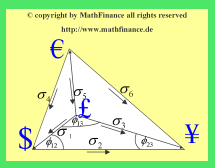
derivatives and risk management in theory and practice

Frankfurt MathFinance Workshop

1st–2nd April 2004

http://workshop.mathfinance.de/



1. Organising committee

- Dr Uwe Wystup, HfB/Commerzbank
- Tino Kluge, University of Oxford, OCIAM
- Susanne Griebsch, Goethe-University

The event takes place at HfB Audimax (Thursday) and in the conference room no 1, 7th floor, Commerzbank Tower (Friday). For further details refer to our web site or contact us at info@workshop.mathfinance.de.

2. Contents

The workshop is intended for practitioners of the areas of trading, quantitative or derivative research and risk management as well as for academics studying or researching in the field of financial mathematics or finance in general.
The talks during the two days of the workshop cover a broad range of current topics and are presented by internationally known academics and practitioners. There will be enough time for questions and discussions after each talk and additional breaks provide you the opportunity to build networks within the quantitative finance community.
The workshop will be held in English.

3. List of speakers

- Dr Ralph Bilger, d-fine
- Dr Andreas Binder, MathConsult, Linz
- Dr Damir Filipovic, ETH Zurich
- Dr Marcus Fleck, Dresdner Bank
- Dr Jürgen Hakala, Commerzbank
- Prof Dieter Hess, HfB, Frankfurt
- Dr Peter Neu, Dresdner Bank
- Dr Thorsten Oest, d-fine
- Dr Alex Popovici, Bonn University
- Prof LCG Rogers, University of Cambridge
- Prof Wolfgang Schmidt, HfB, Frankfurt
- Prof Robert Tompkins, HfB, Frankfurt

This event is supported by HfB and sponsored by

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4. Conference Programme

Wednesday, 1 April 2004: HfB Audimax

08:30 Registration

09:00 Dr Marcus Fleck
New Methods for measuring counterparty exposure consistent with Basel II Capital Accord
The Basel Committee acknowledged only recently that trading book issues have not been given sufficient attention over the past five years, and that the Committee had taken too conservative approach to counterparty risk of derivatives and repo-styled transactions. The stochastic nature of the default process combined with volatility in derivatives prices is a challenge not only for supervisiors but also for banking industry. Based on results from Monte Carlo Simulations we present new methods for measuring counterparty risk consistent with the Basel II framework. A fruitfull dialogue between industry representatives and the Basel Committee on those results has started already.

10:00 tea break

10:15 Prof LCG Rogers
Modelling liquidity and its effects
Liquidity is an important effect in the markets, yet it is hard to come up with a good definition, which not only has some economic explanation but also retains a reasonable degree of tractability. In this paper, we propose a simple microeconomic model in discrete time which carries over to the continuous-time setting; this results in a modification of the usual dynamics of portfolio wealth, which appears to be impossible to analyse exactly, though some asymptotic analysis can be carried through.

11:15 tea break

11:30 Dr Damir Filipovic
Swiss solvency test for insurers
I present and discuss the principles of the Swiss solvency test for insurers with regard to Solvency II.

12:30 lunch

14:00 Prof Dieter Hess
Does Information Quality Explain Asymmetric Price Reactions
It is well documented that the unanticipated news in the U.S. employment report trigger strong price reactions in bond markets around the world. Bayesian updating suggests that the quality of information, i.e. its precision, acts as a catalyst in determining the strength of the price reaction to a given piece of unanticipated information. However, it is difficult to test for this catalyzing effect due to a lack of precision data. Employing additional detail information, we extract release-specific precision measures. Based of these precision proxies, we show that prices respond significantly stronger to more precise information, even after controlling for an asymmetric price response to 'good' and 'bad' news.
This is joint work with Nikolaus Hautsch.

15:00 tea break

15:15 Dr Peter Neu
Statistical Mechanics of Financial Markets and Applications in Risk Management
An overview is given how concepts from statistical physics of disorder systems like scaling, universality, criticality, and bubble nucleation can be used to explain so called "stylized" facts of financial time series. Such facts, which cannot be explained by the in banking popular log-normal diffusion model, are, e.g.: Pareto distributed stock returns, long-ranged temporal volatility correlations (vs. short-ranged temporal stock return correlations), or negative return-volatility correlations. Besides the importance for market risk management it is shown how the dynamics underlying such phenomena is important for stress testing and capital allocation to credit risk and operational risk.

16:15 tea break

16:30 Prof Wolfgang Schmidt
Hedging Basket Credit Derivatives with CDS
We investigate the pricing of basket credit derivatives and their hedging with single name credit default swaps (CDS). The market in credit default swaps quotes fair insurance premiums (spreads) whose dynamics is the natural starting point of our model. Pricing basket credit derivatives requires a model for the dependencies between the default times. In case of a pure jump filtration, dependencies are characterized by default implied spread changes. In this setup we derive a simple system of integral equations involving the notional amounts of the dynamic hedge positions, the price and the spread of a basket derivative. We provide some numerical examples of explicit hedging strategies and valuations of first-to-default baskets illustrating the approach.

Friday, 2 April 2004: Commerzbank Tower, Kaiserplatz

08:30 Registration

09:00 Dr Jürgen Hakala
Higher order methods and non-uniform grid discretization in finite difference schemes for exotic option pricing

10:00 tea break

10:15 Dr Thorsten Oest
A New Approach To Option Pricing For Discrete Hedging And Non-Gaussian Processes
The Black-Scholes option pricing method is correct under certain assumptions, among others continuous hedging and a log-normal underlying process. If any of these two assumptions is not fulfilled, a risk-less replication of an option is in general not possible.
To handle this case, a new pricing method is proposed. In contrast to other methods, not the risk of a hedging portfolio, but the option price is minimized. For the option price minimization the ratio of the averaged return to the averaged risk of the hedging portfolio is fixed. This resulting hedging procedure makes the option most competitive on the market.
A case study for realistic European plain vanilla and binary options was done. Compared to other methods, the option price is up to 10 % lower. In the continuous time limit for a log-normal process, the result of the method converges towards the Black-Scholes result.

11:15 tea break

11:30 Dr Alex Popovici
Numerical analysis of extended Black-Scholes models
The multidimensional Black-Scholes model has been used as a basic and very effective tool for the valuation of derivative instruments in financial markets. In the last years empirical observations from the market (excess kurtosis, fat tails, smile and skew patterns of volatility surfaces, structural dependency between assets) hinted to the fact that the classical Black-Scholes framework is too restrictive for an accurate modelling of multidimensional financial markets. An extension of the Black-Scholes model focusing on the interdependency structure of assets and which delivers excellent result for pricing and hedging multi-asset financial derivatives was introduced by Albeverio and Steblovskaya in 2002. The aim of the talk is to present a numerical implementation of this model (historical estimation vs. calibration of parameters, pricing methods) and practical results obtained using market data (exotic options on baskets, volatility surfaces, etc). The advantages and drawbacks of this model will be discussed.

12:30 lunch

14:00 Dr Andreas Binder
Accuracy does matter: High-End Numerical Techniques for the Robust Pricing of Structured Financial Instruments
Many partial differential equations which arise in pricing of financial instruments under, say, short rate models, are, to speak in the language of engineers, reaction-convection-diffusion equations. In the one-dimensional case, it turns out that combining symbolic techniques (Greens's functions) and high order numerical integrations schemes delivers very accurate results also in cases where binomial trees fail. In the higher dimensional case, computational fluid dynamics has proven that finite element methods combined with streamline diffusion techniques are robust schemes for the treatment of these equations. We present the ideas behind these advanced numerical techniques.
Parameter calibration in interest rate models is a notorious instable problem. We present the reason behind this phenomenon, and how regularization techniques should be applied to stabilize the problem. This is joint work with MathConsult's Computational Finance Group. Part of the work has been supported by the Austrian Science Foundation (Project E67: "Fast Numerical Methods for Computational Finance").

15:00 tea break

15:15 Prof Robert Tompkins
Unconditional Return Disturbances: a Non Parametric Simulation Approach
Simulation methods are extensively used in Asset Pricing and Risk Management. The most popular of these simulation approaches, the Monte Carlo, requires model selection and parameter estimation. In addition, these approaches can be extremely computer intensive. Historical simulation has been proposed as a non-parametric alternative to Monte Carlo. This approach is limited to the historical data available.
In this paper, we propose an alternative historical simulation approach. Given a historical set of data, we define a set of standardized disturbances and we generate alternative price paths by perturbing the first two moments of the original path or by reshuffling the disturbances. This approach is totally non parametric when constant volatility is assumed, or semi-parametric in presence of GARCH (1,1) volatility and is shown without a loss in accuracy to be much more powerful in terms of computer efficiency than the Monte Carlo approach. This approach is extremely simple to implement and is shown to be an effective tool for the valuation of financial assets.
We apply this approach to simulate pay off values of options on the S&P 500 stock index for the period 1982-2003. To verify that this technique works, the common back-testing approach was used. The estimated values are insignificantly different from the actual S&P 500 options payoff values for the observed period.
This is joint work with Rita L. D'Ecclesia.
JEL classifications: C15, G13, G19
Keywords: Simulation Methods, Historical Simulation, Stochastic Volatility, Back-testing.

16:15 tea break

16:30 Dr Ralph Bilger
Valuation of American-Asian Options with the Longstaff-Schwartz Algorithm
The Least-Squares Monte Carlo (LSM) algorithm of Longstaff & Schwartz is a new and powerful approach for the valuation of the price of American options. This approach can also be applied to exotic, path-dependent options where the payoff and the value of the option depends on the value of the underlying, averaged over a given time-window (Asian options). So far, only American-Asian options have been considered where the starting point of the time window used for averaging is fixed. American-Asian options with rolling time-window, i.e. a time window of constant width are particularly complex since they constitute a non-Markovian problem, that can not be transformed to a problem with a finite number of state variables. In this work, the LSM algorithm is applied to American-Asian options with rolling time window. The value of the option is determined. The convergence of the algorithm is studied in dependence of the maximum degree of the polynomials used in the regression and the number of base variables.

5. Personal descriptions

Dr Ralph Bilger, d-fine
Ralph Bilger is a senior consultant at d-fine GmbH, and a lecturer in physics and mathematical finance in the physics department at Tübingen University. Before joining d-fine, Ralph was working as a consultant for the Financial and Commodity Risk Consulting group of Andersen, Eschborn, as a financial engineer for LBBW, Stuttgart and as an assistant professor for Tübingen University. Ralph holds a Masters degree from the State University of New York, Stony Brook, a Ph.D. and a Habilitation in particle physics from Tübingen University.

Dr Andreas Binder, MathConsult, Linz
Andreas Binder is CEO of MathConsult GmbH and of the Industrial Mathematics Competence Center, Linz. Andreas holds a Ph.D. in Industrial Mathematics from Linz. After a research period at the Oxford Centre for Industrial and Applied Mathematics, he became assistant professor at the University of Linz, until 1996, when he joined MathConsult. His research activities include numerical analysis of partial differential equations and stable techniques for paramater identification. Together with his group, he has been working on computational finance since 1997. In 2001, MathConsult released the UnRisk PRICING ENGINE, a package for the pricing of complex structured instruments. Andreas is member of the advisory board of the Austrian Mathematical Society.

Dr Damir Filipovic, ETH Zurich
Damir Filipovic works in the research and development group at the Swiss Federal Office of Private Insurance (FOPI). He develops methods for the new solvency test for Swiss insurance undertakings, which will be in force as of 2005. Before joining FOPI he was assistant professor at the Department of Operations Research and Financial Engineering (ORFE) at Princeton University. Damir Filipovic received his PhD in mathematics from ETH Zurich in 2000, where he is still affiliated as senior researcher.

Dr Marcus Fleck, Dresdner Bank
Marcus Fleck joint Group Risk Control of Dresdner Bank AG in 2001 in the beginning focussing mainly on market risk issues. As a member of the Strategic Risk & Treasury Control Department he started in 2002 to contribute to the ongoing Basel II consultation process in particular on questions regarding counterparty risk modeling for derivatives portfolios. Marcus Fleck obtained a PhD in theoretical physics from the Max-Planck Institute for Solid State Research and the University of Stuttgart.

Dr Jürgen Hakala, Commerzbank
Jürgen Hakala is Head of Quantitative Research in Commerzbank ZGS FX. His research areas are models and products for foreign exchange derivatives and hybrid interest rate and foreign exchange models. Computational Finance is a key element for all his activities. He received a masters degree in theoretical physics from the University of Karlsruhe and a Ph.D. in mathematics from the University of Bonn at the institute for Neural Networks.

Prof Dieter Hess, HfB, Frankfurt
Dieter Hess is currently Professor of Finance at the the Hochschule für Bankwirtschaft (Business School for Banking and Finance) in Frankfurt and Lecturer at the University of Karlsruhe. He worked several years at the Research Center for International Economic Integration and at the Center of Finance and Econometrics at the University of Konstanz and published articles on the microstructure of financial market, risk estimation, and announcement effects.

Dr Peter Neu, Dresdner Bank
After obtaining a degree in Physics from the Imperial College, London, and from the University of Heidelberg (Diploma, PhD), Peter Neu held a Post-Doc position at the Massachusetts Institute of Technology (MIT) in Cambridge, MA, where he specialized in stochastic dynamics of physical and chemical systems. In 1997 Peter joined Group Risk Control of Dresdner Bank AG. As a member of Group Strategic Risk & Treasury Control he worked at various market and credit risk projects and was heavily involved in building Dresdner's economic capital model. Since 2001 he is heading a team being responsible for liquidity risk control, which works in close co-operation with the Group Funding and Liquidity Management within Treasury.

Dr Thorsten Oest, d-fine
Thorsten Oest is senior consultant at d-fine GmbH where he was involved in implementation projects for risk, market data and treasury systems. He holds a MSc in mathematical finance from Oxford university and a PhD in experimental physics from the university of Hamburg. Before joining d-fine he was a research fellow at CERN (Geneva) and at DESY (Hamburg) working on data analysis for large physics experiments.

Dr Alex Popovici, Bonn University
Dr Alex Popovici is a research assistent at the University of Bonn. His research focus lies on equity models with stochastic volatility and jumps, equilibrium markets in continuous time, numerical methods for pricing and hedging exotic and structured products (Monte Carlo, numerical PDEs, Fourier methods). He received a Diploma (Masters) in Mathematics, a Diploma in Computer Science and a PhD from Bonn University and holds a DEA (Masters) degree in "Probability and Finance" from Paris VI University.

Prof LCG Rogers, University of Cambridge
Chris Rogers is Professor of Statistical Science at the University of Cambridge, where he moved in 2002 after nearly nine years at the University of Bath. He is the author of more than 100 publications, including the famous two-volume work, Diffusions, Markov Processes, and Martingales with David Williams. His Finance papers include the potential approach to term structure of interest rates, complete models of stochastic volatility, portfolio turnpike theorems, improved binomial pricing, and Monte Carlo valuation of American options. Chris is co-editor of Finance and Stochastics and an associate editor of several journals, including Mathematical Finance. He is a frequent speaker at industry conferences and courses.

Prof Wolfgang Schmidt, HfB, Frankfurt

Wolfgang M. Schmidt is currently Professor for Quantitative Methods at the Hochschule für Bankwirtschaft (Business School for Banking and Finance) in Frankfurt. From 1992 to 2002 he was Director and Head of Research and Analytics at Deutsche Bank AG in Frankfurt. Prior to joining Deutsche Bank he held teaching and research positions at the University of Jena, Berlin, Moscow and Tbilissi. He graduated in Mathematics from Dresden University of Technology and holds a PhD and Habilitation in the field of probability theory from the University of Jena. Prof. Schmidt is the author of research papers in the fields of probability theory, stochastic processes and mathematical finance as well as co-author (with S. Assing) of the book "Continuous Strong Markov Processes in Dimension One - A Stochastic Calculus Approach", Springer Verlag . His current research interests include mathematical finance, risk management, credit default modelling, term structure modelling.

Prof Robert G Tompkins, HfB, Frankfurt

Dr. Robert G. Tompkins was born in Oklahoma, USA and he received his A.B. (1980), his A.M. (1980) and his MBA (honors) (1986) from the University of Chicago. He moved to England in 1986 and subsequently became a British citizen. He earned a Ph.D. (1998) from the University of Warwick and his Habilitation (2000) from the University of Technology, Vienna, where Dr. Tompkins lived from 1998 to 2003.

Prof Uwe Wystup, HfB/Commerzbank

Uwe Wystup works in the FX product development team at Commerzbank Securities and as Professor of Quantitative Finance at HfB, Frankfurt. Before that he worked for Deutsche Bank, Citibank, UBS and Sal. Oppenheim jr. & Cie. He is founder and manager of the website MathFinance.de and the MathFinance newsletter. Uwe has a PhD in mathematical finance from Carnegie Mellon University. He also lectures on mathematical finance for Goethe University Frankfurt, organizes the Frankfurt MathFinance Colloquium and is founding director of the Frankfurt MathFinance Institute. His area of specialization are the quantitative aspects of foreign exchange markets. He recently published a book on Foreign Exchange Risk. Uwe has given many presentations at both universities and banks around the world. Uwe is editor of the Financial Engineering Review.