

Preface

This book originates from a set of lecture notes for graduate classes I delivered since 2005, first at the Paul Sabatier University in Toulouse, and then at Purdue University in West Lafayette. The lecture notes benefited much from the input and criticism from several students and have been modified and expanded numerous times before reaching the final form of this book.

My motivation is to present at the graduate level and in a concise but complete way the most important tools and ideas of the classical theory of continuous time processes and at the same time introduce the readers to more advanced theories: the theory of Dirichlet forms, the Malliavin calculus and the Lyons rough paths theory.

Several exercises of various levels are distributed throughout the text in order to test the understanding of the reader. Results proved in these exercises are sometimes used in later parts of the text so I really encourage the reader to have a dynamic approach in his reading and to try to solve the exercises.

I included at the end of each chapter a short section listing references for the reader wishing to complement his reading or looking for more advanced theories and topics.

Chapters 1, 2, 5 and 6 are essentially independent from Chapters 3 and 4. I often used the materials in Chapters 1, 2, 5 and 6 as a graduate course on stochastic calculus and Chapters 3 and 4 on their own as a course on Markov processes and Markov semigroups assuming some of the basic results of Chapter 1. Chapter 7 is almost entirely independent from the other chapters. It is an introduction to Lyons rough paths theory which offers a deterministic approach to understand differential equations driven by very irregular processes including as a special case Brownian motion.

To conclude, I would like to express my gratitude to the students who pointed out typos and inaccuracies in various versions of the lecture notes leading to this book and to my colleague Cheng Ouyang for a detailed reading of an early draft of the manuscript. Of course, all the remaining typos and mistakes are my own responsibility and a list of corrections will be kept online on my personal blog. Finally, I thank Igor Kortchmeski for letting me use his nice picture of a random stable tree on the cover of the book.

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