NWO/STAR/WONDER

16th Winter School on Mathematical Finance

Special topics:

Polynomial models

Market imperfections

January 23–25, 2017
Congrescentrum De Werelt, Lunteren

Sponsored by NWO, STAR, WONDER, and FWO

NWO/STAR/WONDER
Winter School on Mathematical Finance

In recent years, the mathematical theory associated with financial risk management and the pricing of contingent claims has been a highly active field of research. The area has established itself as one of the most vigorously growing branches of applied mathematics. Model-based analysis of contracts and portfolios has become a standard in the finance industry, and the number of academic institutions offering curricula in financial mathematics has increased rapidly. In this context, the winter school on Mathematical Finance that will take place on January 23–25, 2017 in Lunteren aims at providing a meeting place for participants both from industry and from academia. The program provides ample opportunity for discussion.

The special topics of the 16th winter school are *Polynomial models*, and *Market imperfections*. These are the subjects of minicourses that will be taught by two distinguished speakers: Professor Damir Filipović (EPFL Lausanne and Swiss Finance Institute) and Professor Jan Kallsen (Christian-Albrechts-Universität zu Kiel). Additionally there will be three one-hour lectures by Professors Erhan Bayraktar (University of Michigan), Thorsten Schmidt (University of Freiburg) and Wim Schoutens (KU Leuven). Thirty-minute lectures on recent research work in the Netherlands will be presented by Anne Balter (Tilburg University), Qian Feng (CWI, Amsterdam), Rutger-Jan Lange (Erasmus Universiteit, Rotterdam) and Anton van der Stoep (Rabobank).

Auspices and sponsoring

The Winter School takes place under the auspices of the research schools STAR and WONDER. The stochastics groups of the mathematics departments of the universities in The Netherlands cooperate in STAR. WONDER is the Dutch research school in Mathematics. The winter school is supported financially by STAR, WONDER, by the Netherlands Organization for Scientific Research (NWO) and by the Research Foundation - Flanders (FWO). Administrative assistance is provided by the Korteweg–De Vries Institute for Mathematics of the Universiteit van Amsterdam.

The FWO WOG research network Stochastic Modelling with Applications in Financial Markets has made available a limited number of grants of € 250 each for young researchers (PhD students and postdocs) to be used as a reduction on the registration fee for the winter school. Priority will be given to grant applicants whose supervisor is a member of the network, but others are invited to apply as well. Applications for the grant can be sent by email to both Michel Vellekoop and Peter Spreij (make sure that both are addressed). Applications are required to contain a brief motivation describing why the grant should be beneficial to the research of the applicant, a brief motivation describing why the applicant has a specific need for the grant, a (link to a) CV of the applicant and the name of her/his principal supervisor. The deadline for applications is November 20, 2016.

Organizers

The winter school is organized by:

Michel Vellekoop (Faculty Economics and Business, Universiteit van Amsterdam; tel. +31 20 5254210, e-mail `m.h.vellekoop@uva.nl`)

Peter Spreij (Korteweg–De Vries Institute for Mathematics, Universiteit van Amsterdam and IMAPP, Radboud University; tel. +31 20 5256070, e-mail `spreij@uva.nl`).

Program outline

The program starts with registration and coffee on Monday, January 25, from 10:30 to 11:30, and ends on Wednesday, January 27, at 16:00. The following events are planned:

Minicourses

Damir Filipović
Polynomial models in finance

Jan Kallsen
Portfolio choice, pricing, and hedging under small frictions

Special invited lectures

Erhan Bayraktar
No-arbitrage and hedging with liquid American options

Thorsten Schmidt
A new perspective on multiple curve models

Wim Schoutens
Applied conic finance

Short contributions

Anne Balter
Sets of indistinguishable models for robust optimisation

Qian Feng
Efficient computation of exposure profiles under real-world and risk-neutral scenarios for Bermudan swaptions

Rutger-Jan Lange
A new approach to filtering for non-linear state space models

Anton van der Stoep
A novel Monte Carlo approach to hybrid local volatility models

Schedule of lectures

	Monday January 23	Tuesday January 24	Wednesday January 25
09:00 - 10:00		Filipović	Filipović
10:30 - 11:30		Filipović	Filipović
11:30 - 12:30	Filipović	Kallsen	Kallsen
14:00 - 15:00			Kallsen
15:00 - 16:00	Kallsen	Kallsen	Bayraktar
16:00 - 17:00	Schoutens	Schmidt	
17:30 - 18:00	Van der Stoep	Feng	
18:00 - 18:30	Balter	Lange	

Web page

Please see `www.mathfin.nl` for the latest information about the winter school.

Venue

The winter school will take place at Congrescentrum De Werelt, Westhofflaan 2, Lunteren, tel. +31-(0)318-484641, fax +31-(0)318-482924. Located in the heart of the Veluwe forest, De Werelt is one of the top accommodations in the Netherlands in terms of attractiveness of surroundings. Access by car or by public transportation is easy. By train, the village of Lunteren can be reached in twenty minutes from Amersfoort, and in ten minutes from Ede-Wageningen. It takes about fifteen minutes to walk from the railway station in Lunteren to the conference center (see directions below). If you come by car, ANWB signs in Lunteren will guide you to the venue. It is also possible to take a taxi from the taxi stand at railway station Ede-Wageningen. To get a taxi in Lunteren, call +31-(0)318-484555. For further details please see `www.congrescentrum.com` (under De Werelt Lunteren and Route).

Directions from the railway station: leaving the station, turn right across the pebble-covered parking lot. Turn left into the forest (Boslaan). At the crossroads, turn right into Molenweg. The first turn left is Westhofflaan.

Abstracts

Mini-course on Polynomial models

Damir Filipović (EPFL Lausanne and Swiss Finance Institute)

Polynomial models in finance

A polynomial jump-diffusion is a special semimartingale whose extended generator maps any polynomial to a polynomial of the same or lower degree. Polynomial jump-diffusions admit closed form conditional moments and have broad applications in finance. In this course, we learn how to construct polynomial jump-diffusions from simple building blocks. We show that the polynomial property of a jump-diffusion is preserved under exponentiation and subordination.

We also revisit affine jump-diffusions. Every affine jump-diffusion is polynomial, but the affine property is in general not invariant with respect to the aforementioned transformations. We provide a generic method for option pricing with polynomial jump-diffusion models. This method builds on the expansion of the likelihood ratio function with respect to an orthonormal basis of polynomials in some conveniently weighted L^2 space.

We study applications to interest rate models, credit risk models, and stochastic volatility models. We also address numerical aspects for the computation of the conditional moments of polynomial jump-diffusions.

Mini-course on Market imperfections

Jan Kallsen (Christian-Albrechts-Universität zu Kiel)

Portfolio choice, pricing, and hedging under small frictions

Real markets are facing bid-ask spreads, transaction costs and related kinds of market imperfections. These affect the performance of investment strategies, the trading volume, the cost of hedging and hence derivative prices. In this minicourse we study market frictions from the perspective of stochastic control. The main idea is to consider imperfections as small perturbations of the simpler frictionless model. This often allows us to quantify their leading-order effect surprisingly explicitly. We discuss a formal heuristic derivation of the asymptotic solution as well as rigorous verification strategies, based on both classical dynamic programming and dual approaches to stochastic control.

Special invited lectures

Erhan Bayraktar (University of Michigan)

No-arbitrage and hedging with liquid American options

Since most of the traded options on individual stocks is of American type it is of interest to generalize the results obtained in semi-static trading to the case when one is allowed to statically trade American options. However, this problem has proved to be elusive so far because of the asymmetric nature of the positions of holding versus shorting such

options. We will establish the Fundamental Theorem of Asset Pricing and sub- and super-hedging dualities. We will first discuss this for a given model and then extend it to the case of model uncertainty.

Thorsten Schmidt (University of Freiburg)

A new perspective on multiple curve models

We consider a general representation of markets with multiple yield curves and provide a characterization of absence of arbitrage via techniques from large financial markets. In particular, we allow for stochastic discontinuities of the associated bond prices, incorporating recent results in term structure theory. The interesting point is that this setup allows us to consider market models as a special case. The obtained drift conditions build the foundation for the development of affine models which turn out to be significantly more complicated than in the classical on-curve markets. This is joint work with Zorana Grbac and Claudio Fontana.

Wim Schoutens (KU Leuven)

Applied conic finance

We give an introduction to conic finance. Conic finance is a brand new quantitative finance theory incorporating in a fundamental way bid and ask pricing. We provide the basics and its connection with the concept of acceptability and coherent risk measures. Distorted expectations are employed to actually calculate bid and ask prices. We elaborate on various applications of the theory such as conic hedging, conic portfolio theory, conic trading and show how conic finance can be used for systemic risk measurement, liquidity measurement and how the counter-intuitive effects of booking profits due to your own credit deterioration (also referred to as Debt Valuation Adjustment or DVA) are mitigated under the conic bid and ask pricing theory.

Short contributions

Anne Balter (Tilburg University)

Sets of indistinguishable models for robust optimisation

Models can be wrong and recognising their limitations is important in financial and economic decision making under uncertainty. Finding the explicit specification of the uncertainty set has been difficult so far. We develop a method that provides a plausible set of models to use in robust decision making. The choice of the specific size of the uncertainty region is what we will focus on. We use the Neyman-Pearson Lemma to characterise a set of models that cannot be distinguished statistically from a baseline model. The set of indistinguishable models can explicitly be obtained for a given probability for the Type I and II error.

Qian Feng (CWI, Amsterdam)

Efficient computation of exposure profiles under real-world and risk-neutral scenarios for Bermudan swaptions

This paper presents a computationally efficient technique for the computation of exposure distributions at any future time under the risk-neutral and some observed real-world probability measures, needed for the computation of credit valuation adjustment (CVA) and potential future exposure (PFE). In particular, we present a valuation framework for Bermudan swaptions. The essential idea is to approximate the required value function via a set of risk-neutral scenarios and use this approximated value function on the set of observed real-world scenarios. This technique significantly improves the computational efficiency by avoiding nested Monte Carlo simulation and by using only basic methods such as regression. We demonstrate the benefits of this technique by computing exposure distributions for Bermudan swaptions under the Hull-White and the G2++ models. This is joint work with S. Jain, P. Karlsson, B.D. Kandhai and C.W. Oosterlee.

Rutger-Jan Lange (Erasmus Universiteit, Rotterdam)

A new approach to filtering for non-linear state space models

This paper considers state space models with non-linear and non-Gaussian observation and state equations. We propose a new approximate filter, based on recursive on-line estimation of the posterior mode. The approximation error can be made arbitrarily small in some limit. For each new observation, the proposed filter uses multiple steps of an optimisation routine in order to update its estimate. These steps use the score of the predictive density, rather than the prediction error, making the filter robust and applicable to a wide class of models. Simulation studies reveal that the performance of the proposed filter in terms of RMSE is statistically indistinguishable from that of theoretically optimal methods. Furthermore, the proposed technique improves computational efficiency by several orders of magnitude. The method is illustrated by an application to stock returns subject to stochastic volatility and leverage.

Anton van der Stoep (Rabobank, Utrecht)

A novel Monte Carlo approach to hybrid local volatility models

We present in a Monte Carlo simulation framework a novel approach for the evaluation of hybrid local volatility models (Dupire 1994, Derman and Kani 1998). In particular, we consider the stochastic local volatility model - see e.g. Lipton et al. (2014), Piterbarg (2007), Tataru and Fisher (2010), Lipton (2002) - and the local volatility model incorporating stochastic interest rates - see e.g. Atlan (2006), Piterbarg (2006), Deelstra and Rayee (2012), Ren et al. (2007). For both model classes a particular (conditional) expectation must be evaluated, which cannot be extracted from the market and is expensive to compute. We establish accurate and 'cheap to evaluate' approximations for the expectations by means of the stochastic collocation method (Babuska et al. 2007, Xiu and Hesthaven 2005, Beck et al. 2012, Nobile et al. 2014, Sankaran and Marsden 2011), which was recently applied in a financial context (Grzelak et al. 2014, Grzelak and Oosterlee 2017), combined with standard regression techniques. Monte Carlo pricing experiments confirm that our method is highly accurate and fast.

Registration

To register for the winter school, please use the electronic registration form that is available at the web page of the winter school (see `www.mathfin.nl` or `www.science.uva.nl/~spreij/winterschool/winterschool.html`). Alternatively, you may complete the registration form on the last page and return it to ms. E. Wallet, Korteweg–De Vries Institute for Mathematics, PO Box 94248, 1090GE Amsterdam.

The registration fee includes accommodation (single room) for the nights of January 25 and 26, all meals starting with lunch on Monday up to and including lunch on Wednesday, and tea and coffee during breaks. Payment can be made by transfer to IBAN account number: NL27 INGB 0007388994 of Winter School Amsterdam, Secretariaat Korteweg–De Vries Instituut, Amsterdam and (for international money transfers) BIC: INGBNL2A. The fee schedule is as follows:

	early registration (before December 1)	late registration (after December 1)
industry professional	€1195	€1350
full-time academic	€395	€445

Inquiries concerning fees for partial attendance may be directed to ms. Wallet at the address given below. Registration will be valid after full payment has been received. Refunds can be given only for cancellations received before January 1, 2017.

Accommodation at the venue is limited. Therefore, reservations will be treated on a first-come-first-served basis with priority for full arrangements. Participants who cannot be lodged at the venue will be accommodated in a hotel nearby. Transportation from the hotel to the venue and vice versa will be taken care of by the organization.

Further information

For further information regarding the scientific program, please contact one of the members of the organizing committee. For information concerning registration please contact:

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16th Winter School on Mathematical Finance

Lunteren, January 23–25, 2017

Registration Form

Last name: _____

First name: _____

Affiliation: _____

Address: _____

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_____

Telephone: _____

Fax: _____

Email address: _____

Date: _____

Signature: _____

Please return the completed form *before January 1, 2017* to:

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Registration is valid only after full payment has been received following the fee schedule.