First Berlin-Singapore Workshop on Quantitative Finance & Financial Risk

21-24 May 2014

Berlin

NUS National University of Singapore | Centre for Quantitative Finance Faculty of Science

21-22 May 2014
Weierstraß-Institute
Mohrenstrasse 39
10117 Berlin

23-24 May 2014
Jacob-und-Wilhelm-Grimm-Zentrum
Geschwister-Scholl-Straße 3
10117 Berlin

Jointly organized by
Centre for Quantitative Finance, NUS · Humboldt-Universität zu Berlin
Technische Universität Berlin · Weierstraß-Institute (WIAS)

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PROGRAMME

Overview | Daily Schedule

Programme

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09:00 – 10:00 **Paul GLASSERMAN**	**09:00 – 10:00** **Stephane CREPEY**	**09:00 – 10:00** **Jan KALLSEN**	**09:00 – 10:00** **Steven KOU**
10:00 – 10:30 Qiang HE	**10:00 – 10:30** Marcel LADKAU	**10:00 – 10:30** Ningyuan CHEN	**10:00 – 10:30** Sergey NASEKIN
10:30 – 11:00 Break & Poster Session	**10:30 – 11:00** Break	**10:30 – 11:00** Break	**10:30 – 11:00** Break
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11:30 – 12:15 Christian BAYER	**11:30 – 12:15** Antonis PAPAPANTOLEON	**11:30 – 12:15** Jinniao QIU	**11:30 – 12:15** Robert KIMMEL
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15:00 – 15:30 Samuel DRAPEAU	**15:00 – 15:30** Dorte KREHER	**15:00 – 15:30** Amirhossein SADOGHI	
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ABSTRACTS

Keynote Talks

Counterparty Risk Modeling: Beyond Immersion

Stephane CREPEY, Evry University, France

Basic counterparty risk reduced-form models hinge on an immersion property of a reference (or market) filtration into the full model filtration enlarged by the default times of the counterparties, as well as continuity of some of the data at default time. This is too restrictive for applications with strong wrong-way risk, i.e. strong adverse dependence between the exposure and the credit riskiness of the counterparty. In this work we generalize the basic approach by switching from the class of pseudo-stopping time, which is classically used to model the default of the counterparties, to the much more flexible class of invariant times. For instance, these can be marked default times, where the role of the mark is to convey some additional information about the defaults in order to account for various possible wrong-way risk and gap risk scenarios and features. Additional tools are needed to analyze the cure period (time interval between the default and the liquidation) and the ensuing gap risk of diverging evolutions of the portfolio and of its collateral. In particular, the liquidation time is predictable (as announced by the default), which modifies the nature of the pricing problem. We illustrate our approach in two dynamic copula models of portfolio credit risk.

Joint work with Shiqi Song.

Model Risk, Counterparty Risk, and Robust Monte Carlo

Paul GLASSERMAN, Columbia University, USA

Monte Carlo methodology has traditionally focused on measuring and reducing sampling error in simulating well specified models; it has given less attention to quantifying the effect of model error or model uncertainty. At the same time, concerns about model risk in quantitative finance have attracted heightened attention. We will show that Monte Carlo simulation actually lends itself well to bounding model risk. In particular, if the set of alternative models consists of all models within a certain relative entropy (Kullback-Leibler) distance of a baseline model, then the potential effect of model risk can be estimated nearly costlessly within a simulation of the baseline model. We illustrate this approach to making Monte Carlo robust with examples. The problem of bounding “wrong-way risk” in counterparty risk presents a related question in which model uncertainty is limited to the nature of the dependence between two otherwise certain marginal models. The effect of uncertain dependence can be bounded through a convenient combination of simulation and optimization.

This talk is based on work with Xingbo Xu and Linan Yang.

The effect of small transaction costs on optimal investment, consumption, option pricing, and turnover

Jan KALLSEN, Christian-Albrechts-Universität zu Kiel, Germany

The key insight of this talk is that small transactions costs allow for relatively simple and explicit leading order asymptotics of optimal investment, consumption, and welfare for quite general Ito process dynamics of the risky asset. The involved factors are both the asset's and the frictionless optimiser's volatility, the size of transaction costs, and the investor's indirect risk tolerance. This general structure can be applied to study the effect of small transaction costs on e.g. indifference prices and turnover.

Oligopolies & Mean Field Games

Ronnie SIRCAR, Princeton University, USA

One way to view energy markets is as competition between producers from different fuels and technologies with markedly varied characteristics. Motivated by dynamic oligopoly models of competition between heterogeneous energy producers, we discuss how continuous time Bertrand and Cournot competitions, in which firms producing similar goods compete with one another by setting prices or quantities respectively, can be analyzed as continuum dynamic mean field games under the constraint of finite supplies (or exhaustible resources). The continuum game is characterized by a coupled system of partial differential equations: a backward HJB PDE for the value function and a forward Kolmogorov PDE for the density of players. Asymptotic approximation enables us to deduce certain qualitative features of the game in the limit of small competition. The equilibrium of the game is further studied using numerical solutions, which become very tractable by considering the tail distribution function instead of the density itself. This also allows us to consider Dirac delta distributions to use the continuum game to mimic finite N-player nonzero-sum differential games, the advantage being having to deal with two coupled PDEs instead of N. We find that, in accordance with the two-player game, a large degree of competitive interaction causes firms to slow down production. The continuum system can therefore be used as an effective approximation to even small player dynamic games.

ABSTRACTS

Invited Talks

Asymptotics Beats Monte Carlo: The Case of Correlated Local Vol Baskets

Christian BAYER, Weierstrass Institute, Berlin, German

We consider a basket of stocks with both positive and negative weights, in the case where each asset has a smile, e.g., evolves according to its own local volatility and the driving Brownian motions are correlated. In the case of positive weights, the model has been considered in a previous work by Avellaneda, Boyer-Olson, Busca and Friz [Risk, 2004]. We derive highly accurate analytic formulas for the prices and the implied volatilities of such baskets. These formulas are based on a basket Carr-Jarrow formula, a heat kernel expansion for the (multi-dimensional) density of the asset at expiry and the Laplace approximation. The formulas are almost explicit, up to a minimization problem, which can be handled with simple Newton iteration, coupled with good initial guesses as derived in the paper. Moreover, we also provide asymptotic formulas for the greeks. Numerical experiments in the context of the CEV model indicate that the relative errors of these formulas are of order 10^{-4} (or better) for $= 1/2$, 10^{-3} for $T = 2$, and 10^{-2} for $T = 10$ years, for low, moderate and high dimensions. The computational time required to calculate these formulas is under two seconds even in the case of a basket on 100 assets. The combination of accuracy and speed makes these formulas potentially attractive both for calibration and for pricing. In comparison, simulation based techniques are prohibitively slow in achieving a comparable degree of accuracy. Thus the present work opens up a new paradigm in which asymptotics may arguably be used for pricing as well as for calibration.

Sparse optimal portfolios in continuous time

Dirk BECHERER, Humboldt University Berlin, Germany

We discuss optimal sparse portfolios for investing in multiple risky assets in continuous time. Optimization objective is to maximize an expected utility as in the classical Merton problem but with regularizing sparsity constraints. Such constraints aim for asset allocations which contain only few assets or deviate only in few coordinates from a reference benchmark allocation. We provide analytical solutions for the continuous time problem in terms of backward stochastic differential equations. We show results of empirical test for various portfolio selection strategies with and without sparsity constraints for optimal portfolio allocation between multiple stock indicies, investigating several performance measures and adaptive methods to select regularization parameters. Sparse optimal portfolios are less sensitive to estimation errors and their performance is superior to portfolios without sparsity constraints when employed on real data, where estimation risk and model uncertainty must not be ignored.

Limit Order Books with Stochastic Market Depth

Ningyuan CHEN, Columbia University, USA

We propose a model for limit order books with stochastic, reverse U-shaped, market depth, consistent with empirical studies. Stochastic market depth is necessary to accommodate various order activities, such as limit order submission at and outside the best quotes and order cancellation, which may account for a large proportion of limit order activities. To show the analytical tractability of the model, in addition to a dynamic programming formulation of the optimal execution problem, we provide easily computable and tight upper and lower bounds for the optimal execution cost, as well as their resulting trading strategies via quadratic programming and jump-linear-quadratic control.

Asymptotics for Merton Problem with Capital Gain Taxes and Small Interest Rate

Min DAI, National University of Singapore, Singapore

We consider the Merton problem with capital gain taxes. Since closed form solutions are generally unavailable, we provide asymptotic expansions with small interest rate and other parameters, and then obtain an explicit investment and consumption strategy that effectively approximates the optimal strategy. The expansions also offer qualitative and quantitative insights about the effects of various parameters on the optimal strategy. Moreover, we find that in contrast to a second order effect of transaction costs on investor utility, capital gain taxes can have a first order effect. In addition, we find that the optimal tax-deflated fraction of initial wealth in the risky asset is higher than the "Merton line" provided that there is a positive interest rate.

Keywords: Optimal investment and consumption, Capital gain tax, Merton problem, Continuous-time, Asymptotic analysis.

Authors: Xinfu CHEN, University of Pittsburgh, USA. Min DAI, National University of Singapore, Singapore.

A Fourier Approach to the Computation of CV@R and Optimized Certainty Equivalents

Samuel DRAPEAU, Technical University Berlin, Germany

We consider the class of risk measures associated with optimized certainty equivalents. This class includes several popular examples, such as Expected Shortfall (also known as CV@R) or the entropic risk measures. Beyond explicit formulas to compute them, they also provide a handy way to compute risk contributions in portfolios of risks.

We develop numerical schemes for the computation of such risk measures using Fourier transform methods. This leads to a very competitive method for the calculation of CV@R for instance, which is comparable in computational time to the calculation of V@R. We also address the computation of risk contributions in portfolios of risks, for which the Fourier Transform methods are particularly efficient.

This is a joint work with Michael Kupper and Antonis Papapantoleon.

An Asymptotic Approach to BSDEs with Singular Terminal Condition Arising in Liquidation Problems

Paulwin GRAEWE, Humboldt University Berlin, Germany

We study BSDEs with a singular terminal condition arising within portfolio liquidation problems. Such stochastic control problems are featured by a strong terminal state (liquidation) constraint which typically causes a singularity of the value function at the terminal time. BSDEs with singular terminal conditions have been first considered by Popier (2006) and recently by Ankirchner, Jeanblanc and Kruse (2013). This authors established existence results of minimal solutions by a monotone finite approximation of the singular terminal value. Yet, such approximation bears several computational issues. With our asymptotic approach we aim to overcome these issues, giving an alternative, from a numerical point of view more satisfactory approach. Moreover, we shall settle the question of uniqueness.

We will proceed as follows. First, we derive the explicit asymptotics of the singular behavior by *a priori* bounds obtained from the underlying control problem. This asymptotics give then rise for an ansatz that separates the singularity and reduces the original problem to a BSDE with finite terminal condition. As a trade-off we are faced with a singular coefficient in the driver, which turns out to be tractable though by our *a priori* bounds.

This talk is based on joint work with U. Horst, E. Séré and J. Qiu.

Manifold Functional Principal Component Analysis for Functional Data

Qiang HE, National University of Singapore, Singapore

We propose and generalize the functional principal component analysis (FPCA) to functional data defined on a three-dimensional domain, which provides a natural and parsimonious representation of data that are intrinsically multiple dimensional, such as fMRI data with the signal values defined on a three-dimensional voxel location coordinate system. Compared to the existing methods which utilize the functional data defined on the reduced one-dimensional domain, our proposed methodology preserves the temporal and spatial information to the utmost extent and the accuracy and efficiency of the modeling is guaranteed. Both the proposed method and the existing one-dimensional voxel-wise FPCA method are implemented and compared for the detection of the active brain regions under the occurrence of stimulus. Better performance is expected for the proposed three-dimensional approach.

Estimation and Testing of Asset Pricing Models – Asking the Right Question

Robert KIMMEL, National University of Singapore, Singapore

There is a well-established literature which examines the theoretical and econometric problems involved with estimating the parameters of and testing asset pricing models, although in empirical finance studies, this literature is frequently ignored in favour of ad-hoc procedures which may or may not produce reliable answers to the questions which are asked. A frequent objective of empirical studies is to assess whether a model is "correct", in the sense that it predicts the expected returns of all assets, based on their exposure to various risk factors. However, this question is usually assessed by testing a null hypothesis of correct specification, and the nature of asset pricing models is such that "correctness" can be established (in the sense of failure to reject the null) simply by adding noise to the model, by including factors with little relation to asset prices.

We argue that there is essentially no resolution to this conundrum other than asking a different question, and that, rather than asking "Is this model correct?", researchers should ask, "Is this model useful?" A model which is not correct (i.e., which is rejected by the data) can nonetheless outperform a model which is correct (i.e., not rejected) for reasonable performance metrics.

On the Measurement of Economic Tail Risk

Steven KOU, National University of Singapore, Singapore

This paper attempts to provide a decision-theoretic foundation for the measurement of economic tail risk, which is not only closely related to utility theory but also relevant to statistical model uncertainty. The main result is that the only tail risk measure that satisfies a set of economic axioms proposed by

Schmeidler (1989, Econometrica) and the statistical property of elicitability (i.e, there exists an objective function such that minimizing the expected objective function yields the risk measure; see Gneiting (2011, J. Amer. Stat. Assoc.)) is median shortfall, which is the median of tail loss distribution. Elicitability is important for backtesting. Median shortfall has a desirable property of distributional robustness with respect to model misspecification. We also extend the result to address model uncertainty by incorporating multiple scenarios. As an application, we argue that median shortfall is a better alternative than expected shortfall for setting capital requirements in Basel Accords.

This is a joint work with Xianhua PENG.

Change of measure and (no) arbitrage up to a random time

Dörte KREHER, Humboldt University Berlin, Germany

In this talk we discuss changes of probability measure up to random times and related questions in mathematical finance. Working with continuous processes, the question of NFLVR up to an arbitrary random time is studied by means of the multiplicative decomposition of the Azéma supermartingale. Moreover, we also address some qualitative aspects of arbitrages arising from random times. Examples involving honest times, pseudo-stopping times, and other random times are given.

A new multi-factor stochastic volatility model with displacement

Marcel LADKAU, Weierstrass Institute, Berlin, Germany

We propose a new multi-factor stochastic volatility Libor model which allows for fast and accurate simultaneous calibration to the cap-strike matrix, and ATM swaptions, for all maturities. Unlike stochastic volatility LIBOR models known in the literature so far, in this model each forward LIBOR is driven by its own square-root volatility process. In addition, for maximal flexibility in the calibration, each forward LIBOR is supplied with an extra (possibly non-zero) displacement parameter. Further we provide Fourier based approximation procedures for quasi analytic pricing of caps and swaptions. The proposed approach allows for maximal calibration flexibility, even if, as during the last crisis, the market quotes for caps and swaptions are very inhomogeneous over time.

A Stochastic Free Boundary Problem and Limit Order Book Model

Marvin MÜLLER, Technical University Berlin, Germany

We introduce a continuous model for the limit order book density with infinitesimal tick size, where the evolution of buy and sell side is described by a semilinear second-order SPDE. The mid price process defines a free boundary separating buy and sell side. Price changes are assumed to be determined by the bid-ask imbalance. Following empirical observations by Lipton, Pesavento and Sotiropoulos (2013) we allow this dependency to be nonlinear. The resulting limit order book model can be considered as a generalization of the linear stochastic Stefan problem introduced by Kim, Sowers and Zheng (2012).

In order to show existence of a solution we transform the problem into a stochastic evolution equation, where the boundary interaction leads to an additional non-Lipschitz drift. Despite of the non-standard setting for the stochastic evolution equation, we show existence of a unique maximal mild solution of the general model; extending results of Kim, Sowers and Zheng. We show that this solution is continu-

ous, and, up to a stopping time, solves the equation even in the analytically strong sense. Additional assumptions on the boundary interaction then yield non-explosion and global existence. Finally, we use a Wong-Zakai type approximation to get sufficient conditions for positivity of the order volume.

This talk is based on joint work with Martin Keller-Ressel.

Affine LIBOR models with multiple curves: theory, examples, calibration, TVA

Antonis PAPAPANTOLEON, Technische Universität Berlin, Germany

In this talk, we present an extension of the LIBOR market model with stochastic basis spreads, in the spirit of the affine LIBOR models. This multiple-curve model satisfies the main no-arbitrage and market requirements (such as nonnegative LIBOR-OIS spreads) by construction. The use of multidimensional affine processes as driving motions ensures the analytical tractability of the model. We provide pricing formulas for caps, swaptions and basis swaptions and discuss an efficient numerical implementation. Furthermore, the connection between the affine LIBOR setup and the 'classical' LIBOR market model is clarified. We present some new examples of affine processes on $\mathbb{R}_+^2$ which admit explicit solutions of the Riccati equations and also some calibration results to market data. We conclude this talk by discussing the connection to the HJM framework and present some first results on the computation of value adjustments.

This is joint work with Z. Grbac, J. Schoenmakers, D. Skovmand and R. Wardenga.

A Functional Limit Theorem for Limit Order Books

Jinniao QIU, Humboldt University Berlin, Germany

This work is concerned with a stochastic model for the dynamics of the two-sided limit order book (LOB). For the joint dynamics of best bid and ask prices and the standing buy and sell volume densities, we derive a functional limit theorem, which states that our LOB model converges to a continuous-time limit when the order arrival rates tend to infinity, the impact of an individual order arrival on the book as well as the tick size tend to zero. The limits of the standing buy and sell volume densities are described by two linear stochastic partial differential equations, which are coupled with a two-dimensional reflected Brownian motion that is the limit of the bid and ask price processes.

This is joint work with Christian Bayer and Ulrich Horst.

A General Framework for Pricing Asian Options under Markov Processes

Yingda SONG, National University of Singapore, Singapore

A general framework is proposed for pricing both continuously and discretely monitored Asian options under one-dimensional Markov processes. For each type (continuously monitored or discretely monitored), we derive the double transform of the Asian option price in terms of the unique bounded solution to a related functional equation. In the special case of continuous-time Markov chain (CTMC), the functional equation reduces to a linear system that can be solved analytically via matrix inversion. Thus the Asian option prices under a one-dimensional Markov process can be obtained by first constructing a CTMC to approximate the targeted Markov process model, and then computing the Asian option prices under the approximate CTMC by numerically inverting the double transforms. Numerical

experiments indicate that our pricing method is accurate and fast under popular Markov process models, including the CIR model, the CEV model, Merton's jump diffusion model, the double-exponential jump diffusion model, and the variance gamma model.

This is a joint work with Ning CAI and Steven KOU.

On dynamic portfolio choice with price impact

Moritz VOSS, Technical University Berlin, Germany

We propose a variant of the limit order book model by Obizhaeva and Wang (2013) which allows for both selling and buying stock. Specifically, our price impact model determines bid- and ask-prices via a coupled system of controlled diffusions, allowing us to retain the possibility to specify market depth, tightness and resilience. We discuss the problem of optimal investment in this model. For arithmetic Brownian motion with drift as the unaffected price process and exponential utility, the resulting singular optimal control problem turns out to have a deterministic solution which we construct explicitly by methods from convex analysis. As expected by previous studies in the literature, it turns out to be optimal to trade towards the frictionless Merton portfolio taking into account the initial bid-ask-spread as well as the optimal liquidation of the position when approaching the terminal time.

This is joint work with Peter Bank.

Level Shifts of U.S. Short Term Rates, from Pre-Bubble Years to Post-Tsunami Era: Modeling, Estimation and Prediction

Jing XU, National University of Singapore, Singapore

U.S. short term yields data in the new century exhibits prominent level shifting feature. This empirical fact naturally motivates a question: is it possible to incorporate this feature and hence improve the performance of interest rate models at the short end of yield curve? To answer this question, we propose a novel random level shift extension of short rate models in this paper. On the theoretical side, we comprehensively study the bond pricing issues with random level shift. We propose efficient numerical method and accurate short maturity approximation formula. On the empirical side, we consider the extension of celebrated affine term structure models and estimate them using empirical data, employing an estimation method based on maximum likelihood. We find that those extended affine models uniformly outperform the original ones in terms of out-of-sample predictive power.

Optimal Consumption and Investment with Asymmetric Long-term/Short-term Capital Gains Taxes

Chen YANG, National University of Singapore, Singapore

We propose an optimal consumption and investment model with asymmetric long-term/short-term capital gains tax rates for both lower income and wealthy investors. We characterize and develop an iterative algorithm to compute the optimal policy. Opposite to the existing literature, we show that it may be optimal to defer even large long-term gains and losses. In addition, the optimal policy for lower income investors is qualitatively different from that for wealthy ones. Furthermore, raising capital gains tax rates for lower income investors can significantly increase their consumption, stock investment, and

welfare, due to negative effective tax rates.

This is a joint work with Min DAI, Hong LIU, and Yifei ZHONG.

Robust Utility Maximization via Second Order BSDEs

Chao ZHOU, National University of Singapore, Singapore

The problem of robust utility maximization in an incomplete market with volatility uncertainty is considered, in the sense that the volatility of the market is only assumed to lie between two given bounds. The set of all possible models (probability measures) considered here is non-dominated. We propose studying this problem in the framework of second order backward stochastic differential equations (2BSDEs for short) with quadratic growth generators. We show for exponential, power and logarithmic utilities that the value function of the problem can be written as the initial value of a particular 2BSDE and prove existence of an optimal strategy. Finally several examples which shed more light on the problem and its links with the classical utility maximization one are provided. In particular, we show that in some cases, the upper bound of the volatility interval plays a central role, exactly as in the option pricing problem with uncertain volatility models.

This is a joint work with Anis MATOUSSI and Dylan POSSAMAÏ.

ABSTRACTS

Contributed Talks

A General HJM Framework for Multiple Curves Modeling

Claudio FONTANA, University of Evry, France

We propose a general framework for modeling multiple yield curves which have emerged after the last financial crisis. In a general semimartingale setting, we provide an HJM approach to model the term structure of multiplicative spreads between (normalized) FRA rates and simply compounded OIS risk-free forward rates. We derive an HJM drift and consistency condition ensuring absence of arbitrage and, in addition, we show how to construct models such that the multiplicative spreads are greater than one and ordered with respect to the tenor's length. When the driving semimartingale is specified as an affine process, we obtain a flexible Markovian structure which allows for simple valuation formulas for most interest rate derivatives. Finally, we show that the present framework allows to unify and extend several approaches which have been recently proposed in the literature on multiple yield curve modeling.

Authors: Christa CUCHIERO, Vienna University of Technology, Austria; Claudio FONTANA, Université d'Évry, France; Alessandro GNOATTO, Ludwig-Maximilians-Universität München, Germany.

TEDAS – Tail Event Driven Asset Allocation

Sergey NASEKIN, Humboldt-Universität zu Berlin, Germany

Given that the current bond market has been driven to a level that causes discomfort to asset allocators, many funds with large exposures to bond market are seeking ways to insure the downside of the portfolio. This talk will give an account of the development of asset allocation approaches and their shortcomings. A new approach named TEDAS is developed in response to more frequent occurrences of tail event. Strategies are devised to mitigate risk and enhance returns using state-of-the-art quantitative finance techniques. The seminar is conducted with practitioners in mind, and at the same time, communicates to the more technically inclined audience the usefulness of feasible quantitative techniques and their availability.

Portfolio selection and risk management is one of very actively studied topics in quantitative finance and applied statistics. It is closely related to the dependency structure of portfolio assets or risk factors. The correlation structure across assets, especially in the tails, is a main component of the asset allocation problem, since it determines the level of risk in a position. Correlation alone is not informative on the distributional details of the asset components. By introducing TEDAS -Tail Event Driven Asset Allocation, one studies the dependence between assets at different quantiles. In a hedging exercise, TEDAS uses adaptive Lasso based quantile regression in order to optimally assign portfolio weights.

Authors: Wolfgang Karl HÄRDLE and Sergey NASEKIN, Humboldt-Universität zu Berin, Germany; David LEE Kuo Chuen and PHOON Kok Fai, Singapore Management University, Singapore.

Adaptive Order Flow Forecasting with Multiplicative Error Models

Andrija MIHOCI, Humboldt-Universität zu Berlin, Germany

Local adaptive multiplicative error models accommodate time-varying parameters and statistically outperform models with ad hoc selected estimation windows. Since the best forecasting performance is achieved in intraday analysis, this framework is here used to forecast the order flow dynamics based on the buyer and seller initiated trading volume series. A data-driven optimal length of local windows is

selected, yielding adaptive forecasts at each point in time. Analyzing order flow series of the mini Nikkei 225 index futures traded at the Osaka Securities Exchange in 2012 and 2013, our results show that local windows up to approximately 1-2 hours are reasonable to capture parameter variations. The proposed approach is profitable in intra-day trading.

Authors: Wolfgang K. HÄRDLE and Andrija MIHOCI, Humboldt-Universität zu Berlin, Germany; Christopher Hian-Ann TING, Singapore Management University, Singapore.

Tail Interdependence

Arnold POLANSKI, University of East Anglia, United Kingdom

We define tail interdependence as a situation where extreme outcomes for some variables are informative about such outcomes for other variables. We apply total correlation (multi-information) to quantify tail interdependence and devise statistical procedures to test: a) tail independence, b) symmetry of the interdependence structure and c) whether the empirical interdependence is generated by a theoretical model. The framework can be also used to generate synthetic data which emulate the observed dependence structure of a particular dataset. We illustrate this methodology by applying it to several datasets and confirm some existing and discover some new and intriguing stylized facts.

Authors: Arnold POLANSKI, University of East Anglia, United Kingdom; Evarist Stoja, University of Bristol, United Kingdom

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Optimum Strategy in Market Order Execution Associated with the Poisson Cluster Process

Amirhossein SADOGHI, Frankfurt School of Finance and Management, Germany

Algorithmic Trading is an electronic trading developed to trade a large quantity of shares to reduce market impact price. The main question is how to slice the order, when and how to trade optimally.

In this research, we consider discrete optimal execution problem for market order trading under different micro structure such as order book shape, resilience of price impact. In this market, the agent will take offers in the order book and trade-off between optimal liquidate the asset and minimize the price impact cost and the fluctuation of market supply.

Order flow can be viewed as occurring to a Poisson cluster process with stochastic intensity. The minimizing of temporary price impact can be done via splitting large orders into smaller pieces to avoid huge loss. Interaction between price impact and price dynamics can model as a dynamic optimization with price impact as a linear function in the self-exciting process dynamic.

The highlight of the study is to construct numeric boundaries based on an order flow. Whenever the bidding price hits or higher than the boundary, we execute the amount of notional that is associating with this boundary. We assess the algorithm regarding to market constraints on optimal strategy numerically.

This is a joint work with Qixiang ZHOU and Jan VECER.

Committee

Ulrich HORST (Humboldt-Universität zu Berlin, Germany)

Steven KOU (National University of Singapore, Singapore)

Antonis PAPAPANTOLEON (Technische Universität Berlin, Germany)

John SCHOENMAKERS (Weierstraß-Institute, Berlin, Germany)

Local Organizer

Paulwin GRAEWE (Humboldt-Universität zu Berlin, Germany)

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