universität wien

Sixth European Summer School in Financial Mathematics

An EMS Applied Mathematics School

Vienna, 26 -30 August 2013

Book of Abstracts

Welcome to Vienna !

We warmly welcome you to the Sixth European Summer School in Financial Mathematics and wish you a successful time in Vienna !

This school belongs to the series of the EMS Applied Mathematics schools and brings together the most talented young researchers in the field.

We gratefully acknowledge the support of the French Federation of Banks (Fédération Bancaire Française), INFORM (Scientific Association for Insurance, Financial, and Operational Risk Management) and the European Research Council (ERC).

We also wish to express our sincere thanks to all lecturers who accepted the invitation to teach at the Summer School.

Organizing Institution

Faculty of Mathematics, Oskar-Morgenstern-Platz 1, 1090 Wien, Austria

Local Organizing Committee

Beatrice Acciaio
Mathias Beiglboeck
Christa Cuchiero
Christoph Czichowsky
Walter Schachermayer
Pietro Siorpaes

Event Homepage

http://www.mat.univie.ac.at/~finance_hp/summer_school_Vienna_2013

General information

Location

The venue of the Sixth European Summer School in Financial Mathematics is the Campus of the Vienna University, in lecture hall C2, Spitalgasse 2-4, 1090 Wien.

The closest subway station is Alser Straße on U6. The closest tram stop is Lange Gass on trams 43 and 44, from which you easily get to the lecture hall C2. See map overleaf.

Internet

Eduroam

The Campus is equipped with the Eduroam wireless network. If you have an Eduroam account, you should be able to connect without any problems.

Wireless network

We also provide an open wireless network. Each participant needs an individual password which can be requested from the registration desk.

Printing and photocopying service

Printing is possible via the university's printing service u:print. A copy card is necessary which can be purchased from the portier or student service or Uni-shops. To print simply insert the card in the card reader by the printer.

Further instructions can be found:
https://zid.univie.ac.at/services/fuer-studierende/pc-raeume-drucken-kopieren/drucken-kopieren-uprint/

Printing locations are :

- Fachbibliothek Zeitgeschichte
  1090 Wien, Spitalgasse 2, Hof 1, Raum:1G-Z1-34

- Fachbereichsbibliothek Kunstgeschichte
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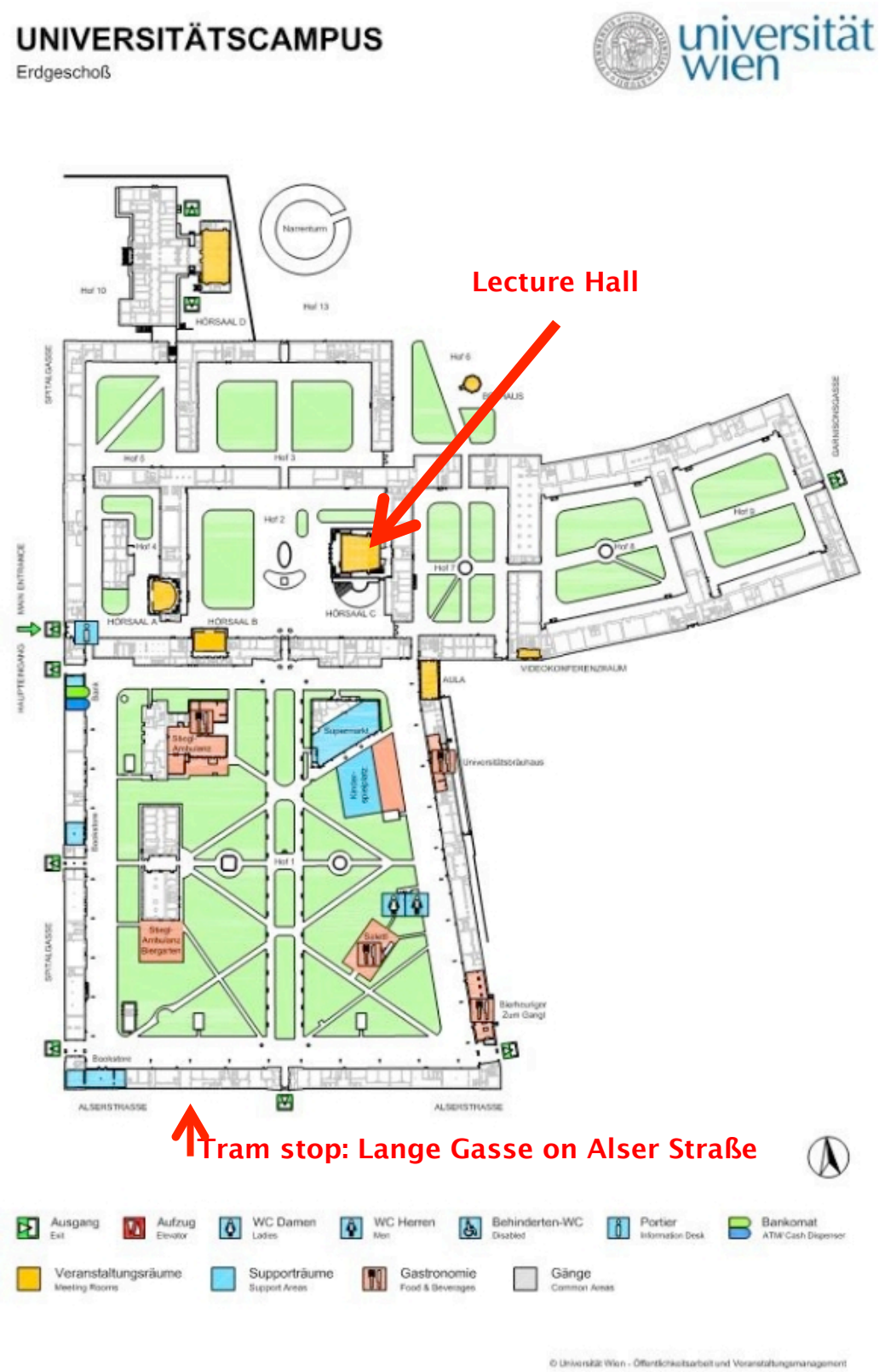
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Portier
Bankomat
Veranstaltungsräume
Supporträume
Gastronomie
Gänge

Summer School Time Table

	Monday	Tuesday	Wednesday	Thursday	Friday
09.15-10.00	Registration	J. Kallsen	J. Kallsen	J. Kallsen	J. Kallsen
10.15-11.00	D. Hobson	D. Hobson	D. Hobson	D. Hobson	J. Kallsen
11.15-12.00	J. Kallsen	J. Kallsen	M. Klimmek	J. Kallsen	A. Cox
12.15-13.00	D. Hobson	D. Hobson	D. Hobson	D. Hobson	J. Muhle-Karbe
	Lunch	**Lunch**		**Lunch**	
14.30-15.15	H. Oberhauser	M. Nutz		J. Obloj	
15.15-15.30	**Break**	**Break**		**Break**	
15.30-15.50	A. Altarovici	S. Kallbad		R. Pickova	
15.50-16.10	C. Belak	K. Kentia Tonleu		L. Tangpi Ndounkeu	
16.20-16.40	A. Cerny	S. Li		M.H. Weber	
16.40-17.00	N. Gabrielli	A. Meireles Rodrigues		T. Zhang	

Mini Courses

David Hobson (University of Warwick, UK)

Model-independent pricing and hedging of derivatives

The standard approach for the pricing of financial options is to postulate a model and then to calculate the price of a contingent claim as the suitably discounted, risk-neutral expectation of the payoff under that model. In practice we can observe traded option prices, but know little or nothing about the model. Hence the question arises, if we know vanilla option prices, what can we infer about the underlying model? At one extreme, if we know a single call price, then we can calibrate the volatility of the Black-Scholes model. (However, if we know the prices of more than one call then together they will typically be inconsistent with the Black-Scholes assumption of a constant volatility.) At the other extreme, if we know the prices of call options for all strikes and maturities, then we can find a unique martingale diffusion consistent with those prices. If we know call prices of all strikes for a single maturity, then we know the marginal distribution of the asset price, but there may be many martingales with the same marginal at a single fixed time. Any martingale with the given marginal is a candidate price process. A right-continuous martingale with a given distribution at time 1, can be viewed as a Brownian motion with a given distribution at a random time. In this way the problem of finding candidate price processes translates to one about embedding distributions in Brownian motion via a stopping time --- the Skorokhod embedding problem. These talks are about this correspondence, and the idea that extremal solutions of the Skorokhod embedding problem lead to robust, model independent prices and hedges for exotic options.

Jan Kallsen (Christian-Albrechts-Universität zu Kiel, DE)

Leading-order corrections in Mathematical Finance

Many aspects of real markets are often ignored in order to obtain tractable models and equations. Here, we focus on transaction costs, jumps, and stochastic volatility but one may also think of illiquidity, random endowment, time discretisation etc. In these lectures we consider such phenomena as perturbations of a given simpler setup. Being interested in quantities such as option prices, optimal portfolios etc., the goal is to obtain general explicit and robust leading-order corrections, which highlight the main effects of the perturbation under consideration. Specifically, we consider the effect of small transaction costs on portfolio choice, welfare, and turnover. Moreover, we discuss first-order corrections of hedging errors and option prices in the presence of jumps and stochastic volatility.

Abstracts – invited speakers

Alexander Cox (University of Bath, GB)

"Optimal robust bounds for variance options"

Robust, or model-independent properties of the variance swap are well-known, and date back to Dupire and Neuberger, who showed that, given the price of co-terminal call options, the price of a variance swap was exactly specified under the assumption that the price process is continuous. In Cox & Wang we showed that a lower bound on the price of a variance call could be established using a solution to the Skorokhod embedding problem due to Root. In this talk, we describe a construction, and a proof of optimality of the upper bound, using results of Rost and Chacon, and show how this proof can be used to determine a super-hedging strategy which is model-independent. In addition, we outline how the hedging strategy may be computed numerically. Using these methods, we also show that the Heston-Nandi model is 'asymptotically extreme' in the sense that, for large maturities, the Heston-Nandi model gives prices for variance call options which are approximately the lowest values consistent with the same call price data.

Martin Klimmek

"Monge-optimal martingale couplings"

Between 1776 and 1784, Gaspard Monge developed a variety of simple principles for the optimal transport of earth from a deposit to a target site. "Optimal" meant "cheap" when cost of carriage is
proportional to the Euclidean distance. Monge showed that i.) mass should not be split, ii.) transport should proceed along straight lines and iii.) these lines should not generally cross. Over the last
quarter century optimal transport has had a profound impact on a variety of mathematical disciplines, most recently perhaps in mathematical finance. In an article for its "Quant of the year" award, Risk magazine wrote: "Optimal transport looks at how to find a 'path' from one distribution to another, while minimising the value of a cost function... it has (an) application in how to evolve a risk-neutral distribution, as implied by vanilla options prices, from one maturity to another while excluding arbitrage" (Risk 10/01/2013). Starting from Monge's principles, in this talk, we find the 'paths' that are optimal for Monge's cost function. (Joint work with David Hobson)

Johannes Muhle-Karbe (ETH Zürich, CH)

"Optimal Liquidity Provision in Limit-Order Markets"

In today's electronic markets, investors can choose to trade by either market or limit orders. Market orders guarantee immediate execution, but investors have to pay the bid-ask spread for taking liquidity out of the order book in this way. In contrast,

limit orders allow to earn the spread by providing liquidity, but a posted order is only executed when a suitable counterparty arrives. We study the resulting tradeoff between profits from liquidity provision and inventory risk in a general setting, allowing for arbitrary preferences, asset price and cost dynamics, and arrival rates. In the limit for small spreads, the corresponding non-Markovian singular control problem can be solved in closed form, leading to explicit formulas for the optimal policy and welfare.
(Joint work with Christoph Kühn)

Marcel Nutz (Columbia University, USA)

"On Model Uncertainty in Discrete Time"

We study the problems of arbitrage, superhedging and utility maximization in a nondominated model of a discrete-time financial market. We show that absence of arbitrage in a quasi-sure sense is equivalent to the existence of a suitable family of martingale measures, that a superhedging duality holds, and that optimal strategies for robust utility maximization exist (arXiv:1305.6008 and arXiv:1307.3597). Based on joint work with Bruno Bouchard.

Harald Oberhauser (TU Berlin, D)

"Root's and Rost's solution of the Skorokhod embedding problem"

An intuitive solution of the Skorokhod embedding problem is due to Root and Rost who showed that one can find a subset of time-space such that its first hitting time by time-space Brownian motion solves the Skorohod embedding problem. More recently and motivated by applications in finance these solutions received again increased interest (work of Dupire, Cox--Wang, Carr--Lee, etc). I discuss some applications, connections to viscosity theory, reflected FBSDEs, numerics etc. (Joint work with Goncalo dos Reis).

Jan Obloj (University of Oxford, GB)

"Two tales in tractable (robust) portfolio optimisation"

We consider portfolio choice problems in continuous time. Traditionally, and distinctively in the framework of maximisation of expected utility, the optimal strategies intertwine the choice of the underlying model and the investor's risk preferences. We seek to advance formulations which disentangle these influences and make things tractable. Our aim is to develop a robust and practically relevant approach to portfolio optimisation. In particular we provide a solid theoretical footing to fractional Kelly strategies.

The Kelly strategy, or the growth optimal strategy, depends on the choice of reference model. In contrast, the fraction of wealth invested in it does not. In the first part of the talk, it encompasses the investor's risk attitudes expressed through drawdown constraints. In the second part of the talk, it measures the investor's confidence in the model.

The first part of the talk in based on a joint paper with Constantinos Kardaras and Eckhard Platen and I also present general existence and uniqueness results on portfolio optimisation subject to drawdown constraints. The second part of the talk is based on a joint work with Sigrid Kallblad and Thaleia Zariphopoulou and I also present some general duality results on robust forward performance criteria.

Abstracts – contributed talks

Albert Altarovici (ETH Zürich, CH)

"Asymptotics with fixed transaction costs: multi-dimensions"

We consider the problem of an agent seeking to optimally invest and consume in a market with one risk-less asset and many risky, possibly correlated, assets. The agent is allowed to re-balance her portfolio subject to a small fixed fee. We explicitly calculate the leading order loss of utility due to transaction costs. In addition, we explicitly calculate the asymptotic shape of the no-transaction region for any number of risky assets. The formal calculations are rigorously proven using techniques from viscosity theory. This is a joint work with Mete Soner and Johannes Muhle-Karbe.

Christoph Belak (Dublin City University, IRL)

"A Worst-Case Approach to Portfolio Optimization in a Market with Bubbles"

We consider an investor who aims to maximize her expected utility from terminal wealth in a financial market which is under the threat of crashes in the risky asset. We assume the crash scenarios to be subject to Knightian uncertainty, meaning that the investor is only aware of the maximum relative crash size, but has no information about the distribution of the crash time and/or size. The maximum crash size is identified with an observable finite-state Markov process, and we assume that in between the jump times of the Markov process at most one crash may occur. The investor is assumed to take a worst-case perspective towards these crashes, i.e. given a fixed trading strategy, we determine the worst-case crash scenario and then find the strategy which performs best in its worst-case scenario.

Ales Cerny (City University London, GB)

"Optimal portfolios for monotone mean-variance preferences"

We report a link between optimal portfolios generated by a special type of variational preferences called divergence preferences (cf. Maccheroni et al. 2006) and optimal portfolios generated by classical expected utility. As a special case we connect optimization of truncated quadratic utility (cf. Cerny 2003) to the optimal monotone mean-variance portfolios (cf. Maccheroni et al.2007), thus simplifying the computation of the latter.

Nicoletta Gabrielli (ETH Zürich, CH)

"Pathspace Representation of Affine Processes"

When facing the problem of pricing path dependent options, an efficient method for the simulation of the trajectories of the underlying stock is essential. However, in some cases, e.g. when the vector field lacks the Lipschitz regularity, standard discrete approximation schemes cannot be applied.
We therefore seek high order and geometry preserving discretization methods.

The starting point of our analysis is the investigation of the evolution of an Affine process not only in terms of time, but also with respect to its initial value. Inspired by the well known relationship between Feller diffusion and compound Poisson processes, we develop a representation of Affine processes as realizations of path-valued L´evy processes which leads to a new perspective on numerics of their paths.

Sigrid Kallblad (University of Oxford, GB)

"Robust Forward Performance Criteria"

Motivated by the extensive study in the literature of, on the one hand, forward investment performances and, on the other, ambiguity averse portfolio selection, these notions are combined and robust forward criteria are introduced. While the former notion addresses issues of horizon and preference ambiguity, the latter deals with model uncertainty. The combination of these concepts is therefore natural as an investor who acknowledges her inability to specify the market model, is likely to also admit her inability to specify the preferences exactly. In the same way as standard forward criteria describe the evolution of value-processes and preferences in general, the study of robust forward criteria contribute to our understanding of the evolution of time-consistent ambiguity averse preferences. The main focus is on establishing dual characterizations of the robust forward criteria.

Klebert Kentia Tonleu (Humboldt-Universität zu Berlin, D)

"Generalized Good-Deal Bounds and Robust Hedging under Model Uncertainty"

In incomplete financial markets, the existence of infinitely many no-arbitrage prices typically results in arbitrage bounds being too large for practical use, hence yielding trading opportunities which are "too favorable". This kind of opportunities are called good-deals and should be ruled out from the market. A recent approach to no-good-deals consists in tightening the arbitrage bounds by pricing only with the equivalent martingale measures which satisfy a bound on the growth rates of returns. In this talk, we present a no-good-deal theory using correspondences (multi-valued mappings) to describe the no-good-deal restriction, and deriving the good-deal bounds and their corresponding hedging strategies in terms of solutions of BSDEs. In the presence of model uncertainty, we generalize the results and show the link between our robust good-deal hedging strategy and the Föllmer-Schweizer local risk minimizing strategy.

Shen Li (CAU Kiel, D)

"Portfolio Optimization under Small Transaction Costs: A Convex Duality Approach"

We consider the portfolio optimization problem as in [Kallsen and Muhle-Karbe. Option Pricing and Hedging with Small Transaction Costs. Mathematical Finance, 2012, to appear]. An investor with constant absolute risk aversion trades a risky asset with general Itô dynamics, in the presence of small proportional transaction

costs. In this setting, we carry out a convex duality approach facilitated by the concept of shadow price in order to prove - under some integrability conditions - the leading-order optimal trading policy and the associated welfare expressed in terms of the local dynamics of the frictionless optimizer.

Andrea Meireles Rodrigues (University of Edinburgh, GB)

"Optimal Portfolio Choice for a Behavioural Investor in Continuous-Time Markets"

Our aim consists in the study of the optimal investment strategy for an investor behaving consistently with Cumulative Prospect Theory. This problem involves a considerable degree of complexity, especially since many of the mathematical tools used in Expected Utility Theory are no longer applicable. In particular, we are dealing with an overall S-shaped utility function; moreover, due to the fact that probabilities are distorted, Choquet integrals now appear in the definition of the payoff functional to be maximised, thus preventing the use of the dynamic programming principle. Within a continuous-time financial market framework and assuming that asset prices are modelled by semimartingales, we derive sufficient and necessary conditions for the well-posedness of the problem in the case of piecewise-power probability distortion and utility functions. Finally, under straightforwardly verifiable conditions, we demonstrate the existence of an optimal strategy. This talk is based on joint work with M. Rásonyi (University of Edinburgh).

Radka Pickova (Columbia University, USA)

"Volatility-Stabilized Processes"

We consider systems of interacting diffusion processes which generalize the volatility-stabilized market models introduced in Fernholz and Karatzas (2005). We show how to construct a weak
solution of the underlying system of stochastic differential equations. In particular, we express the solution in terms of time-changed squared-Bessel processes and discuss sufficient conditions under which one can argue that this solution is unique in distribution. Sufficient conditions for the existence of a strong solution are also provided. Moreover, we discuss the significance of these processes in the context of arbitrage relative to the market portfolio within the framework of Stochastic Portfolio Theory.

Ludovic Tangpi Ndounkeu (Humboldt Universität zu Berlin, D)

"Representation of Minimal Supersolutions of Convex BSDEs"

In this talk, we give a dual representation of minimal supersolutions of BSDEs with non-bounded, but integrable terminal conditions and under weak requirements on the generator which is allowed to depend on the value process of the equation. Our representation agrees with
the robust representation of cash-subadditive risk measures and is based on a truncation argument and a stability result for minimal supersolutions of BSDEs.

Marko Hans Weber (Dublin City University, IRL)

"Dynamic Trading Volume"

We derive the process followed by trading volume, in a market with finite depth and constant investment opportunities, where a representative investor, with a long horizon and constant relative risk aversion, trades a safe and a risky asset. Trading volume approximately follows a Gaussian, mean-reverting diffusion, and increases with depth, volatility, and risk aversion. The model generates an endogenous ban on leverage and short-selling.

Tao Zhang (University of Mannheim, D)

"A Hot-Potato Game Under Transient Price Impact and Some Effects of a Transaction Tax"

Building on observations by Schöneborn (2008), we consider a Nash equilibrium between two high-frequency traders in a simple market impact model with transient price impact and additional quadratic transaction costs. We show that for small transaction costs the high-frequency traders engage in a "hot-potato game", in which the same asset position is sold back and forth. We then identify a critical value for the size of the transaction costs above which all oscillations disappear and strategies become buy-only or sell-only. Numerical simulations show that for both traders the expected costs can be lower with transaction costs than without. Moreover, the costs can increase with the trading frequency when there are no transaction costs, but decrease with the trading frequency when transaction costs are sufficiently high. We argue that these effects occur due to the need of protection against predatory trading in the regime of low transaction costs.