derivatives and risk management in theory and practice

Frankfurt MathFinance Workshop

April 3-5

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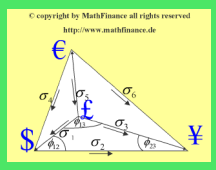

1. Organising committee

- Hans-Peter Deutsch, Andersen
- Götz Kersting, Frankfurt MathFinance Institute
- Tino Kluge, Chemnitz University of Technology
- Uwe Wystup, Commerzbank

The event takes place in Andersen and Commerzbank conference rooms. Further details are available on our web site.

2. Registration

Please register at *workshop@institute.mathfinance.de* and provide your name, affiliation, email address, mailing address and phone number. To cover the cost we have to ask the delegates to donate 300 Euro to the following bank account:

bank	Frankfurter Sparkasse
bank code	500 502 01
name	Goethe Universitaet
account number	28605
use	Sachkonto 530 50 000, Projektnum 305 00 000

You will get a donation receipt.

3. List of speakers

- Arun Bagchi, University of Twente
- Hans-Peter Deutsch, Andersen
- Jürgen Hakala, Commerzbank
- Wolfgang Härdle, Humboldt University of Berlin
- Norbert Hofmann, Goethe-University
- Tino Kluge, Chemnitz University of Technology
- Lutz Molgedey, Andersen
- Jörn Rank, Andersen
- L. C. G. Rogers, University of Bath
- Uwe Schmock, ETH and University of Zürich
- Ingo Schneider, BHF-Bank
- Peter Schwendner, Sal. Oppenheim jr. & Cie
- Tino Senge, Commerzbank
- Steven E. Shreve, Carnegie Mellon University
- Gerhard Stahl, Federal Banking Supervisory Office
- Hermann Stahl, Commerzbank
- Felix Streichert, University Tübingen
- Josef Teichmann, Technical University Vienna
- Robert Tompkins, Technical University Vienna
- Jürgen Topper, Andersen

This event is sponsored by

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4. Conference Programme

Wednesday, 3 April 2002: Kaisersaal, Commerzbank main branch, Kaiserstrasse 30

09:00 Registration

09:15 Tino Senge

Jump-Diffusion Models in Foreign Exchange Markets

Jump-diffusion models to price FX options will be considered. Different distributions for the jump size will be stated and analysed. Features and limitations of the obtained models will be presented. Besides theoretical results and notes on implementation, the question will be discussed whether this models can be used to price options taking the volatility smile in todays FX markets into account.

10:30 L. C. G. Rogers

Monte Carlo valuation of American options

This paper introduces a 'dual' way to price American options, based on simulating the path of the option payoff, and of a judiciously-chosen Lagrangian martingale. Taking the pathwise maximum of the payoff less the martingale provides an upper bound for the price of the option, and this bound is sharp for the optimal choice of Lagrangian martingale. As a first exploration of this method, three examples are investigated numerically; the accuracy achieved with even very simple-minded choices of Lagrangian martingale is surprising. The method also leads naturally to candidate hedging policies for the option, and estimates of the risk involved in using them.

11:30 Jürgen Hakala, Tino Kluge

Stochastic volatility models: A Finite Difference Approach Many exotic options are very sensitiv to changes in implied volatility. In such cases it is essential to have a model of the underlying which reflects the change of volatility with time quite well. One approach is Heston's stochastic volatility model which assumes that the volatility of an asset is a stochastic process itself. However for exotic options no closed form solutuions are known. Instead a PDE derived from the stochastic model is solved. We present some ideas and first results on how to improve the speed to calculate quite accurate prices using the Finite Difference Method.

12:45 lunch

14:00 Norbert Hofmann

Approximating the square root process We consider numerical methods for the simulation of paths of the square root process. We introduce a special implicit method that reflects the positivity of the exact dynamics. Moreover we show that the new method is suited to overcome stability problems. By means of simulation studies we compare the new method with the Euler scheme. It turns out that modifications of the Euler scheme fail.

This is joint work with Eckhard Platen (University of Technology Sydney, Australia).

14:45 Jörn Rank

Improving VaR Calculatuions by Using Copulas and Non-Gaussian Margins

Apart from historical simulation, most Value-at-Risk (VaR) methods assume a multivariate normal distribution of the risk factors. In this work we present the application of copulas for the calculation of the VaR. This enables us to use arbitrary distribution functions for the risk factros. The risk factors themselves are linked together by a copula function that describes the dependence structure between them. We discuss the modification of the Monte-Carlo (MC) method of the VaR calculation under this generalization. Usinga financial portfolio based on historical FX rates over a period of ten years, we compare the backtesting results obtained from the "traditional" MC method with the one from the "copula" MC method, using various copulas and various distribution functions for the margins.

15:45 tea break

16:00 Josef Teichmann

On finite dimensional Term structure models

We provide the characterization of all finite-dimensional Heath–Jarrow–Morton models that admit arbitrary initial yield curves. It is well known that affine term structure models with time-dependent coefficients (such as the Hull–White extension of the Vasicek short rate model) perfectly fit any initial term structure. We find that such affine models are in fact the only finite-factor term structure models with this property. We also show that there is usually an invariant singular set of initial yield curves where the affine term structure model becomes time-homogeneous. We also argue that other than functional dependent volatility structures – such as local state dependent volatility structures – cannot lead to finite-dimensional realizations. Finally, our geometric point of view is illustrated by several examples.

17:00 Hermann Stahl

Documentation of OTC Derivatives and other Financial Instruments

The markets for OTC derivatives and securities repurchase and lending have created their own documentation standards. Transactions are documented with trade confirmations which refer to a master agreement. The master agreement provides for the legal and credit terms and integrates all transactions into the master agreement by forming one single agreement. Organizations on national and international level have produced master agreements for various types of business and published sets of definitions that simplify the task of documenting individual trades.

A positive side effect of master agreements is that the credit exposure that both parties have under the various transactions may be netted for capital adequacy purposes.

Thursday, 4 April 2002: Andersen building, Eschborn, Mergenthalerallee 55

08:30 Hans-Peter Deutsch

Second Order Approximations for Fast Value-at-Risk Computations

As soon as a portfolio contains significant optionality standard (delta normal) variance-covariance Value-at-Risk calculations lead to very inaccurate results while full fledge Monte Carlo Simulations with full re-pricing often involve unacceptably long computing time. A natural compromise is to extend the delta normal variance-covariance methods to include 2nd order terms of the portfolio value's taylor expansion. This talk highlights the algebraic, analytical and statistical tasks involved when doing such a delta-gamma approximation and presents several different alternative ways for calculating a Value at Risk in such a framework.

10:00 Felix Streichert

Evolutionary Alogrithms and Finanical Applications

Evolutionary Algorithms (EA) constist of serveral heuristics which are able to solve optimization tasks by imitating some aspects of natural evolution. They may use different levels of abstraction, but they are always working on whole populations of possible solutions for a given task. EAs are an approved set of heurisitcs which are flexible to use and postulate only neglectible requirements on the optimization task.

As a practical application technical trading rules found by the use of EA will be presented.

10:50 tea break

11:15 Gerhard Stahl

Modelling Event Risk

The talk will review the on-going joint work with E. Platen, Sydney, on modelling specific market risk for equities. The talk will cover the following topics: benchmarked prices as basic inputs of risk models, modelling event risk based on t-distributions and regulatory implications. Finally, an empirical study for the relevant equity marktes provides insights on the validity of the proposed models.

12:15 Robert Tompkins

The relation between implied and realised probability density functions

A number of financial regulators [see Neuhaus (1995), Bahra (1996, 1997), McManus (1999) and Shiratsuka (2001)] have suggested that risk neutral densities (RND) associated with options markets could provide useful indicators of future market turbulence. Critical to this assumption is that such RNDs should provide an unbiased forecast of realised probability density functions. To date, this assumption has not been fully examined.

In this research, we test the ability of RNDs for options on the S&P 500 and the British Pound / US Dollar to predict future probability densities. We consider three approaches to estimate the RNDs, which are consistent with approaches proposed and used by financial regulators. We also provide a number of new testing procedures to assess the efficiency and unbiasness of the forecasts. These tests provide more power than the usual Komolgorov/Smirnov tests.

Using non-overlapping quarterly data from the mid 1980s to 2000, we find that we can reject the hypothesis that the RNDs for both the S&P 500 and British Pounds are unbiased forecasts. Even with a limited number of observations, the tests are powerful enough to allow rejection. These results are consistent with Weinberg (2001) and are more robust as this work relied upon the use of overlapping data.

These results tend to support the conclusions of Shiratsuka (2001), that RNDs should not be used by financial regulators as financial indicators, and that such use could prove counterproductive; actually increasing future market turbulence rather than alleviating it.

13:00 lunch

14:15 Arun Bagchi

Parameter Estimation in Continuous-Time Financial Data: Application to Exponential-Affine Term Structures

The exponential-affine term structure model is a class of models in which the yields to maturity are affine functions of some state vector $x(t)$. Since the interest rate factors $x(t)$ are not directly observed, unknown parameters in these models need to be estimated on the basis of observing the bond prices of different maturities. Although the state space model is set-up in continuous time, all existing parameter estimation techniques discretize the observation equation in time in order to use known statistical/filtering methods. We resolve this incongruity in the present paper by working throughout with the original continuous-time formulation. We explain the maximum likelihood parameter estimation methodology in this framework and discuss modifications needed when the observation noise covariance is unknown. Finally we illustrate the methods by means of extensive simulation studies. Application to real treasury data will also be discussed.

15:10 Uwe Schmock

Term structure models for credit risks

This talk gives an overview on the available theoretical methods for pricing defaultable bonds. We review popular models for the term structure of risk-free interest rates, introduce hazard rates and loss fractions and thereby motivate default-adjusted interest rates. Several modelling assumptions for recovery at default are mentioned. We proceed by discussing the term structure of credit spreads and their dependence on risk-free interest rates. We conclude with remarks on the modelling of dependent defaults.

16:00 tea break

16:30 Steven E. Shreve

A Unified Model for Credit Derivatives

This is joint work with Alain Belanger of Scotia Capital Markets and Dennis Wong of Bank of America. A framework is provided for pricing derivatives on defaultable bonds and other credit-risky contingent claims. The framework includes structural models (those in which the time of default is determined by the value of the issuing firm), general reduced-form models (those in which default is exogenous), and reduced-form models in which default can occur only at specific times, such as coupon payment dates. Within the general framework, multiple recovery conventions for contingent claims are considered: recovery of a fraction of par, recovery of a fraction of a no-default version of the same claim, and recovery of a fraction of the pre-default value of the claim. These recovery conventions are matched to appropriate default protection contracts. A stochastic-integral representation for credit-risky contingent claims is provided, and the integrand for the credit exposure part of this representation is identified. In the case of intensity-based reduced-form models, credit spread and credit-risky term structure are studied.

17:45 dinner

Friday, 5 April 2002: Andersen building, Eschborn, Mergenthalerallee 55

09:15 Wolfgang Härdle

The Dynamics of Implied Volatilities: A Common Principle Component Approach

It is common practice to identify the number and sources of shocks that move implied volatilities across space and time by applying Principal Components Analysis PCA) to pooled covariance matrices of changes in implied volatilities. This approach, however, is likely to result in a loss of information, since the surface structure of implied volatilities in the maturities and moneyness dimension is neglected. In this paper we propose to estimate the implied volatility surface at each point in time nonparametrically and to analyze the implied volatility surface slice by slice with a common principal components analysis (CPCA). As opposed to traditional PCA, the basic assumption of CPCA is that the space spanned by the eigenvectors is identical across groups, whereas variances associated with the components are allowed to vary. This allows us to study a p variate random vector of k groups, say the "volatility smile" at p different grid points of moneyness for k maturities, simultaneously. Our evidence suggests that surface dynamics can indeed be traced back to a common eigenstructure between covariance matrices of the surface "slices", which allow for the usual shift, slope, and twist interpretation of shocks to implied volatilities. This insight is a suitable starting point for VaR Monte Carlo Simulations of delta-gamma neutral, vega sensitive option portfolios.

10:15 tea break

10:40 Peter Schwendner

Quantitative Aspects of Equity Derivatives Trading

Academics usually analyse the pricing of very complicated derivatives, regardless if they are actively traded or not. But also plain vanilla option books can be a rich playground for quantitative concepts. In this talk, I present some quant aspects of the risk management of a large number of simple equity derivatives. I will refer to some joint work with colleagues and friends. Contents:

- What is special about equity derivatives in comparison to other asset classes?
- Retail derivatives business model
- Hedging of equity derivatives books using EUREX options
- Fast pricing of a large number of options for market-making using price caching
- Implementation of Monte Carlo simulation for value-at-risk estimation

11:45 Lutz Molgedey

Libor market model with stochastic time homogenous mean reverting volatility

We present a variant of the Libor market model with stochastic volatility. As for the usual deterministic volatility Libor market model we require the parametrization of the model to be as time homogenous as possible. Here, this is achieved by using time homogenous mean reversion levels and speeds for the stochastic volatilities of the respective forward rates. Correct (perfect) pricing of the (at-the-money) caplets corresponds then to non-stationary initialvalues of the forward rate volatilities. However, demanding a time homogenous model restricts possible caplet smile surfaces. Those restrictions (and advantages) will be discussed in the talk.

12:45 lunch

14:00 Jürgen Topper

Applying Generalized Passport Options

Except for special cases, generalized passport options do not have closed-form solutions. Here we show how to derive approximate solutions using finite element methods. We also show that finite elements offer advantages in computing the hedge parameters. These techniques are applied to special cases of the generalized passport option which include Asian options and diverse passport options with caps and/or barriers.

14:45 Ingo Schneider

Using Finite Differences for Pricing Options

This is a pratical session which emphasizes the details implementing a numerical method. We will show a step by step implementation of various finite difference schemes in order to solve a Partial Differential Equation. Based on a a paper about "Pricing Arithmetic Average Asian Options (Vecer 2001) we apply the finite difference methodologie and compare the results with Monte Carlo. The interested participant is asked to bring his laptop with EXCEL and VBA installed.

16:15 tea break

18:00 dinner

5. Personal descriptions

Arun Bagchi, University of Twente

Hans-Peter Deutsch, Andersen

Dr Hans-Peter Deutsch is a Partner at Andersen and head of Andersen's Financial and Commodity Risk Consulting (FCRC) in Germany, which he founded in 1997 and developed from scratch to the over hundred people strong consulting practice it is today. He is also Faculty Member and Member of the Advisory Board of the Mathematical Finance Programme at the University of Oxford (see http://www.conted.ox.ac.uk/mathsfinance/) England, and Director of the German Chapter of GARP, the Global Association of Risk Professionals (see http://www.garp.com/). He has worked with clients in several IT-based trading and risk management projects, including software selection and development, pricing and risk management models for derivatives, and is author of several books (see for instance http://www.palgrave.com/catalogue/catalogue.asp?Title_Id=0333977068) and many publications in this area and a regular speaker at conferences. Before joining Andersen, Hans-Peter headed trading system development at a major German Bank and served as a consultant with Andersen Consulting (now Accenture). He holds a Ph.D. in theoretical physics and is also author of about 20 international scientific publications in this field, mainly on Monte Carlo simulations of stochastic processes.

Jürgen Hakala, Commerzbank

Jürgen Hakala is Head of Quantitative Reserach at Commerzbank Treasury and Financial Products since 4 years. 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.

Wolfgang Härdle, Humboldt University of Berlin

Norbert Hofmann, Goethe-University

Norbert Hofmann is scientific assistant to Prof.Dr.P.E.Kloeden in the Section: Numerics, dynamics and optimization at Goethe-University in Frankfurt. He formerly worked at the Weierstrass-Institute of Applied Analysis and Stochastics in Berlin, at the University of Erlangen-Nuernberg and as a visiting research fellow at the Australian National University in Canberra (Australia). His research area is stochastic numerics. Particularly he is interested in numerical methods for stochastic differential equations. Computational Finance turned out to be an important application of his work. He has written papers on the application of weak approximation of stochastic differential equations in option pricing and on the approximation of large portfolios.

Tino Kluge, Chemnitz University of Technology

Tino Kluge is a student of Mathematics and Technology at Chemnitz University of Technology. He recently worked in the Quantitative Research department at Commerzbank as an intern where he pursued a project about stochastic volatility models and finite difference methods.

Lutz Molgedey, Andersen

Jörn Rank, Andersen

Jörn Rank is a senior consultant at Andersen's Financial and Commodity Risk Consulting Group. During his time at Andersen, he has worked with several German banks. The main part of his work was the implementation of trading and risk management systems. Before he joined Andersen in 1998, he worked for a few months at Commerzbank in Frankfurt. Jörn holds a Ph.D. in theoretical physics from the University of Bielefeld and a diploma in Mathematical Finance from the University of Oxford. He is author of several international scientific publications on high energy physics.

L. C. G. Rogers, University of Bath

Chris Rogers is Professor of Probability 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, infrequent portfolio review high-frequency data modelling. 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, and consults for a number of financial clients.

Uwe Schmock, ETH and University of Zürich

Uwe Schmock is currently director of the program Master of Science in Finance, which is offered jointly by the Swiss Federal Institute of Technology (ETH) and the University of Zürich. Uwe studied mathematics and physics at the Technical University of Berlin, Germany, and at the California Institute of Technology. He holds a diploma and a Ph.D. in mathematics from the TU Berlin. He formerly worked for five years as a postdoc at the University of Zürich, for four years as Credit Suisse Research Fellow at ETH Zürich, and for more than two years as Research Director of the finance competence center RiskLab within the Department of Mathematics at the ETH Zürich. The Swiss RiskLab is financially supported by Credit Suisse Group, Swiss Re, UBS AG, and ETH Zürich. Uwe's research interests include applications of large and moderate deviations theory, securitisation, applications of extreme value theory, model risk, risk capital allocation, and mathematical finance in general.

Ingo Schneider, BHF-Bank

Ingo Schneider is Fixed Income Derivatives Trader at BHF-Bank, (ING-Group) Frankfurt. He trades interest rate derivatives, develops and implements OTC interest rate derivative products and works on term structure models. He received his diploma and doctorate degree in Physics from Goethe-University in Frankfurt.

Peter Schwendner, Sal. Oppenheim jr. & Cie

Peter Schwendner holds a Ph.D. in theoretical physics from the University of Goettingen. Since 1998, he works at the Equity Trading & Products Department of Sal. Oppenheim, where he develops and implements equity derivative products. Some joint work with Bernd Engelmann and others can be downloaded from www.oppenheim.de/quant.

Tino Senge, Commerzbank

Tino Senge is a Quantitative Research Specialist at Commerzbank Treasury and Financial Products in Frankfurt where he is working on models for pricing foreign exchange derivatives. Tino has studied Mathematics in Jena (Germany) and Cork (Ireland). Before joining Commerzbank he had worked with Commerz Financial Products and DG Bank. His current research interests include jump-diffusion model models for modeling the volatility smile in foreign exchange markets and its application to the pricing of exotic derivatives.

Steven E. Shreve, Carnegie Mellon University

Steven E. Shreve is a Professor of Mathematics at Carnegie Mellon University. Steven is the author with I. Karatzas, of two books related to finance: "Brownian Motion and Stochastic Calculus" and "Methods of Mathematical Finance," co-editor of the proceedings "Mathematical Finance, Vol. 65, Institute for Mathematics and its Applications," and advisory editor of the journal "Finance and Stochastics." Steve began research on the capital asset pricing model in 1980, and has worked in various aspects of mathematical finance since then, including the effect of transaction costs on option pricing, the effect of unknown volatility on option prices, pricing and hedging of exotic options, and models of credit risk. In 1991 he founded the Ph.D. program in Mathematical Finance at Carnegie Mellon, and in 1994 was one of the founders of the Master's program in Computational Finance.

Gerhard Stahl, Federal Banking Supervisory Office

Hermann Stahl, Commerzbank

Hermann Stahl is a lawyer and admitted to the bar in Frankfurt am Main and New York. He heads an area within Commerbank's central legal department which deals with derivatives, trading and exchanges. Her received his education in law and related subjects at Universitt Bayreuth, Bayreuth, Germany, Washington & Lee University, Lexington, Virginia, USA, and the University of Illinois at Urbana-Champaign, Champaign, Illinois, USA.

Felix Streichert, University Tübingen

Felix Streichert is currently Research Assistant at the Department of Computer Architecture within the Wilhelm-Schickard-Institute of the Eberhard-Karls-University T?bingen. He holds a diploma in Technical Cybernetics from the University of Stuttgart. His research interests are Evolutionary Algorithms in general, Hybrid Evolutionary Algorithms and financial applications of Evolutionary Algorithms.

Josef Teichmann, Technical University Vienna

Born in Lienz, Eastern Tyrol, Austria. Studies of Mathematics in Graz, Besancon and Vienna. Thesis on Infinite dimensional Lie groups at the University of Vienna (supervised by Peter Michor). Assistent Professor at the Department of Financial and Actuarial Mathematics at the Technical University of Vienna (Walter Schachermayer). Research in Interest Rate Models, HJM-Theory and Differential Geometry.

Robert Tompkins, Technical University Vienna

Robert Tompkins is a University Dozent at the Technical Universitt, Vienna. He has recently accepted an Honorary Professorship at the University of Warwick Business School, where he has taught courses on Financial Markets during the 2000/2001 academic year.

Dr. Tompkins was formerly the Head of International Quantitative Research at Kleinwort Benson Investment Management. In addition, he remains the Managing Director of the Minerva Group. Prior to this, he was the Futures and Options Specialist at Merrill Lynch, Europe and an Interest Rate Options Dealer and Currency Options Trader at two major Chicago banks. He has three degrees from the University of Chicago, including an MA in Quantitative Methods and an MBA (honours). In addition, he completed his Ph.D. in Finance at the University of Warwick in 1998 and his Habilitation in Finanzwirtschaft at the University of Technology, Vienna in 2000.

Robert has authored three books on Options and edited a book on exotic options "From Black Scholes to Black Holes". Robert is currently writing a series on Exotic Options, which appears in the Austrian Journal, Bank Archiv. This series will form the basis of a book that will be published by Cambridge University Press in 2002. He has published widely in RISK Magazine, and a number of academic journals including Journal of Futures Markets, Journal of Derivatives, Journal of Risk Finance, Journal of Risk, Quantitative Finance and the European Journal of Finance. Robert's current research interests include comparisons of established and emerging markets, volatility estimation and forecasting, implied volatility smile patterns and the hedging of exotic contingent claims.

Jürgen Topper, Andersen

Jürgen Topper joined Andersen in 1997 after finishing a master's degree in economics at the University of Hannover (Germany). During his university years, Jrgen worked on several projects for mechanical engineering in academia and industry on coupling finite element analysis with tools from operations research. Jürgen's primary areas of interest are exotic derivatives and structured products. His consulting practice includes numerous international banks and European corporates.

Uwe Wystup, Commerzbank

Uwe Wystup works in the Global Structured Risk Management team at Commerzbank Treasury and Financial Products, 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.