of the strong law of large numbers and the central limit theorem in all their many shades. Along the way, the course will develop the measure theory that is necessary for a modern understanding of probability theory (including Kolmogrov’s O-1 law, the pi-lambda theorem, and conditional expectations), and it will develop considerable analytic machinery (including the theory of characteristic functions, Lévy’s inversion formula, and continuity theorem).

The last third of the course will focus on martingales in discrete time, and the main results obtained will include Doob’s stopping time theorem and the martingale convergence theorem. This course will not cover Markov process, Brownian motion, continuous time martingales, or stochastic calculus; these topics are addressed in Statistics 531 (Stochastic Processes) and Statistics 955 (Stochastic Calculus).

In accordance with the interests of the attending students, the course may address some special topics, such as the new game theoretic interpretations of the law of large numbers, Talagrand’s concentration inequalities, or Stein’s method for estimation of expectations.

Texts: The class will follow rather closely a set of notes that will be made available as the course progresses. Still, the notes do not cover everything, and the text *A Users Guide to Measure Theoretic Probability* by David Pollard is also required — but do not be put off by the title, measure theory will take up a relatively fraction of our energy and what we need will be developed from scratch. For the later part of the course, the text *Probability and Martingales* by Williams is recommended but not required.

Grading: Grades are based on regular homework (40%) and a take-home final (60%). Auditors are welcome.

Office Hours: Will be determined shortly.