Preface

There are already several excellent books on Malliavin calculus. However, most of them deal only with the theory of Malliavin calculus for Brownian motion, with [35] as an honorable exception. Moreover, most of them discuss only the application to regularity results for solutions of SDEs, as this was the original motivation when Paul Malliavin introduced the infinite-dimensional calculus in 1978 in [158]. In the recent years, Malliavin calculus has found many applications in stochastic control and within finance. At the same time, Lévy processes have become important in financial modeling. In view of this, we have seen the need for a book that deals with Malliavin calculus for Lévy processes in general, not just Brownian motion, and that presents some of the most important and recent applications to finance.

It is the purpose of this book to try to fill this need. In this monograph we present a general Malliavin calculus for Lévy processes, covering both the Brownian motion case and the pure jump martingale case via Poisson random measures, and also some combination of the two. We also present many of the recent applications to finance, including the following:

- The Clark–Ocone theorem and hedging formulae
- Minimal variance hedging in incomplete markets
- Sensitivity analysis results and efficient computation of the “greeks”
- Optimal portfolio with partial information
- Optimal portfolio in an anticipating environment
- Optimal consumption in a general information setting
- Insider trading

To be able to handle these applications, we develop a general theory of anticipative stochastic calculus for Lévy processes involving the Malliavin derivative, the Skorohod integral, the forward integral, which were originally introduced for the Brownian setting only. We dedicate some chapters to the generalization of our results to the white noise framework, which often turns out to be a suitable setting for the theory. Moreover, this enables us to prove
results that are general enough for the financial applications, for example, the
generalized Clark–Ocone theorem.

This book is based on a series of courses that we have given in different
years and to different audiences. The first one was given at the Norwegian
School of Economics and Business Administration (NHH) in Bergen in 1996,
at that time about Brownian motion only. Other courses were held later, every
time including more updated material. In particular, we mention the courses
given at the Department of Mathematics and at the Center of Mathematics for
Applications (CMA) at the University of Oslo and also the intensive or com-
 pact courses presented at the University of Ulm in July 2006, at the University
of Cape Town in December 2006, at the Indian Institute of Science (IIS) in
Bangalore in January 2007, and at the Nanyang Technological University in

At all these occasions we met engaged students and attentive readers.
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