Invited lecture:

Uwe Franz

An invitation to noncommutative probability and quantum stochastic calculus

Well-known probability distributions, such as the normal distribution and the Poisson distribution, arise naturally when one constructs Fock-type representations of real Lie algebras. This extends to decompositions B_t=A_t+A_t^+, N_t=L_t+A_t+A_t^++t of Brownian motion B and the Poisson process N as sums of non-commuting operators on the Fock space, which satisfy simple Lie algebraic relations. Identifying the Fock spaces with the L^2-spaces of Brownian motion and the Poisson process, this new operators can be expressed in terms of stochastic integration and the derivation operator from Malliavin calculus. Hudson and Partharasathy have developped a stochastic integration theory for these operator processes that allows to describe time evolutions of noisy quantum systems. In my lectures I will give an overview over this theory and discuss several applications. At the end I will also give an outlock over extensions of this theory to other "noncommutative" notions of independence (in particular freeness).

Outline:
1. Quantum probability spaces and quantum random variables
2. The Fock space and the four fundamental noises
3. Quantum stochastic integrals
4. Quantum stochastic differential equations
5. Other independences (freeness)

ABSTRACTS OF TALKS

Sofian Aboura

Should employers pay their employees better?

We uncover a new anomaly in asset pricing that is linked to the remuneration: the more a company spends on salaries and benefits per employee, the better its stock performs, on average. Moreover, the companies adopting similar remuneration policies share a common risk, which is comparable to that of the value premium. For this purpose, we set up an original methodology that uses firm financial characteristics to build factors that are less correlated than in the standard asset pricing methodology. We quantify the importance of these factors from an asset pricing perspective by introducing the factor correlation level as a directly accessible proxy of eigenvalues of the correlation matrix. A rational explanation of the remuneration anomaly involves the positive correlation between pay and employee performance. Joint paper with S. Valeyre, D. Grebenkov, F. Bonnin. https://arxiv.org/pdf/1602.00931v2.pdf

Anna Aksamit

Duality for American options in non-dominated discrete-time models

The duality for American options with semi-static hedging does not hold in general in the simple formulation inherited from European option set-up. However, the duality can be recovered by considering bigger class of models and rendering an American option a European one. Another way to recover the duality for American is by relaxing static trading and allowing dynamic trading in the set of vanilla options. The connections to classical enlargement of filtration are also remarked. The problem of stopping only at stopping times w.r.t. price process filtration can be related to pseudo-stopping times (as well randomized stopping times) and the immersion property.
The talk is based on a work with Shuoqing Deng, Jan Obloj and Xiaolu Tan.

Sahar Albosaily

The optimal investment and consumption for the financial market generated by the spread of risky assets

The aim of this talk is to find the optimal investment and consumption for the financial markets generated by the spread of risky assets. As usual in the portfolio optimization problems it is considered the financial assets of geometric Brownian motion type. In this talk we use the model of financial markets ” spread” generated by the Ornstein-Uhlenbeck process. This extends the Boguslavsky and Boguslavskaya (BB, 2004) pure investment problem of the same model. Moreover, we apply the probabilistic representation method for the solution of parabolic partial differential equations based onthe Feynman-Kac formula. We chose this method as we could not apply the method proposed in (BB, 2004) to find an explicit solution of this equation. As for the problem with the consumption there are additional variables. Finally, the H-J-B equation for this problem is obtained. Also, the existence and uniqueness theorem for the classical solutions for this problem is shown.

Hansjoerg Albrecher

On capital injections and dividends in risk theory

Some recent advances in modelling capital injections and dividend payments for the surplus process of collective risk theory in insurance are presented. Several explicit formulas and identities are derived, some of which also extend tax identities developed earlier in the literature. Particular emphasis will be given on results for an underlying Lévy risk process.

Cagin Ararat

Multi-objective stochastic optimization via multivariate risk measures

Risk-averse stochastic optimization is concerned with the minimization of a risk

measure of a random cost function over the feasible choices of a deterministic and a random decision variable. We study the multi-objective version of this problem in which case the cost function is vector-valued and its risk is quantified via a multivariate (set-valued) risk measure. We reformulate the resulting problem with a set-valued objective function as a convex vector optimization problem and propose customized versions of Benson's algorithm to solve it. In particular, by randomizing the deterministic decision variable, we develop convex duality-based decomposition methods to solve the scalar subproblems appearing in Benson's algorithm. The algorithm is illustrated on examples including the multi-asset portfolio optimization problem with transaction costs.

Matteo Basei

Coordination of centralized and distributed generation

Consumers satisfy their electricity demand by self-production (solar panels) and centralized production (energy companies). Both companies and consumers are interested in characterizing the production strategies which minimize the costs and satisfy some properties; in particular, consumers need low-variance policies so as to have a stable flux of energy, whereas companies face carbon taxes and a penalty in case of under/overproduction. We address three problems: namely, we consider the point of view of a representative consumer, a representative energy company and a social planner. We deal with McKean-Vlasov control problems with stochastic coefficients and provide explicit formulas for the optimal strategies of each problem; finally, we compare the results and look for an electricity price such that the optimal controls asymptotically coincide in mean.

Based on a joint work with R. Aïd, I. Ben Tahar and H. Pham.

Dirk Becherer

Hedging, liquidation and stability under transient price impact

In illiquid markets with positive prices, we discuss optimal trading strategies for a large traders with transient price impact. We discuss how stability properties are relevant for the definition of asymptotically realizable trading proceeds, and we discuss related control problems, e.g. liquidation under stochastic resilience, or hedging for large traders.

Joint work with T. Bilarev and P. Frentrup from HU, some related preprints are on the arXiv.

Belak Christoph

Portfolio optimization with constant and proportional costs

We study the problem of maximizing expected utility of terminal wealth for an investor facing a mix of constant and proportional transaction costs. While the case of purely proportional transaction costs is by now well understood and existence of optimal strategies is known to hold for very general price processes extending beyond

semi-martingales, the case of constant costs remains a challenge since the existence of optimal strategies is not even known in tractable models such as the Black-Scholes model. In this talk, we present a novel approach which allows us to construct optimal strategies in a multidimensional continuous-time diffusion market with price processes driven by a factor process and for general lower-bounded utility functions.

The main idea is to characterize the value function associated with the optimization problem as the pointwise infimum of a suitable set of superharmonic functions. The advantage of this approach is that the pointwise infimum inherits the superharmonicity property, which in turn allows us to prove a verification theorem for candidate optimal strategies under mild regularity assumptions on the pointwise infimum. Indeed, for the verification procedure based on superharmonic functions to be applicable, it suffices that the pointwise infimum is continuous.

In order to establish the continuity of the pointwise infimum, we adapt the stochastic Perron's method to our situation to show that the it is a discontinuous viscosity solution of the associated quasi-variational inequalities. A comparison principle for discontinuous viscosity solutions then closes the argument and shows that the pointwise infimum is continuous. With this, the verification theorem becomes applicable and it follows that the pointwise infimum coincides with the value function and that the candidate optimal strategies are indeed optimal.

This is joint work with Sören Christensen (University of Hamburg).
https://ssrn.com/abstract=2774697.

Tatiana Belkina

Asymptotic investment behaviors under insurance risk processes

We consider an insurance company whose surplus is represented by an insurance risk process. The company can invest its surplus in a risk free asset and in a risky asset, governed by the Black-Scholes equation. As an insurance risk process both the classical Cramér-Lundberg (CL) process and its modification with perturbation of a Brownian motion are considered. The objective is to find an optimal investment policy that minimizes the probability of ruin. We study the optimal control policies and its properties in different statements of the optimization problem. In particular, constrained investments is studied when the insurance company can only invest in the risky asset at a limited leveraging level, while the shortselling is allowed. We show that the interrelation between the parameters of the model is very significant for the qualitative behavior of the optimal policy. As a general result we conclude that the risky assets play a crucial role in strengthening of the insurer’s solvency in a zone of a big own risk.

Yana Belopolskaya

Probabilistic interpretations of the Cauchy problem solutions for systems of nonlinear parabolic equation

We construct probabilistic representations for classical, generalized and viscosity solutions of the Cauchy problem for systems of nonlinear parabolic equations that arise as mathematical models in physics, biology and finance. Moreover we reduce the construction of a solution to the Cauchy problem for a PDE system to solution of a certain stochastic system such that one components of its solution gives a required solution of the original problem In this way we construct classical and viscosity solutions of parabolic systems with diagonal second order terms having either equal or various coefficients and nondiagonal lower order terms. Besides we construct a stochastic representation of the Cauchy problem weak solutions for a quasilinear parabolic systems with nondiagonal second order terms called parabolic systems with cross diffusion.

Rostislav Berezovsky
Set-valued risk measures in non-conical case

Blanchard Romain
Robust optimal investment in discrete time for unbounded utility function

We investigates the problem of maximising expected terminal utility in a discrete-time financial model with a finite horizon under non-dominated model uncertainty. We use dynamic programming framework together with measurable elections arguments to prove that under mild integrability assumption, an optimal portfolio exists for unbounded utility function defined on the half-real line. We revisit also the non-arbitrage condition in the robust framework.

Elena Boguslavskaya
Appell integral transforms and fractional polynomials

Appell polynomials and their properties are well-known and widely used in probability. Here we introduce fractional Appell polynomials and discuss their properties and applications. The motivation for the definition of fractional Appell polynomials is the following: as it was shown in [1], Appell polynomials of order n can be obtained as A-transforms of the corresponding monomials of order n. In a similar way fractional Appell polynomials of order a can be obtained as A-transforms of the corresponding monomials of order a. Fractional Appell polynomials exhibit many nice properties similar to those of Appell polynomials.For example, fractional Appell polynomials are martingales if built on Levy processes (or some other Markov processes). We show how fractional Appell polynomials can be applied to calculate some functionals of some Markov processes.

[1] Boguslavskaya E. Solving optimal stopping problems for Levy processes in infinite horizon via A-transform.

http://arxiv.org/pdf/1403.1816.pdf
[2] Boguslavskaya E. Fractional Appell Polynomials. In preparation.

Bruno Bouchard
Stochastic invariance of closed sets and applications in finance

This paper provides a new characterization of the stochastic invariance of a closed subset with respect to a diffusion. We extend the well-known inward pointing Stratonovich drift condition to the case where the diffusion matrix can fail to be differentiable: we only assume that the covariance matrix is. In particular, our result can be directly applied to construct affine and polynomial diffusions on any arbitrary closed set.

Eugene Burnaev
Online conformalized density- and distance-based anomaly detection in time-series data

Anomalies (unusual patterns) in time-series data give essential and often actionable information in critical situations. Examples can be found in such fields as healthcare, intrusion detection, finance, security and flight safety. In this paper we consider new approaches to anomaly detection in one-dimensional time-series data using newly developed conformalized density- and distance-based anomaly detection algorithms. They are based on a combination of a feature extraction method, an approach to assess a score whether a new observation differs significantly from a previously observed data, and a probabilistic interpretation of this score based on the conformity paradigm. Moreover, we consider an application of developed methods to various types of time-series data.

Matteo Burzoni

Pathwise arbitrage theory in discrete time

We provide a pathwise framework for the analysis of discrete-time models of financial markets based on agents' beliefs. We interpret the additional information which might be at disposal of an agent as a subset of feasible trajectories with minimal measurability requirements. An according pathwise version of the First Fundamental Theorem of Asset Pricing and the Superhedging Duality Theorem are given, for markets where dynamic trading is combined with static positions in vanilla options. This is a joint work with M. Frittelli, Z. Hou, M. Maggis and J. Obloj.

Laurence Carassus

Robust optimal investments in discrete time for unbounded utility function

This paper investigates the problem of maximizing expected terminal utility in a discrete-time financial market model with a finite horizon under non-dominated

model uncertainty. We use a dynamic programming framework together with measurable selection arguments to prove that under mild integrability conditions, an optimal portfolio exists for an unbounded utility function defined on the half-real line.

Thomas Cayé

Trading with small nonlinear price impact

We study a portfolio choice problem with nonlinear price impact in a general setting. Using probabilistic techniques, we show that the limiting control problem for small price impact can be reduced to the ergodic control of an OU-type process with nonlinear mean-reversion speed. This problem can be solved explicitly up to a single nonlinear ODE, which identifies the optimal trading speed and the welfare loss due to the trading friction. Previous asymptotic results for proportional and quadratic trading costs are obtained as particular limiting cases. A joint work with Johannes Muhle-Karbe and Martin Herdegen.

Ngoc Huy Chau

On optimal investment with processes of long or negative memory

We consider the problem of utility maximization for investors with power utility functions. Building on the earlier work Larsen et al. (2014), we prove that the value of the problem is a Frechet-differentiable function of the drift of the price process, provided that this drift lies in a suitable Banach space. We then study optimal investment problems with non-Markovian driving processes. In such models there is no hope to get a formula for the achievable maximal utility. Applying results of the first part of the paper we provide first order expansions for certain problems involving a fractional Brownian motion either in the drift or in the volatility. We also point out how asymptotic results can be derived for models with strong mean reversion.

Hye-Jin Cho

Economics of regulation: credit rationing and excess liquidity

In examining the global imbalance by the excess liquidity level, the argument is whether commercial banks want to hold excess reserves for the precautionary aim or expect to get better return through risky decision. By pictorial representations, risk preference in the Machina's triangle (1982, 1987) encapsulates motivation to hold excess liquidity. This paper introduces an endogenous liquidity model for the financial sector where the imbalance argument comes from credit rationing extended from outside liquidity (Holmstrom and Tirole, 2011). We also conduct a stylistic analysis of excess liquidity in Jordan and Lebanon from 1993 to 2015. As such, the proposed model exemplifies the combination of credit, liquidity and regulation.

Tahir Choulli

Explicit parametrisation for local martingale deflators for models stopped at the death time

Rama Cont

Stochastic calculus without probability: pathwise integration and calculus for functional of paths of finite quadratic variation

Stéphane Crépey

XVA analysis from the balance sheet

In the aftermath of the financial crisis, regulators launched a major effort of banking reform aimed at securing the financial system by raising collateralisation and capital requirements. Notwithstanding finance theories, according to which costs of capital and of funding for collateral are irrelevant to decisions, banks have introduced an array of XVA metrics to precisely quantify them. In particular, KVA (capital valuation adjustment) and FVA (funding valuation adjustment) are emerging as metrics of key relevance.We frame a capital structure model acknowledging the impossibility for a bank to replicate jump-to-default related cash flows. Because of this counterparty credit risk incompleteness, deals trigger wealth transfers from bank shareholders to bank creditors and shareholders need to set capital at risk. On this basis we devise a theory of XVAs where so-called contra-liabilities and cost of capital are sourced from bank clients at trade inceptions, on top of the fair valuation of counterparty credit risk, in order to compensate shareholders for wealth transfers and risk on capital.

Christa Cuchiero
Cover's portfolio, stochastic portfolio theory and the numeraire portfolio

Cover's celebrated theorem states that the long run yield of aproperly chosen universal constant rebalanced portfolio is as good as thelong run yield of the best retrospectively chosen constant rebalanced portfolio. The universality pertains to the fact that this result is model free, i.e., not dependent on an underlying stochastic process. We extend Cover's theorem to the setting of stochastic portfolio theory as initiated by R. Fernholz: the rebalancing rule need not to be constant anymore but may depend on the present state of the stock market. This result is complimented by a comparison with the log-optimal numeraire portfolio when fixing a stochastic model of the stock market. Roughly speaking, under appropriate assumptions, the optimal long run yield coincides for the three approaches mentioned in the title. We present our results in discrete as well as in continuous time.
The talk is based on joint work with Walter Schachermayer and Leonard Wong.

Albina Danilova
Equilibrium with imbalance of the derivative market

We investigate the impact of imbalanced derivative markets - markets in which not all agents hedge - on the underlying stock market. The availability of a closed-form representation for the equilibrium stock prices in the context of a complete (imbalanced) market with terminal consumption allows us to study how this equilibrium outcome is affected by the risk aversion of agents and the degree of imbalance. In particular, it is shown that the derivative imbalance leads to signicant changes in the equilibrium stock price processes: volatility changes from constant to local, while risk premia increase or decrease depending on the replicated contingent claim, and become stochastic processes. Moreover, the model produces implied volatility skew consistent with empirical observations.

Doncho Donchev

Brownian motion exit densities for general one-sided boundaries
In our recent paper, we characterized the exit density of a Brownian motion for one-sided smooth boundaries in terms of a suitable solution of some parabolic second-order PDE. It turns out that this equation can be reduced to a first-order PDE. It is shown that the last equation admits closed solutions only for three classes of boundaries: parabolic boundaries, square-root boundaries, and rational functions. Our approach is substantiated by an example, where we find the exit density for a boundary not studied so far.

Ernst Eberlein
Multiple curve interest rate modelling with negative rates

We develop a multiple curve forward process as well as a multiple curve forward rate model. In both approaches time-inhomogeneous Lévy processes are used as drivers. Negative interest rates are taken into account in a natural way. We derive valuation formulas for standard interest rate financial products such as caps and floors or digital interest rate options. Some calibration results are presented.
The talk is based on joint work with Christoph Gerhart and Zorana Grbac.

Eugene Feinberg

Jump Markov processes and Kolmogorov's equations

As well-known, transition probabilities of jump Markov processes satisfy Kolmogorov's backward and forward equations. In the seminal 1940 paper, William Feller investigated solutions of Kolmogorov's equations for nonhomogeneous jump Markov processes and showed that the transition probability of the corresponding jump Markov process is the minimal solution of Kolmogorov's backward and forward equations, if the process does not have accumulation points. This talk describes solutions to the problems studied by Fellers and their generalizations. For Kolmogorov's backward equation, if the transition rate at each state is locally

integrable, then the transition probability is the minimal solution. For Kolmogorov's forward equation, the corresponding sufficient condition is that the transition rate at each state is locally bounded.
The talk is based on the papers by E. Feinberg, M. Mandava & A. Shiryaev

Kathrin Glau

Magic points for finance and stochastics

Essential tasks in mathematical finance are driven by parametric models and parametric financial entities. Examples are option pricing, hedging, calibration, risk allocation, and uncertainty quantification. We propose a new tool to integrate parametric families of integrands. The main idea is to achieve fast and accurate real-time evaluation of the integrals, founded on a precomputation step. The architecture of the method decomposes into two separate phases. In the so-called offline phase, the algorithm parses the complexity of the family of integrands and extracts a quadrature rule tailored to this family. This is the computationally demanding part. In the so-called online phase, real-time evaluation of the integral is performed. We derive conditions for the exponential conergence of the resulting quadrature rule. Applying the procedure to Fourier transform based option pricing, we obtain a new Fourier-pricing method that exhibits several advantages and in particular displays higher efficiency when compared to the cosine method.
[1] Barrault, Maday, Nguyen, Patera (2004). An empirical interpolation method: application to efficient reduced-basis discretization of partial differential equations, Comptes Rendus Mathématique 339 (9), 667-672
[2] Gaß, Glau (2015), Parametric Integration by Magic Point Empirical Interpolation, http://arxiv.org/abs/1511.08510
[3] Gaß, Glau, Mair (2015). Magic Points in Finance: Empirical Interpolation for Parametric Option Pricing, http://arxiv.org/abs/1511.00884

Lucas Gonon

Filtering of affine processes with Riccati equations

The classical filtering problem is studied in the setting where the signal is an affine process. We show that the solution to the Zakai equation can be approximated by solving a system of generalized Riccati equations.
Based on joint work with Josef Teichmann.

Matheus Grasselli

Macroeconomic modelling with heterogeneous agents: the master equation approach

Modern mainstream macroeconomics seeks to avoid ad hoc assumptions and inconsistent policy prescriptions by being micro-founded, meaning that models of aggregate behaviour ought to be entirely derived from assumptions made on

individual agents. The problem with this approach is that, as soon as some mild heterogeneity is introduced in the population of agents, the results of general equilibrium are not guaranteed to hold, as evidenced by the celebrated (albeit negative) Sonnenschein–Mantel–Debreu theorem. An alternative approach inspired by the older Keynesian revolution is to treat macroeconomics as a subject on its own right and consider the phenomenological relationships between aggregate quantities directly. This is effective and has the advantage of being much closer to available data, but still somewhat unsatisfactory, as it neglects decision making by individual agents. Another approach is to revert back to agents but abandon the constraints of equilibrium and utility optimization, often relying on numerical simulations to obtain aggregate behaviour. In this talk I describe yet another alternative approach inspired by statistical physics, whereby heterogeneous agents transition between different 'types' according to rates that depend on aggregate variables, thereby providing an interaction between the fast time scale of individual decision making and the slower dynamics of macroeconomic aggregates.

Miryana Grigorova

Doubly reflected BSDEs and Dynkin games: beyond the right-continuous case

Maria do Rosário Grossinho

Pricing American style perpetual put options through transformation into nonlinear stationary Black-Scholes equations

We analyze and calculate the early exercise boundary for a class of stationary generalized Black-Scholes equations in which the volatility function depends on the second derivative of the option price itself. A motivation for studying the nonlinear Black Scholes equation with a nonlinear volatility arises from option pricing models including, e.g., non-zero transaction costs, investors preferences, feedback and illiquid markets effects and risk from unprotected portfolio. We present a method how to transform the problem of American style of perpetual put options into a solution of an ordinary differential equation and implicit equation for the free boundary position.

Paolo Guasoni

Leveraged funds: robust replication and performance evaluation

Leveraged and inverse exchange-traded funds and certificates seek daily returns equal to a multiple of an index' return. The trading costs implied by the frequent portfolio adjustments required create a tension between tracking error, which reflects short-term correlation with the index, and excess return, the long-term deviation from the leveraged index' performance. With proportional trading costs, the optimal replication policy is robust to the index' dynamics. Overall fund performance depends on the implied spread, the product of tracking error and excess return, rescaled for

leverage and volatility. The implied spread is insensitive to the risk premia and allows to compare funds tracking different factors of the same index.

Dominique Cuégan

Several approaches for spatial Value-at-Risk: the Kendall VaR and the spectrum VaR

The Value-at-Risk remains the more popular risk measure in financial and insurance domains. To associate a value to a set of risk factors is always a challenge. Here we develop two routes to attain this objective. First we build a multivariate value-at –risk following the work of Embretch and Pucetti and provide an illustration of the method. Second we compute a confidence interval associated to the Value-at-Risk and provide an area which can be used also as a risk measure for a risk factor, and then extended in the multivariate case.

Alexandre Gushchin

Joint law of the terminal values of a nonnegative submartingale and its compensator

Let X be a nonnegative submartingale of class (D) with zero initial value and the Doob--Meyer decomposition X=M+A, where M is a uniformly integrable martingale and A is an integrable predictable increasing process. We provide a characterization of possible joint laws of their values at infinity/ It turns out that we obtain the same set of possible joint laws if we assume, in addition, that is an increasing process, or the square of a martingale. A special attention is given to a description of extreme points (in a certain sense) of this set of two-dimensional laws. We also provide a link between our results and Rogers' characterization of possible joint laws of a martingale and its maximum.

Calypso Herrera

Parallel American Monte Carlo

Introduction of a new algorithm for American Monte Carlo that can be used either for American-style options, callable structured products or for computing counterparty credit risk (e.g. CVA or PFE computation). Leveraging least squares regressions, the main novel feature of this algorithm is that it can be fully parallelized. Moreover, there is no need to store the paths and the payoff computation can be done forwards: this allows to price structured products with complex path and exercise dependencies. The key idea of this algorithm is to split the set of paths in several subsets which are used iteratively.

Tom Hurd

Symmetric cascades in banking networks

Systemic risk (SR) concerns the possibility of large-scale instability in financial networks. The Eisenberg-Noe 2001 model, because of its simplicity and clarity, has become the paradigmatic treatment of cascading in such systems. This talk will explore some important pieces of the SR puzzle that have been omitted from the EN 2001 model. It then provides a way these effects can be built into a minimally more general framework that shares the spirit of elegant simplicity of the original model.

Côme Huré

Algorithmic trading in a microstructural limit order book model

We propose a microstructural modeling framework for studying optimal market making policies in a FIFO (first in first out) limit order book (LOB). In this context, the limit orders, market orders, and cancel orders arrivals in the LOB are modeled as Poisson processes with intensities that depend on the state of the LOB. These are high-dimensional models which are realistic in a micro-structure point of view. This class of models has been developed recently in the literature. We consider a market maker who, based on the LOB, choose to buy and sell stocks on continuous basis at quoted prices; and identify the best strategies that maximize the expected utility of the market maker wealth penalized by her inventory.

We consider micro-structural models for the LOB.

We use the theory of Markov Decision Processes and dynamic programming method to analytically characterize the solutions to our optimal market making problem. The second part deals with the numerical aspect of the trading problem. we randomize the control and use Markovian quantization methods to compute efficiently the optimal strategies.

Several computational tests have been performed on simulated data to illustrate the efficiency of the computed optimal strategy. In particular, we simulated an order book with constant/ symmetric/ asymmetrical/ state dependent intensities. We compare the computed optimal strategy with naive strategies.

Cody Hyndman

A geometric approach to arbitrage-free modelling, estimation, and prediction

We develop a new approach to stochastic modelling, estimation, and prediction in mathematical and computational finance. In the modelling step, we show how to obtain an optimal model by exploiting the implicit geometry characterizing the class of arbitrage-free models. Since the resulting optimal model is non-Euclidean, estimation and implementation is performed using new manifold learning algorithms. We conclude by showing these models best balance the nonlinearities and financial

information present in the data. Moreover, the manifold learning algorithms have greater predictive power than their classical Euclidean counterparts.
This talk is based on joint work with Anastasis Kratsios.

Asgar Jamneshan

Duality results for vector-valued risk measures

In this talk, we present general duality results for vector-valued convex and lower semi-continuous functions based on conditional extension and conditional completion arguments. This results are applied to obtain dual representations for vector-valued convex risk measures satisfying a Fatou continuity property.
This talk is based on joint works with Samuel Drapeau and Michael Kupper.

Monique Jeanblanc

Predictable representation propery in enlarged filtration

We study under which condition the assumed predictable representation property in a reference filtration will be valid in an enlarged filtration. We will focus on progressive enlargement and study in particuicular the case where the reference filtration is a Poisson filtration, which is surprisingly difficult.

Kostas Kardaras

Perpetuities and time-reversal

Nino Kordzakhia
A comparative study on boundary crossing probabilities for Gaussian-Markov processes

The approaches developed in this study for evaluation of boundary crossing probabilities for Gaussian-Markov processes include Girsanov transformation, the lower and upper bounds via numerical integration and the method of integral equations based on Chapman-Kolmogorov equations. These approaches are established using different techniques of diverse complexity which are yet comparable in terms of accuracy of obtained results. The numerical results have been validated using MC simulation method.
Joint work with A. Novikov D. Wu, M. Zhitlukhin.

Antoine Kornprobst

Winning investment strategies based on financial crisis indicators

The aim of this work is to produce systematic trading strategies built upon several financial crisis indicators based on random matrix theory. Within the limitations of our framework and data, we will demonstrate that our systematic trading strategies are able to make money, not as a result of pure luck but, in a reproducible way and

while avoiding the pitfall of over fitting, as a result of the skill of the operators and their understanding and knowledge of the financial market. Using singular valuedecomposition techniques in order to compute all spectra in an efficient way, we have built two kinds of financial crisis indicators with a demonstrable power of prediction. Firstly there are those that compare at every date the distribution of the eigenvalues of a covariance or correlation matrix to a distribution of reference representing either a calm or agitated market reference. Secondly, we have those that merely compute at every date a chosen spectral property (trace, spectral radius or Frobenius norm) of a covariance or correlation matrix. Aggregating the results provided by all the indicators in order to minimize false positive errors, we then build systematic trading strategies based on either a discrete set of rules or a non-linear response function. Finally, we compare our active strategies to a passive reference in order to prove the usefulness of our approach.

Yuri Kutoyants

On Misspecification in Regularity and Properties of Estimators.
We consider the problem of parameter estimation by continuous time observations of a deterministic signal in white Gaussian noise. It is supposed that the signal has a cusp-type or change-point type singularities. The properties of the maximum likelihood and Bayesian estimators are described in the asymptotics of small noise. Special attention is paid to the problem of parameter estimation in the situation of misspecification in regularity, i.e., when the statistician supposes that the observed signal has this singularity, but the real signal is smooth. The rate and the asymptotic distribution of the maximum likelihood estimator in this situation are described.

Tongseok Lim

Optimal transport in general dimensions with various additional constraints

We will introduce variants of the optimal transport problem, namely martingale optimal transport problem and subharmonic martingale transport problem. Their motivation is partly from mathematical finance. We will see that in dimension greater than one, the additional constraints imply interesting and deep mathematical subtlety on the attainment of dual problem, and it also affects heavily on the geometry of optimal solutions. If time permits, we will introduce still another variant of the martingale transport problem, called the multi-martingale optimal transport problem.

Arnaud Lionnet

Equilibrium pricing of external risk in a system of agents with relative performance concerns

We study the impact of social interactions between financial agents on an equilibrium price the benefits of innovation. Specifically, our agents compare their trading gains to the average trading gains of the other agents, and factor this relative performance concern in the evaluation of their satisfaction. They are exposed to a financial risk, which they can hedge by trading in a standard market with exogenously given prices,

and to a non-tradable risk factor (such as temperature). A derivative product is introduced to allow the agents to hedge that risk and its price is determined endogenously, by matching of supply and demand. We find that while introducing the derivative is always immediately beneficial for the agents, reducing their individual risk, they however have incentives to be ever more concerned with their relative performance. This results, on the one hand, in a decrease in the sharing of external risk and, on the other hand, in a potential destabilization of the pre-existing financial market.

Peng Luo

Solvability of multidimensional quadratic BSDEs

We consider multidimensional quadratic BSDEs with bounded and unbounded terminal conditions. We provide sufficient conditions which guarantee existence and uniqueness of solutions. In particular, these conditions are satisfied if the terminal condition or the dependence between the singular equations are small enou**gh.**

Gennady Martynov

Anderson-Darling and Cramér-von Mises statistics

The Anderson-Darling statistic uses the classical empirical process modified by multiplying it by a weighting function (t(1-t)) -1/2 . In practice, the tests can be of interest having other weightfunctions. Here, we propose new formulas for eigenfunctions of the Anderson-Darling statistics. It was analyzed a statistic "inverse" to the Anderson-Darling statistic with the weighting function (t(1-t)) 1/2 . It was considered also another weighting functions.

Shohruh Miryusupov
Particle Monte-Carlo simulation: improvements using Hamiltonian dynamics

We present particle techniques, the principle of which could be intuitively thought of as an adaptive importance sampling, alternating with resampling in order to control the actual number of draws. It applied to the case of hidden variables and rare events simulation. Bayesian estimates of posterior distribution require filtering techniques, we shall show a method based on the Hamiltonian property of the geodesic flow on the statistical manifold to improve on filtering. It turns out to be particularly efficient in high dimensional problems.

Ilya Molchanov

Risk arbitrage and hedging to acceptability I + II (second part by E. Lépinette)

The classical discrete time model of transaction costs relies on the assumption that the increments of the feasible portfolio process belong to the solvency set at each step. We extend this setting by assuming that any such increment belongs to the sum

of an element of the solvency set and the family of acceptable positions, e.g. with respect to a dynamic risk measure. We formulate several no risk arbitrage conditions and explore connections between them. If the acceptance sets consist of non-negative random vectors, that is the underlying dynamic risk measure is the conditional essential infimum, we extend many classical no arbitrage conditions in markets with transaction costs and provide their natural geometric interpretation. The mathematical technique relies on results for unbounded and possibly non-closed random sets in the Euclidean space.

Marvin Mueller

Limit order books: tractable SPDE models

Complexity of nowadays electronic financial markets with high trading frequencies demands for new classes of infinite dimensional models. We set up a class of tractable models as macroscopic descriptions for the dynamics buy and sell side of the limit order book. We show that certain explicit specifications of these models can be calibrated to market data. Following empirical observations by Cont et al (2013), we can use the OFI as a predictor for the direction of the next price move, which induces a model the dynamics of the mid-price process. On this way, we can link properties of the order book evolution directly with the price evolution. Based on a joint work in progress with Rama Cont and Martin Keller-Ressel.

Anastasia Muromskaya

Optimal reinsurance strategy in the model with several risks within one insurance policy

We study the model of insurance company performance that issues insurance policies covering several risks. Each risk can be reinsured according to the arbitrary reinsurance treaty. Parameters of such reinsurance treaties can be changed dynamically. The main aim is to find an optimal reinsurance strategy that maximizes the probability of survival of the insurance company. The Hamilton--Jacobi--Bellman equation for this problem is deduced and existence and uniqueness of its solution are proved. We also establish the optimal reinsurance strategy and give numerical results for the special case of claim distribution.

Mikhail Nechaev

Commodities risk-management and CCP

As a result of financial and economic challenges of the last decades a lot of changes in the regulation for financial markets, their actors and infrastructure appear with accelerating volume and speed. An interesting part of this process is an introduction of requirements for risk modelling (inclusive requirement to use clear statistical methods) with intention to describe how quantitative risk models should be constructed, evaluated and maintained. The presentation aims to summarize these

requirements and present some main modelling trends in this area for European clearing houses as well as challenges and open questions. An introduction part is devoted to high level description of central counter party clearing and details of commodities market derivatives, covering several areas like freight, electricity and natural gas derivatives and the way their risks are reflected by initial margin, default funds and clearing capital.

Thai Nguyen

Optimal investment under VaR-regulation for life insurance contracts with guarantees

We study the VaR-regulated optimal portfolio problem of the equity holder of an equity-linked life insurance contract having some participation surplus in the profit sharing policy. In such a problem, the well-known result in Basak & Shapiro (2001) can not be directly applied because the derived utility function is neither not concave nor strictly increasing. Using a pointwise Lagrangian maximization technique, we show that unlike in the classical VaR-constrained utility maximization problem where the portfolio may suffer bigger losses, the VaR in such special non-concave optimization framework always leads to a better protection than the uncontrained problem in unfavorable market states. However, the VaR constraint does not completely prevent the equity holder form making use of gambling strategies on good market scenarios and an additional minimum insurance payment can be used to fix this shifting risk to the tail effect. Some connections with concavification technique are also pointed out.

Keita Owari

On convex functions on the duals of _2-Orlicz spaces

In the dual L^{Φ*} of a _2-Orlicz space L^Φ, we show that a proper (resp. finite) convex function is lower semicontinuous (resp. continuous) for the Mackey topology (L^{Φ*},L^Φ) if and only if on each order interval [-z,z]={x: -z x z} (z in L^{Φ*}), it is lower semicontinuous (resp. continuous) for the topology of convergence in probability. For this purpose, we provide the following Komlós type result: every norm bounded sequence (x_n)_n in L^{Φ*} admits a sequence of forward convex combinations y_n in conv(x_n,x_{n+1},...) such that sup_n|y_n|\in L^{Φ*} and y_n converges a.s.

Joint work with Freddy Delbaen. arXiv:1611.06218

Igor Pavlov

Martingales on deformed stochastic bases: from discrete to continuous time

Some new results on deformed martingales with discrete time will be presented. The definition of the stochastic basis with continuous time and elements of the corresponding stochastic analysis will be given.

Anatoly Peresetsky

Russian bank credit ratings and bank license withdrawal 2012–2016

We consider 11 credit ratings of Russian banks, assigned by international and Russian rating agencies during 2012–2016. Econometric models of these ratings designed on the public information reveal difference in the approach of the rating agencies to the Russian bank ratings. We also design econometric models of the Russian bank defaults, where we consider default as the bank license withdrawal by the Bank of Russia. We found that the models of the international and domestic rating agencies have different attitudes to the various reasons of the bank license withdrawal formulated in the Bank of Russia orders. International ratings are more related to the "law violation" reason, but national ratings are more related to "money laundering" one.

Serguei Pergamenshchikov

The ruin problem for Lévy-driven linear stochastic equations with applications to actuarial models with negative risk sums

The study deals with the asymptotic as u tends to infinity of the ruin probability for a process described by the linear SDE dX=dP+X_dR, X_0=u, defined by a pair of independent Lévy processes P and R. The setting is that of the model describing the evolution of the capital reserve of an insurance company selling the annuity, or a venture company selling innovations, invested in a risky asset with the price process *E*(R)>0. In this model P is spectrally positive, that is having only upward jumps. We suppose that the cumulant-generating function H(q)=ln **E** exp{-qV_1} of the increment of log price process V=ln E(R) admits a root b>0 at which H is continuous while the business activity process P has a negative drift and not too heavy tail of its Lévy measure. The main result implies a surprising corollary: if R is a process with trajectories of locally unbounded total variation, then the ruin probability always admits the exact asymptotic Cu^{-b} without any further condition. Our approach is based on the Kesten--Goldie theorem on asymptotic of solutions of distributional equations combined with the recent result due to Guivarc'h and Le Page on positivity of the constant in this theorem. We provide also conditions under which the ruin happens with probability one.
The talk is based on a joint work with Yuri Kabanov.

Huyên Pham

Robust Markowitz portfolio selection under ambiguous volatility and correlation

Ernst Presman

Some remarks on general one-dimensional diffusion

David Prömel

A superhedging approach to stochastic integration

Vovk's superhedging approach to model-free financial mathematics allows for quantifying properties which "typical price paths" shouldfulfill to avoid pathwise arbitrage. In this framework we show the existence of quadratic variation and develop a model-free Itô integration for "typical price paths" belonging to the space of non-negative càdlàg functions. In particular, these results imply the existence of quadratic variation in the sense of Föllmer and the existence of Itô integration quasi surely under all martingale measures.

This talk is based on a joint work with Rafal M. Lochowski and Nicolas Perkowski.

Miklos Rasonyi
Model-independent portfolio optimization

In optimal investment problems an investor in real life does not have reliable knowledge of the statistical properties of the underlying processes. Hence trading algorithms should be able to adapt to a possibly changing system dynamics. We have a look at applications of stochastic approximation algorithms in the financial literature and present new results about the tracking error of such procedures.

Max Reppen

Optimal investment and consumption with fixed and proportional transaction costs

We consider the classical optimal investment and consumption problem with infinite horizon, studied in the presence of both proportional and fixed costs with general utility functions. In this context, we outline general results for possibly discontinuous viscosity solutions of the dynamic programming equation, and then discuss asymptotic and numerical methods for these problems.

Ludger Rüschendorf

On the construction of optimal portfolios and payoffs

We solve an optimization problem for real functions under monotonicity restrictions, which makes it possible to deal with a great variety of portfolio optimization problems.The solution of these kind of problems is based on the construction of payoffs with a suitable positive or negative dependence structure with the pricing kernel. As application we consider the problem to find optimal portfolios with law-invariant objectives. In particular, we completely solve the optimal portfolio selection problem for an investor with preferences as in Yaari's Dual Theory. We also consider

the construction of optimal portfolios under the additional state-dependent constraint of a fixed copula between the optimal payoff and some benchmark asset. This kind of constraints allows to determine in which states it is wished to receive payments.
The talk is based on joint work with Steven Vanduffel.

Wissal Sabbagh

Weak BSDEs with American type constraint

Thorsten Schmidt

Towards general term structure models

Extending the HJM-theory to allow stochastic discontinuities we develop a general treatment of dynamic term-structure models with semi-martingale drivers. This has important and interesting applications to interest-rate models, credit risk, multiple yield curve and other areas.

Isaac Sonin

Elimination-insertion in Markov Chains and their applications

An insightful observation of A. Kolmorov and W. Doeblin that a Markov chain (MC) observed only when it is outside of a subset D is again a MC with a new transition matrix P_D have had numerous applications in Probability Theory. This matrix can be obtained also in a few iterations, each requiring O(n^2) operations, when the states from D are "eliminated" one at a time. We show how to modify these iterations to allow for a state previously eliminated to be "reinserted" into the state space in one iteration. This modification sheds a new light on the relationship between an initial and censored MC, and introduces a new operation – "insertion" into the theory of MCs. Some examples of applications of these tools will be presented.

Sara Svaluto-Ferro

Boundary attainment for polynomial jump-diffusions on the unit interval

The class of polynomial jump-diffusions allows for quite general dynamics while, at the same time, preserving some mathematical tractability. A nice property is, for example, that the calculation of (mixed) moments only requires the computation of a matrix exponential. Particular instances of this class are affine processes and processes with quadratic diffusion coefficient. Choosing the unit interval as a state space, boundary attainment for polynomial diffusions have been studied in Filipovic and Larsson (2015), where necessary and sufficient conditions are provided. In the present work we extend this result to polynomial jump-diffusions.

Josef Teichmann

Bayesian Finance

We consider an abstract two filtration setting to model large financial markets: the trader is using information from the smaller filtration whereas the price process is adapted to the larger filtration. We present an FTAP extending seminal work of Kabanov-Stricker in the discrete time setting for small markets. We show that this modeling approach applies to many important real world situations including model uncertainty, non-semimartingale models, Bayesian calibration, etc.

This is a joint work with Christa Cuchiero and Irene Klein.

Alexandra Tsimbalyuk

Perpetuities and time-reversal

Tuan Tran

Asset fire sales and strategic trading by regulated banks

We study how banking regulatory constraints such as liquidity and capital requirements affect the equilibrium price of assets and the behaviour of financial institutions participating on the open market. We consider a static game theoretic model, where each agent is a regulated bank that aims to maximize their profit while still satisfying a certain liquidity or capital requirements set up by the regulator. Trading is assumed to bear transaction costs and has an impact on the asset price via a aggregate demand function. With this setup, we prove the existence of Nash equilibrium strategies for the game and provide algorithms to find these equilibrium strategies in linear time.

Elena Yarovaya
Branching random walks and Brownian motion

Behavior of processes with generation and transport of particles in many ways are determined by properties of a particle motion and a dimension of the space in which the particles evolve. In [1] for studying a change of homopolymers spatial structure under the influence of temperature there was suggested an approach based on a resolvent analysis of the evolutionary operator. Unlike to [1] we consider a multidimensional integer lattice instead of R^d and a random walk instead of a Brownian motion [2]. The description of a random walk in terms of Green's function allows us to offer a general approach to investigation of random walks with finite as well as with infinite variance of jump. We consider a continuous-time symmetric branching random walk on a multidimensional lattice with a finite set of the particle generation centres [3]. Particular attention is paid to branching random walks with infinite variance jumps. Such branching random walks can be used in modeling of complex stochastic systems with singular spatial dynamics, implying the existence of

heavy-tailed distributions of random walk jumps [3]. The main object of study is the evolutionary operator for the mean number of particles both at an arbitrary point and on the entire lattice. The presented results are based on Green's function representation of transition probabilities of an underlying random walk and cover not only the case of the finite variance of jumps but also a less studied case of infinite variance of jumps.

[1] Cranston M., Koralov L., Molchanov S., Vainberg B. Continuous model for homopolymers. J. Funct. Anal., 256:82 (2009), 656–696.
[2] Molchanov S., Yarovaya E. Proceedings of the Steklov Institute of Mathematics, 282 (2013), 186–201.
[3] Yarovaya E.B. Positive discrete spectrum of the evolutionary operator of supercritical branching walks with heavy tails. Methodology and Computing in Applied Probability. First online: 12 March, 2016, 1–17.