Preface

There are several good current probability books — Billingsley (1995), Durrett (1991), Port (1994), Fristedt and Gray (1997), and I still have great affection for the books I was weaned on — Breiman (1992), Chung (1974), Feller (1968, 1971) and even Loève (1977). The books by Neveu (1965, 1975) are educational and models of good organization. So why publish another? Many of the existing books are encyclopedic in scope and seem intended as reference works, with navigation problems for the beginner. Some neglect to teach any measure theory, assuming students have already learned all the foundations elsewhere. Most are written by mathematicians and have the built in bias that the reader is assumed to be a mathematician who is coming to the material for its beauty. Most books do not clearly indicate a one-semester syllabus which will offer the essentials.

I and my students have consequently found difficulties using currently available probability texts. There is a large market for measure theoretic probability by students whose primary focus is not mathematics for its own sake. Rather, such students are motivated by examples and problems in statistics, engineering, biology and finance to study probability with the expectation that it will be useful to them in their research work. Sometimes it is not clear where their work will take them, but it is obvious they need a deep understanding of advanced probability in order to read the literature, understand current methodology, and prove that the new technique or method they are dreaming up is superior to standard practice.

So the clientele for an advanced or measure theoretic probability course that is primarily motivated by applications outnumbers the clientele deeply embedded in pure mathematics. Thus, I have tried to show links to statistics and operations research. The pace is quick and disciplined. The course is designed for one semester with an overstuffed curriculum that leaves little time for interesting excursions or

personal favorites. A successful book needs to cover the basics clearly. Equally important, the exposition must be efficient, allowing for time to cover the next important topic.

Chapters 1, 2 and 3 cover enough measure theory to give a student access to advanced material. Independence is covered carefully in Chapter 4 and expectation and Lebesgue integration in Chapter 5. There is some attention to comparing the Lebesgue vs the Riemann integral, which is usually an area that concerns students. Chapter 6 surveys and compares different modes of convergence and must be carefully studied since limit theorems are a central topic in classical probability and form the core results. This chapter naturally leads into laws of large numbers (Chapter 7), convergence in distribution, and the central limit theorem (Chapters 8 and 9). Chapter 10 offers a careful discussion of conditional expectation and martingales, including a short survey of the relevance of martingales to mathematical finance.

Suggested syllabi: If you have one semester, you have the following options: You could cover Chapters 1–8 plus 9, or Chapters 1–8 plus 10. You would have to move along at unacceptable speed to cover both Chapters 9 and 10. If you have two quarters, do Chapters 1–10. If you have two semesters, you could do Chapters 1–10, and then do the random walk Chapter 7 and the Brownian Motion Chapter 6 from Resnick (1992), or continue with stochastic calculus from one of many fine sources.

Exercises are included and students should be encouraged or even forced to do many of them.

Harry is on vacation.

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