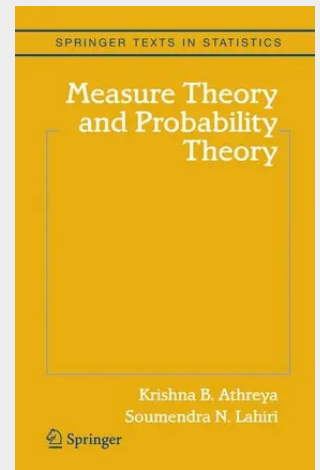


Measure Theory and Probability Theory

This is a graduate level textbook on measure theory and probability theory. It presents the main concepts and results in measure theory and probability theory in a simple and easy-to-understand way. It further provides heuristic explanations behind the theory to help students see the big picture. The book can be used as a text for a two semester sequence of courses in measure theory and probability theory, with an option to include supplemental material on stochastic processes and special topics. It is intended primarily for first year Ph.D. students in mathematics and statistics although mathematically advanced students from engineering and economics would also find the book useful. Prerequisites are kept to the minimal level of an understanding of basic real analysis concepts such as limits, continuity, differentiability, Riemann integration, and convergence of sequences and series. A review of this material is included in the appendix.

This book arose out of two graduate courses that the authors have taught during the past several years; the first one being on measure theory followed by the second one on advanced probability theory. The traditional approach to a first course in measure theory, such as in Royden (1988), is to teach the Lebesgue measure on the real line, then the differentiation theorems of Lebesgue, L^p -spaces on $\mathbb{R}$, and do general measure at the end of the course with one main application to the construction of product measures. This approach does have the pedagogic advantage of seeing one concrete case first before going to the general one. But this also has the disadvantage in making many students' perspective on measure theory somewhat narrow. It leads them to think only in terms of the Lebesgue measure on the real line and to believe that measure theory is intimately tied to the topology of the real line. As students of statistics, probability, physics, engineering, economics, and biology know very well, there are mass distributions that are typically nonuniform, and hence it is useful to gain a general perspective. This book attempts to provide that general perspective right from the beginning. The opening chapter gives an informal introduction to measure and integration theory. It shows that the notions of σ -algebra of sets and countable additivity of a set function are dictated by certain very natural approximation procedures from practical applications and that they are not just some abstract ideas.



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