Poster Presentations

WU Vienna, Mon-Wed, September 12-14, 2016
LC.0.000 LC Forum, LC - Learning Center, ground floor

First Session (Mon, Sept. 12, 2016, first coffee break, until Tue, Sept. 13, 2016 in the morning)

Camilla **Damian** (WU Vienna)
Filter-Based Discrete-Time EM Algorithm with Diffusion and Point Process Observation

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Tobias **Fissler** (University of Bern)
Testing the maximal rank of the volatility process for continuous diffusions observed with noise

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Lei **Ge** (City University of Hong Kong)
An accurate approximate solution for portfolio selection under stochastic volatility and consumption

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Lingqi **Gu** (University of Vienna)
On the existence of shadow prices for optimal investment with random endowment

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Rainer **Hirk** (WU Vienna)
Multivariate analysis of corporate credit ratings

Chun-Sung **Huang** (University of Cape Town)
Efficient Option Pricing under the Double Jump Model with Stochastic Volatility and Stochastic Interest Rate Based on Fourier-Cosine Expansions

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Ethan Owen **Petersen** (Rose-Hulman Institute of Technology, Indiana)
The Stock Price Effect of Apple Keynotes

Sergei **Sidorov** (Saratov State University)
Optimal payoffs for an investor with asymmetric attitude to gains and losses

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Mailan **Trinh** (University of Sussex)
Performance of model selection within a class of models for intraday trading data

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Barbara **Trivellato** (Politecnico di Torino)
Exponential models and utility maximization by Orlicz spaces

Christoph E. **Weiss** (University of Cambridge)
Modelling and Forecasting Inflation Rate Volatility

Bilgi **Yilmaz** (Middle East Technical University, Ankara)
A Stochastic Model Approach to Determine the Pattern in House Prices

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Yeliz **Yolcu Okur** (Middle East Technical University, Ankara)
Option Pricing under Heston Stochastic Volatility Model using Discontinuous Galerkin Finite Elements

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Yeliz **Yolcu Okur** (Middle East Technical University, Ankara)
Pricing Equity Options under a Double-Exponential Jump-Diffusion Process in the presence of Stochastic Barrier

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Dariusz **Zawisza** (Jagiellonian University in Krakow)
A consumption - investment problem when some coefficients might be unbounded

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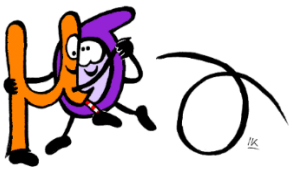
VCMF 2016 – Poster Presentations



Second Session (Tue, Sept. 13, 2016, first coffee break, until Wed, Sept. 14, 2016 last talk)

Emre **Akdoğan** (Middle East Technical University, Ankara)
A Survey on Stochastic Control of Itô- Levy Processes: Applications in Finance and Insurance

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Suhan **Altay** (TU Wien)
Stein-Chen approximation and error bounds for the sum of path-dependent indicators of stochastic processes

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Mária **Bohdalová** (Comenius University in Bratislava)
Copula Quantile Regression Hedging

Martin **Glanzer** (University of Vienna)
Robust acceptability pricing of contingent claims: A stochastic programming approach

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Margarita **Grushanina** (Erste Group Bank AG, Vienna)
Forecasting government bond yields using error-correction model and neural networks

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Tijana **Levajkovic** (University of Innsbruck)
Numerical framework for the stochastic linear quadratic control problem

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Duc Hoang **Luu** (Max Planck institute for mathematics in the sciences, Leipzig)
Stationary solution of the variance process in fractional Heston model

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Giovanni **Masala** (University of Cagliari)
Electricity derivatives: an application to IDEX Italian Market

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Christian **Pötz** (Technical University of Munich)
Chebyshev interpolation for analytic and non-analytic option prices

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Emel **Savku** (Middle East Technical University)
Maximum Principle For A Delayed Stochastic Hybrid Model and An Application to Finance

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Wayne **Tarrant** (Rose-Hulman Institute of Technology, Indiana)
Effective historical risk measures

Robert **Wardenga** (TU Dresden)
Continuous tenor affine LIBOR models and XVA

Daisuke **Yoshikawa** (Hokkai-Gakuen University)
On the market of contingent claims in models with uncertainty

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Aleksandra **Zhukova** (Institution of Russian Academy of Sciences)
A model of optimal consumption with random times of obtaining loans

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Abstracts of Poster Presentations

Poster presentation: second session, starting on Tuesday

Emre **Akdoğan** (Middle East Technical University, Ankara)

A Survey on Stochastic Control of Itô- Levy Processes: Applications in Finance and Insurance

In this study, the literature, recent devolepments and new achievements in stochastic optimal control theory are surveyed. Optimal control theory is an important direction of mathematical optimization for deriving control policies subject to time-dependent processes whose dynamics follow stochastic differential equations. In this study, this methodology is used to deal with those infinite-dimensional optimization programs for problems from finance and insurance that are indeed motivated by the real life. Stochastic optimal control problems can be further treated and solved along different avenues, two of the most important ones of being (i) Pontryagin's maximum principle together with stochastic adjoint equations (within both necessary and sufficient optimality conditions), and (ii) Dynamic Programming principle together with Hamilton-Jacobi-Bellman (HJB) equations (within necessary and sufficient versions, e.g., a verification analysis). Here we introduce into the needed instruments from economics and from Ito calculus, such as the theory of jump-diffusion and Lévy processes. In particular, we will present Dynamic Programing Principle, HJB Equations, Verification Theorem, Sufficient Maximum Principle for stochastic optimal control of jump diffusions, and we state connections and differences between Maximum Principle and the Dynamic Programing Principle. Our discussion will also take into account the potentials of our two avenues towards future improvement and generalization. We will give examples from financal mathematics and actuarial sciences, namely, stochastic portfolio selection in the stock market and optimal investment and liability ratio for an insurer, respectively. In our examples, we shall refer to various utility functions such as exponential, power and logarithmic ones, and to different parameters of risk averseness. The paper ends with a conclusion and an outlook to future studies, addressing elements of information, memory and stochastic games.

This is joint work with Yeliz Yolcu Okur and Gerhard-Wilhelm Weber.

Poster presentation: second session, starting on Tuesday

Suhan **Altay** (TU Wien)

Stein-Chen approximation and error bounds for the sum of path-dependent indicators of stochastic processes

We study certain approximation results for the distribution of sum of indicators, which are jointly determined by the maximum and the minimum of stochastic processes during successive intervals, by a Poisson distribution. By using certain dependence structures such as association and/or positive cumulative dependence and applying the well known Stein-Chen methodology, we show how the sum of indicators given by path-dependent functionals such as maximum and minimum of the stochastic processes in successive time intervals can approximated by a Poisson distribution.

Poster presentation: second session, starting on Tuesday

Mária **Bohdalová** (Comenius University in Bratislava)

Copula Quantile Regression Hedging

Our study deals with the problem of hedging portfolio returns. Many practitioners and academicians try to solve the problem of how to calculate accurately the optimal hedge ratio. In this study we compare estimations of the hedge ratio using the classical approach, linear quantile regression approach based on the selected quantiles as median, etc. and we compare them with non-linear quantile regression approach. To estimate the hedge ratios we have calibrated Student t distribution for the marginal densities and Student t copula of the portfolio returns. We have created two portfolios of the assets, one for equal weights and the second one for the optimal weights in the sense of minimal risk. Our findings show that assumption of Student t marginal leads to a better estimation of the hedge ratio.

This is joint work with Michal Greguš and Ondrej Bohdal.

Poster presentation: first session, starting on Monday

Camilla **Damian** (WU Vienna)

Filter-Based Discrete-Time EM Algorithm with Diffusion and Point Process Observation

The poster focuses on statistical inference in a dynamic, reduced form, partial-information model for Eurozone sovereign credit spreads. The main assumption is that default intensities are driven by an unobservable finite-state Markov chain.

Regarding methodology, an extension of the EM algorithm is involved: instead of pure diffusion information (see Elliott, 1993), both diffusive and point-process observations are considered. In the financial application, the point process represents default history of a given country. The techniques employed in Frey and Schmidt (2012) are used to solve the nonlinear filtering problems arising in the E-step, while the approaches of Clark (1978) and James et al. (1996) provide a framework to obtain a robust discretization of the continuous-time filters.

The goal is to estimate the model parameters, in particular the infinitesimal generator of the underlying Markov chain. Moreover, as shown in James et al. (1996), using the filter-based discrete-time EM algorithm makes it possible to obtain an MLE estimate also for the observation noise variance. The results are those of a simulation analysis, essential to check performance, accuracy and stability of the algorithm before applying it to real data.

This is joint work with Zehra Eksi-Altay and Rüdiger Frey.

Poster presentation: first session, starting on Monday

Tobias **Fissler** (University of Bern)

Testing the maximal rank of the volatility process for continuous diffusions observed with noise

We present a test for the maximal rank of the volatility process in continuous diffusion models observed with noise. Such models are typically applied in mathematical finance, where latent price processes are corrupted by microstructure noise at ultra high frequencies. Using high frequency observations, we construct a test statistic for the maximal rank of the time varying stochastic volatility process. Our methodology is based upon a combination of a matrix perturbation approach and pre-averaging. We will show the asymptotic mixed normality of the test statistic and obtain a consistent testing procedure. We complement the presentation with a simulation and an empirical study showing the performances on finite samples.

This is joint work with Mark Podolskij.

References:

T. Fissler and M. Podolskij (2016). Testing the maximal rank of the volatility process for continuous diffusions observed with noise. To appear in Bernoulli.

Poster presentation: first session, starting on Monday

Lei **Ge** (City University of Hong Kong)

An accurate approximate solution for portfolio selection under stochastic volatility and consumption

We study optimal portfolio and consumption problem in finite horizon and in continuous time. We consider that volatility is stochastic and investors have hyperbolic absolute risk aversion (HARA) utility for both consumption and terminal wealth. Commonly studied utility functions such as constant relative risk aversion (CRRA)/power, quadratic, logarithmic and exponential utility functions, are special cases of HARA utility function. Therefore, the HARA utility function which we considered represents a wide class of investors.

This is a difficult dynamics optimization problem and it involves nonlinear partial differential equation. Numerical computation has been the main tool for studying this problem. We develop closed-form approximate solutions of optimal portfolio and consumption rules for this problem. The theoretical predictions from our solutions are in good agreement with the numerical solutions. In particular, the relative errors of our approximate solutions are smaller than the relative errors in the parameter estimation. Therefore, for practical purpose, our approximate solutions can be treated as "exact".

This is joint work with Qiang Zhang.

Poster presentation: second session, starting on Tuesday

Martin **Glanzer** (University of Vienna)

Robust acceptability pricing of contingent claims: A stochastic programming approach

Classical superhedging bounds for the price of a contingent claim are often too large to be practically useful. Therefore, instead of requiring superreplication almost surely w.r.t. the physical measure P corresponding to the underlying market model, we allow for an accepted occurrance of negative events controled by acceptability functionals. Typically, this lowers the superhedging price. On the other hand, with this approach, it is not only the null sets of the probability model P which are taken into account, as is the case with almost sure superhedging. Thus, due to the fact that it is practically impossible to pose/estimate the true probability model for the underlying asset price evolution, introducing acceptability to the pricing procedure puts us in a classical situation of Knightian uncertainty. In particular, we incorporate this model uncertainty problem in the following sense: the hedging strategy is required to superreplicate the payoff(s) of a claim w.r.t. the specified acceptability functional(s) in terms of all probability models which lie in a nested distance neighbourhood (the 'ambiguity set') around some baseline model. We present some duality results, as well as algorithms which allow the computation of explicit superhedging prices within this setting, i.e. in particular, taking into account the whole ambiguity set when only the maximum nested distance to some baseline scenario tree model is given. Moreover, we examine the behaviour of the superhedging price surface w.r.t. the level of acceptability as well as the size of the ambiguity set. We discuss some particularly interesting applications of the presented framework and show some numerical results.

This is joint work with Georg Pflug.

Poster presentation: second session, starting on Tuesday

Margarita **Grushanina** (Erste Group Bank AG, Vienna)

Forecasting government bond yields using error-correction model and neural networks

In this study I analyse the long- and short-term dynamics of the government bond yields of 10 core euro area countries. First, I use the panel cointegration approach, which takes into account financial and economic interdependencies between the countries, for the analysis of both long- and short-term dynamics. As long-term determinants I use debt-to-GDP ratio, current account balance and potential GDP growth rate, while in the short-run the government bond yields are determined by inflation, short-term interest rate, real exchange rates, budget deficit and output gap. As the second step, I apply machine learning methods (neural networks) to the same panel aiming at minimizing prediction error of the forecast. I argue that machine learning technique shows significantly better prediction accuracy in forecasting short-term dynamics, while in case of the long-run analysis the error-correction model shows better performance. This is in line with the theoretical assumption, that in the long run the dynamics of government borrowing costs is determined by the fundamental factors while in the short run factors come into play which are difficult to formalise (e.g. policy uncertainty).

Poster presentation: first session, starting on Monday

Lingqi **Gu** (University of Vienna)

On the existence of shadow prices for optimal investment with random endowment

In this paper, we consider a numéraire-based utility maximization problem under proportional transaction costs and random endowment. Assuming that the agent cannot short sell assets and is endowed with a strictly positive contingent claim, a primal optimizer of this utility maximization problem exists. Moreover, we observe that the original market with transaction costs can be replaced by a frictionless shadow market that yields the same optimality. On the other hand, we present an example to show that in some case when these constraints are relaxed, the existence of shadow prices is still warranted.

This is joint work with Yiqing Lin and Junjian Yang.

Poster presentation: first session, starting on Monday

Rainer **Hirk** (WU Vienna)

Multivariate analysis of corporate credit ratings

Credit risk modeling, including the measurement of credit quality, has been intensively investigated by academics and practitioners over the past decades. This work contributes to this field of research by developing a framework for jointly modeling ordinal credit ratings and possibly defaults as outcomes. When ratings from different rating sources are available, the joint modeling of the panel of raters can uncover important information about the correlation in the different rating processes and possible systematic and rater-specific patterns. The model is based on the assumption that each ordinal outcome is a coarser version of an underlying latent process which depends on firm-specific and global covariates. This rating implied creditworthiness score is modeled as a consensus score plus rating errors. Focusing on the class of multivariate cumulative link mixed models, several existing estimation procedures (e.g., composite likelihood methods) for ordinal data models are investigated and extended. Firm-level and stock price data for publicly traded North American companies as well as long-term issuer credit ratings from the big three rating agencies (Standard & Poor's, Moody's and Fitch) are collected and analyzed to illustrate the proposed framework.

This is joint work with Rainer Hirk and Laura Vana.

Poster presentation: first session, starting on Monday

Chun-Sung **Huang** (University of Cape Town)

Efficient Option Pricing under the Double Jump Model with Stochastic Volatility and Stochastic Interest Rate Based on Fourier-Cosine Expansions

This paper focuses on the pricing of European options when the underlying asset follows a double exponential jump diffusion model with stochastic volatility and stochastic interest rates. In particular, we explore the efficient pricing methodology based on the Fourier-cosine expansions (COS), and compare the resulting efficiency to the widely utilized Fast Fourier Transform (FFT). Our numerical results show that not only is the COS method more efficient, but is also more accurate than the alternative FFT when benchmarked to the existing closed-form solution. Furthermore, we show that variability in the correlation between volatility and the underlying asset, as well as the interest rate dynamic, has a significant impact on the resulting option prices across a range of strikes and maturity dates.

This is joint work with John G. O'Hara and Sure Mataramvura.

Poster presentation: second session, starting on Tuesday

Tijana **Levajkovic** (University of Innsbruck)

Numerical framework for the stochastic linear quadratic control problem

Many problems in mathematical finance can be formulated as stochastic linear quadratic control (SLQR) problems. The dynamics of the system is linear and the cost functional quadratic. For a well-posed SLQR problem, the optimal control is given in terms of Riccati equation. We provide a numerical framework for solving the SLQR problem using a polynomial chaos expansion approach in white noise setting. After applying polynomial chaos expansion to the state equation, we obtain a system of infinitely many deterministic partial differential equations in terms of the coefficients of the state and the control variables. We set up a control problem for each equation, which results in a set of deterministic linear quadratic regulator problems. Solving these control problems, we find optimal coefficients for the state and the control. We prove the optimality of the solution expressed in terms of the expansion of these coefficients compared to a direct approach. Our approach can be applied to a very general case where the coefficients, both in the state equation and the cost are random. Moreover, the results can be extended to control problems where the dynamics are driven by fractional Brownian motion.

Poster presentation: second session, starting on Tuesday

Duc Hoang **Luu** (Max Planck institute for mathematics in the sciences, Leipzig)

Stationary solution of the variance process in fractional Heston model

It is well known that the variance process in the classical Heston model possesses a stationary distribution to which other measures converge to with exponential rate. In this poster the fractional Heston model is considered in which the variance process, although still a mean reversion, is driven by a fractional Brownian motion. Since it is not Markovian, little is known about the long term behavior of the solution. The approach uses theories of rough path, random dynamical systems and random attractors. The main results are the existence and uniqueness and the positiveness of the solution, the existence of a global random attractor for the random dynamical system generated by the initial equation.

Poster presentation: second session, starting on Tuesday

Giovanni **Masala** (University of Cagliari)

Electricity derivatives: an application to IDEX Italian Market

The liberalization of electricity markets has produced more volatile electricity prices and increased trading in electricity derivatives.

Besides, the electricity markets are currently facing significant changes with the introduction of renewable energies and new demand-response mechanisms.

The pricing of electricity derivatives is a challenging task due to electricity peculiar characteristics as compared to stocks and commodities (namely non-storability, generation constraints, transmission constraints, seasonality and weather dependence for example).

Another important aspect in pricing electricity derivatives is the fact that electricity must be produced in the same quantity as is consumed in real time, in order to avoid damaging network collapses.

Energy risk management uses futures to hedge against spot price fluctuations during the delivery period. Futures contracts are sold and bought to lock the price in advance for the planned generation or consumption of the next years, quarters and months so that spot trading is only used to optimize the procurement and sale of power in the short-run. Futures are also the most natural vehicles for investors willing to take positions in power markets without the underlying physical constraints.

We focus then on the Italian market. At this purpose, IDEX is the Energy Derivatives segment of IDEM, the Italian derivatives market managed by "Borsa Italiana" which is a company of London Stock Exchange Group. It has been launched in 2008 and it represents a regulated market where Italian power derivatives are traded. It currently trades both baseload and peakload power futures (on a monthly, quarterly and yearly basis).

It is well known that the features of electricity price dynamics determine high price volatility. For this reason, power futures allow operators within the industry to face this kind of risk by providing hedging tools in a safe trading environment. The goal is to provide an efficient business planning with greater operational profitability.

The underlying power spot market, namely the day-ahead market is managed by a state owned company, GME ("Gestore Mercati Energetici"). Besides, the single national purchase price PUN ("Prezzo Unico Nazionale") is calculated for every hour as a weighted average of the zonal prices determined on the day-ahead market.

In this survey, we attempt to investigate the relationships between IDEX futures' prices and electricity price and load for the Italian Market.

This is joint work with Laura Casula.

Main references:

[1] Aïd R. Electricity Derivatives (2015), Springer, ISBN 978-3-319-08394-0.
[2] Benth F.E. and Krühner P. Derivatives Pricing in Energy Markets: An Infinite-Dimensional Approach (2015), SIAM J. Financial Math., Vol. 6, pp. 825–869.
[3] Caporin M., Preś J. and Torro H. Model based Monte Carlo pricing of energy and temperature Quanto options (2012), Energy Economics, Vol. 34, pp. 1700–1712.
[4] Füss R., Mahringer S. and Prokopczuk M. Electricity derivatives pricing with forward-looking information (2015), Journal of Economic Dynamics & Control, Vol. l58, pp. 34–57.
[5] Weron R. Modeling and forecasting electricity loads and prices. A statistical approach (2006), John Wiley & Sons Ltd.

Poster presentation: first session, starting on Monday

Ethan Owen **Petersen** (Rose-Hulman Institute of Technology, Indiana)

The Stock Price Effect of Apple Keynotes

In this paper, we analyze the volatility of Apple's stock beginning January 3, 2005 up to October 9, 2014, then focus on a range from 30 days prior to each product announcement until 30 days after. Product announcements are filtered; announcements whose 60 day range is devoid of other events are separated. This filtration is chosen to isolate, and study, a potential cross-effect. Concerning Apple keynotes, there are two significant dates: the day the invitations to the event are received and the day of the event itself. As such, the statistical analysis is conducted for both invite-centered and event-centered time frames. A comparison to the VIX is made to determine if the trend is simply following the market or deviating. Regardless of the filtration, we find that there is a clear deviation from the market. Comparing these data sets, there are significantly different trends: isolated events have a constantly decreasing, erratic trend in volatility but an increasing, linear trend is observed for clustered events. According to the Efficient Market Hypothesis, we would expect a change when new information is publicly known and the results of this study support this claim.

Poster presentation: second session, starting on Tuesday

Christian **Pötz** (Technical University of Munich)

Chebyshev interpolation for analytic and non-analytic option prices

Based on Gaß et al. (2015) we investigate the Chebyshev interpolation method in the context of parametric option pricing. Gaß et al. (2015) propose Chebyshev interpolation of option prices in the parameters to gain efficiency for recurrent pricing tasks. They show that for a large set of options, models and free parameters, prices are analytic functions of the parameters and the interpolation converges (sub)exponentially. For some interesting models, however, the price function is not analytic but still smooth. We apply a convergence result for differentiable functions and obtain polynomial error decay for the approximation of smooth option prices and their derivatives. We analyse the regularity of the option price in Lévy models using Fourier pricing techniques. As an example of a model which is non-analytic in some of the parameters, we investigate the Normal Inverse Gaussian (NIG) model in detail. For a numerical convergence study the method is implemented for 1,2 and 3 free parameters in the NIG model and for comparison in the Black-Scholes model. The error decay is observed for different parameter constellations and compared to the theoretical bound. The empirical results confirm a very high accurateness and efficiency of the method.

This is a joint work with Kathrin Glau.

Reference:

Gaß, M., Glau, K., Mahlstedt, M., and Mair, M. (2015). Chebyshev interpolation for parametric option pricing. arXiv preprint https://arXiv:1505.04648.

Poster presentation: second session, starting on Tuesday

Emel **Savku** (Middle East Technical University)

Maximum Principle For A Delayed Stochastic Hybrid Model and An Application to Finance

Stochastic Hybrid Systems are natural and efficient candidates to model abrupt changes in the financial markets with their heterogenous nature. We study on a stochastic optimal control problem of a stochastic hybrid model within the framework of regime-switches.The necessary and sufficient maximum principle for a Markov regime-switching jump-diffusion with delay is developed. The associated adjoint equations are shown to satisfy an anticiapted backward stochastic differential equation (ABSDE). We provide the existence uniqueness result for such ABSDEs. We illustrate our results by an application to optimal consumption from a cash flow with delay.

Poster presentation: first session, starting on Monday

Sergei **Sidorov** (Saratov State University)

Optimal payoffs for an investor with asymmetric attitude to gains and losses

The description of Cumulative Prospect Theory (CPT) includes three important parts: a value function over outcomes, v; a weighting function over cumulative probabilities, w; CPT-utility as unconditional expectation of the value function v under probability distortion w. In this paper we consider the problem of choosing an CPT-investor's portfolio in the case of complete market. The problem of finding the optimal portfolio for CPT-investor is to maximize the unconditional expectation of the value function v under probability distortion w over terminal consumption, subject to budget constraint on initial wealth. We find the optimal payoffs for CPT-investor for the classic Black-Scholes environment assuming that there are a single lognormally distributed stock and a risk free bond. We compare the optimal payoffs of CPT-investor with the optimal payoffs of the investor that maximizes expected power utility over terminal payoffs, subject to budget constraint on initial wealth (EU-investor). Moreover, we examined the problem of optimal portfolio choice for PT- and CPT-investors assuming that dynamic trading is prohibited. We have considered a simple stochastic model with one risk-free asset and one risky asset that follows geometrical Brownian motion. We proved existence of a non-trivial optimal choice for the weights of the assets under some conditions on the parameters of the value function v.

This is joint work with Sergei Mironov.

Poster presentation: second session, starting on Tuesday

Wayne **Tarrant** (Rose-Hulman Institute of Technology, Indiana)

Effective historical risk measures

In this talk we look at the efficacy of typical historical risk measures on different markets. We consider both the Value at Risk and the Expected Shortfall as the most common risk measures. We calculate over varying time frames and confidence levels in order to determine if some historical measures predict the level of future losses with any reliability.

We will be most interested in stock market indices, bonds, foreign exchange rates, and commodities. We consider times of recession and expansion to see if there are differences in the efficacy of the measures. In the end we compute a spectral risk measure for each market and time frame to see if there is some one measure that is consistently accurate across type of market, level of confidence, and/or time frame.

Poster presentation: first session, starting on Monday

Mailan **Trinh** (University of Sussex)

Performance of model selection within a class of models for intraday trading data

Analysis of high-frequency data suggests that intraday trading exhibits non-stationary behaviour. Therefore, we propose a simple model for non-stationary returns based on a non-homogeneous normal compound Poisson process. For practical reasons, we are mainly interested in the performance of information criteria (IC) for model selection within this class of models. In a Monte Carlo experiment, we test the commonly used IC: Akaike's information criterion (AIC), the Bayesian information criterion (BIC) and the Hannan Quinn information criterion (HQ). The IC perform relatively well in cases of few parameters, but performance decreases with growing number of parameters. This is joint work with Linda Ponta (University of Genoa), Marco Raberto (University of Genoa), Enrico Scalas (University of Sussex) and Silvano Cincotti (University of Genoa).

Poster presentation: first session, starting on Monday

Barbara **Trivellato** (Politecnico di Torino)

Exponential models and utility maximization by Orlicz spaces

Applications of statistical exponential models built on Orlicz spaces arise in several fields, such as differential geometry, algebraic statistics and information theory. Their use in finance is quite new, although the importance of Orlicz spaces in utility maximization problems and in the theory of risk measures is known. We explore some theoretical concepts in the theory of maximal exponential models and address the classical problem of exponential utility maximization in incomplete markets. In the exponential framework, the starting point is the notion of maximal exponential model centered at a given positive density p, introduced by Pistone and Sempi (1995). In that paper, the set of (strictly) positive densities is endowed with a structure of exponential Banach manifold, using the Orlicz space associated to an exponentially growing Young function.

One of the main result of Cena and Pistone (2007) states that any density belonging to the maximal exponential model centered at p is connected by an open exponential arc to p and viceversa, (by "open", we essentially mean that the two densities are not the extremal points of the arc).

Many examples in the literature show that the minimal entropy martingale (density) measure q is connected to p = 1 by an open exponential arc, and this obviously reflects on the solution of the primal problem. In Santacroce, Siri and Trivellato (2016), the equivalence between the equality of the maximal exponential models centered at two (connected) densities p and q and the equality of the Orlicz spaces referred to the same densities is proved. By duality methods (see Biagini (2008), Biagini and Frittelli (2008) for an Orlicz space approach), this result is used in an ongoing research in order to characterize the solution of the maximization problem in terms of the solution of the dual problem.

Poster presentation: second session, starting on Tuesday

Robert **Wardenga** (TU Dresden)

Continuous tenor affine LIBOR models and XVA

We consider the class of affine LIBOR models with multiple curves, which is an analytically tractable class of discrete tenor models. By introducing an interpolating function, we extend the affine LIBOR models to a continuous tenor and derive expressions for the instantaneous forward rate and the short rate. We show that the continuous tenor model is arbitrage-free, that the analytical tractability is retained under the spot martingale measure, and that under mild conditions an interpolating function can be found such that the extended model fits any initial forward curve. This allows us to compute value adjustments (i.e. XVAs) consistently. As an application, we compute the price and value adjustments for a basis swap, and study the model risk associated to different interpolating functions.

This is joint work with Antonis Papapantoleon.

Poster presentation: first session, starting on Monday

Christoph E. **Weiss** (University of Cambridge)

Modelling and Forecasting Inflation Rate Volatility

The adverse effects of inflation volatility on economic growth and welfare are well known. The generating process that underlies inflation volatility is not as well understood as it should be.
Using monthly data that underlies the Retail Price Index for the U.K., for the period since inflation targeting was introduced in October 1992, we analyse the drivers of the inflation rate and its volatility. We explore patterns in the time-varying covariation among product inflation rates that aggregate up to category inflation rates that in turn aggregate up to the overall inflation rate. We find that aggregate inflation volatility closely tracks the time paths of covariation, which turns out to be mainly driven by the variances of common shocks shared by all products, and the covariances of idiosyncratic, product-level shocks.
Using a forecasting system that comprises of models for the mean and the variance, following the disaggregated approach of the hierarchical time series forecasting framework, we exploit the index structure of the aggregate inflation rate and obtain forecasts that - depending on choice of forecast horizon and choice of proxy for 'actual' inflation volatility - are between 16 and 108% more accurate than a GARCH(1,1) for the aggregate inflation rate/volatility.

This is joint work with Paul Kattuman.

Poster presentation: first session, starting on Monday

Bilgi **Yilmaz** (Middle East Technical University, Ankara)

A Stochastic Model Approach to Determine the Pattern in House Prices

The increase in interest in real estate as investment tools required more sophisticated methods as the traditional valuation methods became inadequate to analyze the improvement in house prices changes. Common valuation methods such as hedonic and multi-regression enable researchers to display the importance and the impact of the significant house characteristics on its price. Even if, the econometric methods are the most commonly used ones, the estimation power of these methods is questionable when required conditions such as normality, independency and linearity conditions are not satisfied. Therefore, there is a need to construct new approaches that capture properly the important factors and the unexpected fluctuations in house prices.

The aim of this study is to design a model, based on stochastic processes, on the house prices and related indicators. The development of such a model that captures the pattern of house prices indirect to the underlying other stochastic variables is expected to define the price structure. Based on stochastic differential equation systems (SDEs), we aim to determine theoretical fair house prices. One of the main advantages of this approach is to identify the house prices that share common time series components with explanatory variables, such as mortgage rates. The model allows arbitrary correlation between house prices and mortgage rates, and therefore, it generalizes and combines the historical house prices and mortgage rates by using all the information in the initial term structures of both historical prices and mortgage rates. The full probabilistic inference for the model parameters is facilitated by adapting a Monte Carlo (MC) algorithm in the formulation of proposed model. The critical part in this pricing approach is the precise description of the stochastic process governing the behavior of the housing price and the interest rate. It is the characteristics of this process which determines the exact nature of both variables. The study contributes to the existing literature by offering the use of SDEs to the econometric analysis of the housing market.

This is joint work with A. Sevtap Selçuk-Kestel.

Poster presentation: first session, starting on Monday

Yeliz **Yolcu Okur** (Middle East Technical University, Ankara)

Option Pricing under Heston Stochastic Volatility Model using Discontinuous Galerkin Finite Elements

We consider interior penalty discontinuous Galerkin finite element (dGFEM) method for variable coefficient diffusion-convection-reaction equation to discretize the Heston PDE for the numerical pricing of European options. The mixed derivatives in the cross diffusion term are handled in a natural way compared to the finite difference methods. The advantages of dGFEM space discretization and Cranck-Nicholson method with Rannacher smoothing as time integrator for Heston model with non-smooth initial and boundary conditions are illustrated in several numerical examples for European call, butterfly spread and digital options. The convection dominated Heston PDE for vanishing volatility is efficiently solved utilizing the adaptive dGFEM algorithm. Numerical experiments illustrate that dGFEM is highly accurate and very efficient for pricing financial options.

This is joint work with Sinem Kozpinar, Murat Uzunca and Bülent Karasözen.

References:
[1] Heston, S. L. (1993). A closed-form solution for options with stochastic volatility with applications to bond and currency options, Review of Financial Studies, 6, 327-343.
[2] Riviere, B. (2008). Discontinuous Galerkin Methods for Solving Elliptic and Parabolic Equations, Theory and Implementation, SIAM.
[3] Winkler, G., Apel, T., Wystup, U. (2001). Valuation of options in Heston's stochastic volatility model using finite element methods, Foreign Exchange Risk, 283-303.

Poster presentation: first session, starting on Monday

Yeliz **Yolcu Okur** (Middle East Technical University, Ankara)

Pricing Equity Options under a Double-Exponential Jump-Diffusion Process in the presence of Stochastic Barrier

We consider that the firm defaults when its asset value hits a stochastic barrier related to its outstanding obligations. We derive a partial integro-differential equation for pricing equity options where the underlying security is driven by a double-exponential jump-diffusion model. In order to find a numerical solution for the corresponding partial integro-differential equation, a localization of the infinite domain is used, and then, a finite difference scheme is applied. We also compare the approximate solutions obtained with the results of Monte Carlo simulation to validate our findings.

This is joint work with Sinem Kozpinar, Omur Ugur and Cansu Evcin.

References:
[1] Cont, R., Voltchkova, E. (2005). A finite difference scheme for option pricing in jump diffusion and exponential Levy models, SIAM Journal on Numerical Analysis, 43 (4), 1596-1626.
[2] Kou, S. (2002). Jump diffusion model for option pricing, Management Science, 48 (8), 1086-1101.
[3] Sepp, A. (2006). Extended credit grades model with stochastic volatility and jumps, Wilmott magazine, 50-62.

Poster presentation: second session, starting on Tuesday

Daisuke **Yoshikawa** (Hokkai-Gakuen University)

On the market of contingent claims in models with uncertainty

As the bankruptcy of Lehman Brothers shows, the probability of huge loss is often surprisingly unexpected. However, some people hung on the financial market, not having sufficient information on the true loss probability. For the stabilization of financial market, it is necessarily to pay attention to such people. In this paper, we focus on this problem in, especially, derivative market.

Any investor expects the higher satisfaction by the trade of derivatives, even if the knowledge on the true probability is different from each other. Thus, they would offer the price of derivatives better than the standard which is at least allowable for them. For such a standard, we use the framework of indifference pricing; we derive the utility indifference price when the true probability is not specified. For this, we consider the investor fallen into pessimism by less information on the probability will prepare for loss, assuming the worst scenario even if this scenario happens with extremely small probability. The principle of this decision making is called maxmin expected utility (MEU). That is, we derive the derivative prices with MEU.

Based on the result of derivative prices with and without MEU, we consider how the transaction of derivatives is formed. Further, we analyse the sensitivity of the amount of transaction of derivatives on investors' initial wealth and averseness to risk.

Poster presentation: first session, starting on Monday

Dariusz **Zawisza** (Jagiellonian University in Krakow)

A consumption - investment problem when some coefficients might be unbounded

During the talk I will present our recent results concerning an existence theorem for HJB equations arising in some consumption - investment problems. Assets prices are diffusions with dynamics affected by a correlated non-tradable (but observable) stochastic factor and our investor tries to maximize the standard HARA utility functional. We put the emphasis on the problems when the interest rate or the market price of risk are unbounded functions of the factor process. We consider the finite and the infinite horizon problem formulation. Our results generalize many other optimization problems. The talk will be based on Zawisza [1] paper and current research.

[1] D. Zawisza, Smooth solutions to discounted reward control problems with unbounded discount rate and financial applications, arXiV 1602.00899v2.

Poster presentation: second session, starting on Tuesday

Aleksandra **Zhukova** (Russian Academy of Sciences)

A model of optimal consumption with random times of obtaining loans

This work continues studies of the influence of random moments of change in control on the behavior of a consumer. In this paper we introduce random (Poisson) moments of access to credit. The model assumes an infinitely-living discounted utility maximizer (of CRRA type) that has external income and who may take loans to purchase consumption goods for the known price. The result of the analysis is that the optimal control is such that in the high-frequency limit the consumption expenditure is a non-random function that depends only on time. Perturbations methods suggest the dependence of the found function on the integral characteristics of the external income. The method we use to solve the optimal control problem is sufficient optimality conditions using Lagrange multipliers.

This is joint work with Igor Pospelov.