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Book review: Advances in mathematical finance by Michael C. Fu, Robert A. Jarrow, Ju-Yi J. Yen, Robert J. Elliott (Editors)

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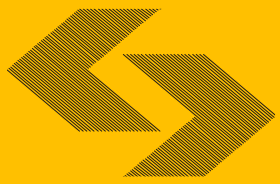

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Book review:

ADVANCES IN MATHEMATICAL FINANCE

by

Michael C. Fu, Robert A. Jarrow, Ju-Yi J. Yen, Robert J. Elliott (Editors)

The book is a *Festschrift* in honour of Dilip B. Madan, one of the best known scientists in mathematical finance. It is a collection of articles written by the participants of the "Mathematical Finance Conference in Honour of the 60th Birthday of Dilip B. Madan", which was organized at the Norbert Wiener Center of the University in Maryland, on September 29 – October 1, 2006.

The book is organized as follows. The Preface introduces the readers to the contents. There are also some photos of Dilip Madan and other participants of the conference at the end of it. The proper articles are divided into three parts and they are preceded by Career Highlights and List of Publications of Dilip Madan.

All articles are written by eminent world-known scientists from the field of mathematical finance and stochastic analysis. The articles contained in the first part are dedicated to stochastic processes and their applications to mathematical finance. The second part deals with asset pricing and hedging of derivatives. The third part contains contributions concerning credit risk and investments.

The first article in Part I, "The Early Years of the Variance-Gamma Process", written by Eugene Seneta, is a history of collaboration of Dilip Madan and the author. It presents the beginning of applications of the symmetric Variance-Gamma distribution and the Variance-Gamma (VG) process for log-price increments. It also describes the character of Dilip Madan as a man and a distinguished researcher. The next article, by Michael Fu, presents methods of simulation the VG process. It describes three methods of sequential sampling: Simulating VG as Gamma Time-Changed Brownian Motion, Simulating VG as Difference of Gammas, and Simulating VG as (Approximate) Compound Poisson Process. Among them the third method is the most general and can be applied to any Levy process. The article also presents two methods of bridge sampling: Simulating VG via Brownian (Gamma Time-Changed) Bridge and Simulating VG via Difference-of-Gammas Bridge. They are especially valuable for pricing path-dependent options. Moreover, the author considers variance reduction via important sampling. Finally, he discusses the problem of estimation

sensitivities of derivative prices with respect to various parameters, especially by using of infinitesimal perturbation analysis. Marc Yor, the author of the next two articles, is a long-time collaborator of Dilip Madan. Both articles are important from the mathematical point of view. The first one is dedicated to mathematical properties of gamma processes. Problems concerning the realisation of gamma bridges, the filtration of gamma bridges, absolute continuity relationships, the gamma process as an inverse local time and problems of time changes are considered. Some properties are compared with their Brownian counterparts. The second article of Marc Yor deals with some identities in law, which are equivalent to expressions of Selberg's integrals, involving beta, gamma and normal variables. In the final article of Part I, Robert J. Elliott and John van der Hoek present the white noise analysis and a new approach to the proof of Itô-type formulas for fractional Brownian motion.

Part II is dedicated to asset pricing and hedging problems. The first article of this part, written by Robert Jarrow, discusses notions of a zero volatility spread and an option adjusted spread applied to bonds with embedded options. The article by Robert Jarrow, Phillip Protter, and Kazuhiro Shimbo extends the theory of mathematical finance onto new facts concerning asset price bubbles in complete markets. It contains a martingale characterization of the bubbles. The asset price bubble is the asset market price less the asset fundamental price. The authors describe three types of bubbles, which can exist under the assumption of no-arbitrage: uniformly integrable martingales with an infinite lifetime (Type 1 bubbles), nonuniformly integrable martingales with finite, but unbounded lifetime (Type 2 bubbles), and Type 3 bubbles, i.e. strict local martingales that are not martingales, having a finite lifetime. Under an additional no-dominance assumption, only Type 1 bubbles exist. It is a significant contribution to description of the phenomenon of market bubbles. Then, the article by Xing Jin and Frank Milne is devoted to a construction of equilibrium model of asset markets with transaction costs and taxes. It is shown that for a general cost technology and a general tax system a competitive equilibrium exists. The authors of the next article, Ernst Eberlein and Wolfgang Kluge, notice that in spite of a long history of Levy processes, they were applied to mathematical finance for the first time in the last decade of the twentieth century. The article presents the problem of calibration of Levy term structure models with respect to the real-world measure and with respect to the risk-neutral martingale measure. In the next article, by Massoud Heidari, Ali Hirsa and Dilip Madan, an affine term structure model with stochastic volatility (ATSM) is applied to price swaptions. To this aim, the characteristic function of the log swap rate is obtained and the fast Fourier transform is used. The proposed method enables analyzing the cross-properties of swap rates and swaptions. The authors of the next article, Peter Carr and Ali Hirsa, use forward partial integrodifferential equations for up-and-out and down-and-out call options. It is assumed that the underlying assets are jump diffusions and the jump part of the returns process is an additive process. The framework used is a generalization of many other

models, e.g. Black-Scholes, Variance-Gamma and Merton jump diffusion model. The last article of Part II, written by Hélyette Geman, is dedicated to modelling energy commodity price using historical data. Furthermore, the hypothesis of mean reversion for oil and natural gas prices is tested.

Part III of the book is entitled "Credit Risk and Investments". In the article by Dorje Brody, Lane Hughston and Andrea Macrina there is a proposal of a new approach to credit risk modelling that avoids the use of inaccessible stopping times. In this approach the market filtration is modelled explicitly and it is generated by market information processes. The article also contains an analytical formula for the value of an option on a defaultable discount bond. The next article, written by Hansjörg Albrecher, Sophie Ladoucette and Wim Schoutens, unifies approaches for pricing collateralized debt obligations based on one-factor Gaussian, one-factor Variance-Gamma, normal inverse Gaussian factor and the Brownian Variance-Gamma models. In place of them more general generic one-factor Levy model is introduced and large homogeneous portfolio approximation is worked out. In this case the distribution functions for assets value can be analytically expressed. As a result, improvements with respect to computation times can be obtained. The main aim of the article by Ronnie Sircar and Thaleia Zariphopoulou is the analysis of the impact from risk aversion on the valuation of credit derivatives. In place of arbitrage-free measure application, the utility-based valuation methodology is used. The last article of Part III, written by Marek Musiela and Thaleia Zariphopoulou, is devoted to integrated portfolio management in incomplete markets. It contains an extension of the notion of forward dynamic utilities in a diffusion model with a correlated stochastic factor. Additionally, forward and backward utilities approaches are compared. The notion of forward dynamic utilities was earlier introduced and applied by the authors to a multiperiod incomplete binomial model.

The book is very interesting from both theoretical and practical points of view. The authors develop theoretical and application-oriented aspects of stochastic analysis, as well as simulation techniques for important classes of processes. All the presented contributions prove that the field of applications of stochastic processes, especially processes with stationary independent increments, is very an important and promising part of mathematical finance. I recommend this book for researchers, students and practitioners in mathematical finance.

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M.C. Fu, R.A. Jarrow, J.-Y.J. Yen, R.J. Elliott (Editors): *Advances in Mathematical Finance*. Birkhäuser-Springer. Series: Applied and Numerical Harmonic Analysis. XXVIII+340 pages, 2007. ISBN: 978-0-8176-4544-1. Price: 64.90 EUR (hardcover).