Preface to the Second Edition

In the second edition of this book many errors have been corrected. Furthermore, the text has been extended carefully in many places. In particular, there are more exercises and a lot more illustrations.

I would like to take the opportunity to thank all of those who helped improving the first edition of this book, in particular: Michael Diether, Maren Eckhoff, Christopher Grant, Matthias Hammer, Heiko Hoffmann, Martin Hutzenthaler, Martin Kolb, Manuel Mergens, Thal Nowik, Felix Schneider, Wolfgang Schwarz and Stephan Tolksdorf.

A constantly updated list of errors can be found at www.aklenke.de.

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Achim Klenke
Preface to the First Edition

This book is based on two four-hour courses on advanced probability theory that I have held in recent years at the universities of Cologne and Mainz. It is implicitly assumed that the reader has a certain familiarity with the basic concepts of probability theory, although the formal framework will be fully developed in this book.

The aim of this book is to present the central objects and concepts of probability theory: random variables, independence, laws of large numbers and central limit theorems, martingales, exchangeability and infinite divisibility, Markov chains and Markov processes, as well as their connection with discrete potential theory, coupling, ergodic theory, Brownian motion and the Itô integral (including stochastic differential equations), the Poisson point process, percolation and the theory of large deviations.

Measure theory and integration are necessary prerequisites for a systematic probability theory. We develop it only to the point to which it is needed for our purposes: construction of measures and integrals, the Radon–Nikodym theorem and regular conditional distributions, convergence theorems for functions (Lebesgue) and measures (Prohorov) and construction of measures in product spaces. The chapters on measure theory do not come as a block at the beginning (although they are written such that this would be possible; that is, independent of the probabilistic chapters) but are rather interlaced with probabilistic chapters that are designed to display the power of the abstract concepts in the more intuitive world of probability theory. For example, we study percolation theory at the point where we barely have measures, random variables and independence; not even the integral is needed. As the only exception, the systematic construction of independent random variables is deferred to Chapter 14. Although it is rather a matter of taste, I hope that this setup helps to motivate the reader throughout the measure-theoretical chapters.

Those readers with a solid measure-theoretical education can skip in particular the first and fourth chapters and might wish only to look up this or that.

In the first eight chapters, we lay the foundations that will be needed in all subsequent chapters. After that, there are seven more or less independent parts, consisting of Chaps. 9–12, 13, 14, 15–16, 17–19, 20 and 23. The chapter on Brownian motion
(21) makes reference to Chaps. 9–15. Again, after that, the three blocks consisting of Chaps. 22, 24 and 25–26 can be read independently.

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I am especially indebted to my wife Katrin for proofreading the English manuscript and for her patience and support.

I would be grateful for further suggestions, errors etc. to be sent by e-mail to math@aklenke.de

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