

Preface

This volume contains the Proceedings of the *Fifth Seminar on Stochastic Analysis, Random Fields and Applications*, which took place at the Centro Stefano Franscini (Monte Verità) in Ascona (Ticino), Switzerland, from May 30 to June 3, 2005. *All papers in this volume have been refereed.*

The previous four editions of this conference occurred in 1993, 1996, 1999 and 2002. This Seminar focused on fundamental aspects of stochastic analysis, such as stochastic partial differential equations (spde's) and random fields, but also emphasized applications to fields such as biostochastics, stochastic turbulence and, as in the previous editions, financial mathematics, which was the subject of the *Fifth Minisymposium on Stochastic Methods in Financial Models*.

One of the traditional topics of the Seminar, where a significant part of the organizers' research activity is located, is the area of *stochastic partial differential equations* and more generally infinite-dimensional diffusions. The state of the art of a large part of this subject was presented in several lectures that covered porous media equations, well-posedness for degenerate equations, pathwise integral methods, Navier-Stokes equations, and numerical schemes for spde's. In particular, the study of the equations which are related to fluid mechanics presents many challenging open questions. Within the broad area of random fields, in addition to the study of spde's, there is much activity concerning *random media* in discrete and continuous environments. One typical example of such a model is a system of stochastic differential equations where the drift is a random (and very often an irregular) field.

Among the areas of application we mentioned, research in *biostochastics* is developing in several separate directions. This conference covered: *neuroscience*, in which time series and dynamical systems, but also Gaussian random fields, are important tools; *genomic analysis*, which makes strong use of tools from probability theory such as hidden Markov chains; and *adaptive population evolution*, which naturally involves spde's and measure-valued processes.

As mentioned above, several talks were devoted to *turbulence*. In particular, recent investigations in partial differential equations such as Burgers, Euler and Navier-Stokes equations with stochastic perturbations were presented. As in the volume devoted to the Seminar of 2002, pathwise stochastic methods have also been implemented in several vortex filament models.

Concerning *financial mathematics*, an intense area of activity concerns random volatility models: different types of mean reverting processes, which are Markovian or have long memory, are used to describe the evolution of volatility. Another development makes use of statistical non-parametric estimates of the volatility process to filter market microstructure contaminations. Further research in this broad field is directed towards the valuation of volatility derivatives. Infinite-dimensional stochastic analysis (Dirichlet forms and Malliavin calculus) are used here for sensitivity analysis and for market stability indicators.

Two important topics, which were beginning to emerge during the previous edition of this conference, received special attention:

- *Energy and other commodity markets.* The continuing worldwide process of electricity market deregulation has turned the analysis of the structure of electricity prices into a topic of central importance. Electricity is different from other commodities due to its non storable nature. In this context, infinite-dimensional tools borrowed from the analysis of the term structure of interest rates appear, as well as Lévy processes in order to take into account price peaks.
- *Detection of insider trading.* This remains a challenging subject because of the problems caused by defaults of large companies, which are not anticipated by rating agencies. At the mathematical level, enlargement of filtration techniques and forward stochastic integrals, but also game theory approaches, are used to analyse the asymmetric behaviour of agents.

The *Minisymposium on Stochastic Methods in Financial Models* took place on June 2 and 3. As in other editions of these Ascona conferences, one afternoon was devoted to interactions between practitioners and the academic community. In the first part of the afternoon, talks by Marek Musiela (BNP Paribas), Franco Moriconi (Università di Perugia) and Hélyette Geman (Essec and Paris Dauphine) were featured. The afternoon concluded with two conferences coorganized with the “Dipartimento dell’ Economia e delle Finanze” of Ticino, both devoted to energy markets. The session was opened by Paolo Rossi (Director of the “Azienda Elettrica Ticinese”) whose presentation was titled “*Energy markets: the increasing need for analyzing data*”: it described the current state of the electricity market in Switzerland. This was followed by the lecture of Prof. René Carmona (Princeton University) whose title was “*Energy trading: new challenges in financial mathematics*”.

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Robert C. Dalang, Marco Dozzi and Francesco Russo
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