

Preface

Stochastic analysis is currently undergoing a period of intensive research and various new developments, motivated in part by the need to model, understand, forecast, and control the behavior of many natural phenomena that evolve in time in a random way. Such phenomena appear in the fields of finance, telecommunications, economics, biology, geology, demography, physics, chemistry, signal processing, and modern control theory, to mention just a few.

Often, it is very convenient to use stochastic differential equations and stochastic processes to study stochastic dynamics. In such cases, research needs the guarantee of some theoretical properties, such as the existence and uniqueness of the stochastic equation solution. Without a deep understanding of the nature of the stochastic process this is seldom possible. The theoretical background of both stochastic processes and stochastic differential equations are therefore very important.

Nowadays, quite a few stochastic differential equations can be solved by means of exact methods. Even if this solution exists, it cannot necessarily be used for computer simulations, in which the continuous model is replaced by a discrete one. The problems of “ill-posed” tasks, the “stiffness” or “stability” of the system limit numerical approximations of the stochastic differential equation. As a result, new approaches for the numerical solution and, consequently, new numerical algorithms are also very important.

This volume contains 8 refereed papers dealing with these topics, chosen from among the contributions presented at the international conference on *Stochastic Analysis and Applied Probability* (SAAP 2010), which was held at Yasmine-Hammamet, Tunisia, from 7 to 9 October 2010. This conference was organized by the “Applied Mathematics & Mathematical Physics” research unit of the preparatory institute to the military academies of Sousse, Tunisia. It brought together some 60 researchers and PhD students, from 14 countries and 5 continents. Through lectures, communications, and posters, these researchers reported on theoretical, numerical, or application work as well as on significant results obtained for several topics within the field of stochastic analysis and probability, particularly for “Stochastic processes and stochastic differential equations.” The conference program was planned by an international committee chaired by Mounir Zili (Preparatory Institute

to the Military Academies of Sousse, Tunisia) and consisted of Darya Filatova (Jan Kochanowski University in Kielce, Poland), Ibtissem Hdhiri (Faculty of Sciences of Gabès, Tunisia), Ciprian A. Tudor (University of Lille, France), and Mouna Ayachi (Faculty of Sciences of Monastir, Tunisia).

As this book emphasizes the importance of numerical and theoretical studies of the stochastic differential equations and stochastic processes, it will be useful for a wide spectrum of researchers in applied probability, stochastic numerical and theoretical analysis and statistics, as well as for graduate students.

To make it more complete and accessible for graduate students, practitioners, and researchers, we have included a survey dedicated to the basic concepts of numerical analysis of the stochastic differential equations, written by Henri Schurz. This survey is valuable not only due to its excellent theoretical conception with respect to modern tendencies, but also with regard to its comprehensive concept of the dynamic consistency of numerical methods for the stochastic differential equations. In a second paper, motivated by its applications in econometrics, Ciprian Tudor develops an asymptotic theory for some regression models involving standard Brownian motion and the standard Brownian sheet. The result proved in this paper is an impressive example of convergence in distribution to a non-Gaussian limit. The paper “General shot noise processes and functional convergence to stable processes” by Wissem Jedidi, Jalal Almhana, Vartan Choulakian, and Robert McGorman also addresses the topic of stochastic processes, and the authors consider a model appropriate for the network traffic consisting of an infinite number of sources linked to a unique server. This model is based on a general Poisson shot noise representation, which is a generalization of a compound Poisson process. In the fourth paper of this volume, Charles El-Nouty deals with the lower classes of the sub-fractional Brownian motion, which has been introduced to model some self-similar Gaussian processes, with non-stationary increments. Then, in a paper by Mohamed Erraoui and Youssef Ouknine, the bounded variation of the flow of a stochastic differential equation driven by a fractional Brownian motion and with non-Lipschitz coefficients is studied. In the sixth paper, Antoine Ayache and Qidi Peng develop an extension of several probabilistic and statistical results for stochastic volatility models satisfying some stochastic differential equations for cases in which the fractional Brownian motion is replaced by the multifractional Brownian motion. The advantage of the multifractional stochastic volatility models is that they allow account variations with respect to time of volatility local roughness. The seventh paper was written by Archil Gulisashvili and Josep Vives and addresses two-sided estimates for the distribution density of standard models, perturbed by a double exponential law. The results obtained in this paper can especially be used in the study of distribution densities arising in some stochastic stock price models. And in the last paper in the volume, Mario Lefebvre explicitly solves the problem of maximizing a function of the time spent by a stochastic process by arriving at solutions of some particular stochastic differential equations.

All the papers presented in this book were carefully reviewed by the members of the SAAP 2010 Scientific Committee, a list of which is presented in the appendix.

We would like to thank the anonymous reviewers for their reports and many others who contributed enormously to the high standards for publication in these proceedings by carefully reviewing the manuscripts that were submitted.

Finally, we want to express our gratitude to Marina Reizakis for her invaluable help in the process of preparing this volume edition.

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Mounir Zili
Daria Filatova

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