12TH INTERNATIONAL WORKSHOP

STOCHASTIC MODELS AND CONTROL

Cottbus, Germany

March 19 – 22, 2019

Brandenburg University of Technology Cottbus - Senftenberg

Deutsche Forschungsgemeinschaft

DAAD

Invited Speakers

Hansjörg Albrecher (Université de Lausanne)
Luis Alvarez Esteban (University of Turku)
Rüdiger Frey (Vienna University of Economics and Business)
Anna Jaśkiewicz (Wroclaw University of Technology)
Rodwell Kufakunesu (University of Pretoria)
Hannelore Lisei (Babes-Bolyai University, Cluj-Napoca)
Michela Ottobre (Heriot Watt University, Edinburgh)
Huyên Pham (Université Paris Diderot (Paris 7))
Łukasz Stettner (Polish Academy of Sciences, Warsaw)
Michaela Szölgyényi (University of Klagenfurt)
Nizar Touzi (École Polytechnique, Palaiseau)

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Welcome

Dear Participants,

We warmly welcome you to the 12th International Workshop on Stochastic Models and Control in Cottbus, Germany. This workshop continues a series of biannual workshops, the latest of which were held in Trier (2017), Kaiserslautern (2015) and Berlin (2013). After 25 years the workshop comes back to the place where it all began in March 1994.

We are very happy to welcome about 60 participants coming from 15 countries. The scientific program comprises 37 paper presentations, among them 11 invited lectures. The social programme with an excursion to the Branitz Park and a conference dinner will provide additional opportunities for scientific exchange and discussion.

We would like to thank the authors who submitted their work, the members of the program committee, as well as our partners and sponsors. We wish you all four wonderful days and we hope that this event will help you to find new ideas for your research.

Welcome to Cottbus and SMC2019,
the local organizers

Venue

The workshop will be held at
Brandenburg University of Technology Cottbus-Senftenberg
Platz der Deutschen Einheit 1
03046 Cottbus
Zentrales Hörsaalgebäude (ZHG)
Lecture Room (Hörsaal) C

For directions, please consult the workshop website at `www.smc2019.b-tu.de`

Internet Access

For all participants with access to **eduroam** service we recommend to use this network. All other participants are kindly asked to come to the reception desk where we provide access data for guest accounts to our university network.

Tuesday, March 19

09:15 – 09:30	**Registration/Welcome**
09:30 – 10:15 Invited Talk	**Hansjörg Albrecher** Chair: Carsten Hartmann On optimal dividend problems in risk theory
10:15 –10:40	**Stefan Thonhauser** Risk theoretic applications of PDMPs
10:40 – 11:05	**Michael Preischl** Optimal Reinsurance for Gerber-Shiu Functions in the Cramér-Lundberg Model
11:05 – 11:35	**Coffee break**
11:35 – 12:20 Invited Talk	**Michaela Szölgyenyi** Chair: Rüdiger Frey Shall I Sell, or Shall I Wait? Optimal Liquidation Under Partial Information with Price Impact
12:20 – 12:45	**Sascha Desmettre** Portfolio Optimization in Fractional and Rough Heston Models
12:45 – 14:15	**Lunch break**
14:15 – 15:00 Invited Talk	**Łukasz Stettner** Chair: Sören Christensen Long Run Control With Degenerate Observation
15:00 – 15:25	**Christoph Belak** Optimal Investment for Private Investors
15:25 – 15:50	**Tobias Sohr** Long Term Average Impulse Control Problems for Lévy Processes
15:50 – 16:20	**Coffee break**
16:20 – 16:45	**Calisto Guambe** Chair: Hansjörg Albrecher Optimal investment-consumption and life insurance selection problem under inflation
16:45 – 17:10	**Imke Redeker** Credit risk with asymmetric information and a switching default threshold
17:10 – 17:35	**Gregor Leimcke** Optimal investment and reinsurance strategies to maximize exponential utility of terminal wealth under a partially observable multivariate claim count model

Wednesday, March 20

08:30 – 09:15 Invited Talk	**Huyên Pham** Chair: Łukasz Stettner Portfolio diversification and model uncertainty: a robust dynamic mean-variance approach
09:15 –09:40	**Dorothee Westphal** Robust Utility Maximization and Asymptotic Behaviour of the Optimal Strategy
09:40 – 10:05	**Elisabeth Leoff** A Multi-Asset Worst-Case Approach for Optimal Portfolios Facing Crash Scenarios
10:05 – 10:30	**Neofytos Rodosthenous** Optimal timing for governmental control of the debt-to-GDP ratio
10:30 – 11:00	**Coffee break**
11:00 – 11:45 Invited Talk	**Nizar Touzi** Chair: Michaela Szölgyenyi Optimal make-take fees for market making regulation
11:45 – 12:10	**Jodi Dianetti** Nonzero-Sum Submodular Monotone-Follower Games: Existence and Approximation of Nash Equilibria
12:10 – 12:35	**Berenice Anne Neumann** Stationary Equilibria of Mean Field Games with Finite State and Action Space
12:35 – 13:00	**Patrick Schuhmann** Full Characterization of the Policy of a Central Bank
13:00 – 14:00	**Lunch break**
14:00 – 18:00	**Excursion**
19:00	**Conference Dinner**

Thursday, March 21

09:00 – 09:45 Invited Talk	**Rüdiger Frey** Chair: Huyên Pham Dynamic Hedging of Reinsurance Counterparty Credit Risk
09:45 –10:10	**Kristoffer Lindensjö** Optimal dividends and capital injection under dividend restrictions
10:10 – 10:35	**Kentaro Kikuchi** A Term Structure Interest Rate Model with the Exit Time from the Quantitative Easing Policy
10:35 – 11:05	**Coffee break**
11:05 – 11:50 Invited Talk	**Michela Ottobre** Chair: Carsten Hartmann Stochastic differential equations with multiple invariant measures: beyond ergodic theory?
11:50 – 12:15	**Martin Redmann** Energy estimates and model order reduction for stochastic bilinear systems
12:15 – 12:40	**Patrice Takam Soh** On Numerical Analysis of Stochastic Differential Equation
12:40 – 14:15	**Lunch break**
14:15 – 15:00 Invited Talk	**Anna Jaskiewicz** Chair: Nicole Bäuerle Markov decision processes with quasi-hyperbolic discounting
15:00 – 15:25	**Alexander Glauner** Dynamic reinsurance in discrete time minimizing the insurer's cost of capital
15:25 – 15:50	**Perpetual Saah Andam** Estimating the Optimal Interest on Microfinance for Small Scale Businesses
15:50 – 16:20	**Coffee break**
16:20 – 17:05 Invited Talk	**Rodwell Kufakunesu** Chair: Luis Alvarez Esteban Risk-based optimal portforlio of an insurer with regime switching and noisy memory
17:05 – 17:30	**Torben Koch** Optimal Installation of Solar Panels under Price Impact
17:30 – 17:55	**Redjil Amel** Existence of stochastic optimal control for G-SDE

Friday, March 22

08:30 – 09:15 Invited Talk	**Hannelore Lisei** Chair: Ralf Wunderlich Optimal and Epsilon-Optimal Control Problems for Stochastic Equations of Schrödinger Type
09:15 –09:40	**Wilfried Grecksch** An Optimal Control Problem for a Fractional Linear Stochastic Schrödinger Equation
09:40 –10:05	**Jörg-Uwe Löbus** Stochastic Calculus on Finite Dimensional Projections of Trajectories and Absolute Continuity under Time Shift
10:05 – 10:35	**Coffee break**
10:35 – 11:00	**Thomas Bernhardt** Chair: Hannelore Lisei Is the optimal control deterministic?
11:00 – 11:25	**Andrea Mazzon** Financial asset bubbles in banking networks
11:25 – 12:10 Invited Talk	**Luis Alvarez Esteban** Ambiguity and Timing
12:40	**Lunch break / Farewell**

TUESDAY 9:30–10:15

On optimal dividend problems in risk theory

Hansjörg Albrecher

Université de Lausanne

We give a survey of some recent results on optimal dividend strategies in insurance risk theory, where part of the surplus in an insurance portfolio can be paid out as profits to the shareholders. In particular, we focus on optimality results under certain constraints including ratcheting, affine strategies and the presence of capital injections.

TUESDAY 10:15–10:40

Risk theoretic applications of PDMPs

Stefan Thonhauser

Graz University of Technology

Joint work with Gunther Leobacher, Peter Kritzer, Michaela Szölgyenyi

The class of piecewise deterministic Markov processes includes several common risk models and their generalizations. In this field many objects of interest such as ruin probabilities, penalty functions or expected dividend payments are typically studied by means of associated integro-differential equations. Unfortunately, only particular parameter constellations allow for closed form solutions such that in the general case one needs to rely on numerical methods. Instead of studying these associated integro-differential equations, we adapt the problem in a way that allows us to apply deterministic numerical integration algorithms such as QMC rules. For the derivation of error bounds for the numerical procedure we need to introduce a smoothing technique which is applied to the integrands involved. On the analytical side, we prove a convergence result for our PDMP approximation, which is of independent interest as it justifies phase-type approximations on the process level which are quite common in the actuarial literature.

TUESDAY 10:40–11:05

Optimal Reinsurance for Gerber-Shiu Functions in the Cramér-Lundberg Model

Michael Preischl

Technische Universität Graz

Joint work with Stefan Thonhauser

Complementing existing results on minimal ruin probabilities, we minimize expected discounted penalty functions (or Gerber-Shiu functions) in a Cramér-Lundberg model by choosing optimal reinsurance. Reinsurance strategies are modelled as time dependant control functions, which leads to a setting from the theory of optimal stochastic control and ultimately to the problem's Hamilton-Jacobi-Bellman equation. We show existence and uniqueness of the solution found by this method and provide numerical examples involving light and heavy tailed claims and also give a remark on the asymptotics.

TUESDAY 11:35–12:20

Shall I Sell, or Shall I Wait? Optimal Liquidation Under Partial Information with Price Impact

Michaela Szölgyenyi

University of Klagenfurt

Joint work with Katia Colaneri, Zehra Eksi, Rüdiger Frey

We study an optimal stopping problem when the state process is governed by a general Feller process. In particular, we examine viscosity properties of the associated value function with no a priori assumption on the stochastic differential equation satisfied by the state process. Our approach relies on properties of the Feller semigroup. We present conditions on the state process under which the value function is the unique viscosity solution to an Hamilton-Jacobi-Bellman (HJB) equation associated with a particular operator. More specifically, assuming that the state process is a Feller process, we prove uniqueness of the viscosity solution which was conjectured by Palczewski, J. and Stettner, L. (2014). We then apply our results to study viscosity property of optimal stopping problems for some particular Feller processes, namely diffusion processes with piecewise coefficients and semi-Markov processes. Finally, we obtain explicit value functions for optimal stopping of straddle options, when the state process is a reflected Brownian motion, Brownian motion with jump at boundary and regime switching Feller diffusion, respectively.

TUESDAY 12:20–12:45

Portfolio Optimization in Fractional and Rough Heston Models

Sascha Desmettre

TU Kaiserslautern (TUK)

Joint work with Nicole Bäuerle

We consider a fractional version of the Heston volatility model which is inspired by Guennoun, Jacquier, Roome, Shi (2018). Within this model we treat portfolio optimization problems for power utility functions. Using a suitable representation of the fractional part, followed by a reasonable approximation we show that it is possible to cast the problem into the classical stochastic control framework. This approach is generic for fractional processes. We derive explicit solutions and obtain as a by-product the Laplace transform of the integrated volatility. In order to get rid of some undesirable features we introduce a new model for the rough path scenario which is based on the Marchaud fractional derivative as defined in Samko, Kilbas, Marichev (1993). We provide a numerical study to underline our results.

References:
Guennoun, H., A. Jacquier, P. Roome, F. Shi, Asymptotic Behavior of the Fractional Heston Model. SIAM Journal on Financial Mathematics 9(3) (2018), 1017–1045.
Samko, S. G., A.A. Kilbas, O.I. Marichev, O. I., Fractional integrals and derivatives: Theory and applications. Gordon and Breach Science Publishers (1993).

TUESDAY 14:15–15:00

Long Run Control With Degenerate Observation

Łukasz Stettner

Polish Academy of Sciences, Warsaw

We consider average reward per unit time problem of controlled partially observed discrete time Markov processes in the case where the only observation of the state is in the form of a deterministic function of the current state of the process. Under nice ergodic assumptions we first solve the problem with at most countable observation space. Then we generalize it to uncountable observation space in which we don't have explicit form of the filtering process and corresponding controlled transition operator. We also study the case of noisy but still degenerate observation.

TUESDAY 15:00–15:25

Optimal Investment for Private Investors

Christoph Belak

Trier University

Joint work with Erhan Bayraktar, Sören Christensen, Lukas Mich, Frank Seifried

We study a portfolio optimization problem under various transaction cost structures which resemble those of a private investor:

(1) proportional and fixed costs;

(2) proportional costs floored and capped at fixed levels;

(3) the limit of (1) as the fixed cost component tends to zero.

In the absence of short-selling and borrowing constraints, the value functions turn out to be truly discontinuous viscosity solutions of the corresponding quasi-variational inequalities, which can nevertheless be characterized uniquely within a suitable class of functions. Having established this unique characterization, we study the optimal trading regions numerically. For power utility investors, we find that the optimal no-trading region in (1) is approximately cone-shaped. For the cost structure (2), the situation is richer in that the optimal action depends on the cost regime (floored, proportional, capped) the investor is in. Finally, regarding (3), we show that the optimal strategies in (1) have an accumulation point which solves the problem with purely proportional costs.

TUESDAY 15:25–15:50

Long Term Average Impulse Control Problems for Lévy Processes

Tobias Sohr

Universität Hamburg

Joint work with Sören Christensen

Impulse control problems deal with the question how to find an optimal payoff for a controlled continuous time process. The allowed strategies, impulse control strategies, allow to shift the process down at discrete stopping times. The aim here is to optimize the long-term average expected payoff. We present a solution technique for such a problem in the case that the underlying process is a Lévy process.
We show under mild continuity assumptions onto running costs and payoff function that either an (s,S)-strategy, i.e. always shifting down the process to the level s, as soon as it exceeds S, is optimal or there is no optimal strategy at all. Furthermore, we establish a way to determine the boundaries s and S in many cases.
Our solution technique first connects the impulse control problem to a stopping problem. We show that this stopping problem has an optimal threshold time that leads to the boundaries for the (s,S) policies. A main ingredient of the proof is the representation of the payoff function as an expected running supremum.
Advantages of our approach are that we do not have to pose strong ergodicity assumptions upon the underlying process and that we are able to calculate the boundaries s and S relatively explicit in some important special cases. These include applications in optimal harvesting as well as in inventory control.

TUESDAY 16:20–16:45

Optimal investment-consumption and life insurance selection problem under inflation

Calisto Guambe

University of Pretoria and Eduardo Mondlane University Maputo

Joint work with Rodwell Kufakunesu

In this talk, we discuss an optimal investment, consumption and insurance problem of a wage earner under inflation. Assume a wage earner investing in a real money account and three asset prices, namely: a real zero coupon bond, the inflation-linked real money account and a risky share described by jump-diffusion processes. Using the theory of quadratic-exponential backward stochastic differential equation (BSDE) with jumps approach, we derive the optimal strategy for the two typical utilities (exponential and power) and the value function is characterized as a solution of BSDE with jumps. Finally, we derive the explicit solutions for the optimal investment in both cases of exponential and power utility functions for a diffusion case.

TUESDAY 16:45–17:10

Credit risk with asymmetric information and a switching default threshold

Imke Redeker

Brandenburg University of Technology

Joint work with Michaela Szölgyenyi, Ralf Wunderlich

We investigate the impact of available information on the estimation of the default probability within a generalized structural model for credit risk. The traditional structural model where default is triggered when the value of the firm's asset falls below a constant threshold is extended by relaxing the assumption of a constant default threshold. The default threshold at which the firm is liquidated is modeled as a random variable whose value is chosen by the management of the firm and dynamically adjusted to account for changes in the economy or the appointment of a new firm management.
Investors on the market have no access to the value of the threshold and only anticipate the distribution of the threshold. We distinguish different information levels on the firm's assets and derive explicit formulas for the conditional default probability given these information levels. Numerical results are presented to illustrate the impact of the information level on the estimation of the default probability and the associated credit yield spread.

TUESDAY 17:10–17:35

Optimal investment and reinsurance strategies to maximize exponential utility of terminal wealth under a partially observable multivariate claim count model

Gregor Leimcke

Karlsruhe Institute of Technology (KIT)

We consider the surplus process of an insurance company with several insurance classes and assume that the insurance company is interested in an investment and reinsurance strategy which maximizes the expected exponential utility of terminal wealth. The claim arrivals of the insurance classes are modelled by a multivariate point process with interdependencies between the marginal point processes where the dependence modelling is reduced to the choice of thinning probabilities. We assume that the thinning probabilities are unobservable. This leads to a stochastic control problem under partial information. Using a Bayesian approach we overcome the issue of uncertainty and obtain a control problem with complete observation. With the help of stochastic control theory, we can identify an optimal investment and reinsurance strategy.

WEDNESDAY 08:30–09:15

Portfolio diversification and model uncertainty: a robust dynamic mean-variance approach

Huyên Pham

University Paris Diderot (Paris 7)

Joint work with Xiaoli Wei Chao Zhou

This talk is concerned with a multi-asset mean-variance portfolio selection problem under model uncertainty. We develop a continuous time framework for taking into account ambiguity aversion about both expected return rates and correlation matrix of the assets, and for studying the effects on portfolio diversification. We prove a separation principle for the associated robust control problem, which allows to reduce the determination of the optimal dynamic strategy to the parametric computation of the minimal risk premium function. Our results provide a justification for under-diversification, as documented in empirical studies. We explicitly quantify the degree of under-diversification in terms of correlation and Sharpe ratio ambiguity. In particular, we show that an investor with a poor confidence in the expected return estimation does not hold any risky asset, and on the other hand, trades only one risky asset when the level of ambiguity on correlation matrix is large. This extends to the continuous-time setting the results obtained by Garlappi, Uppal and Wang , and Liu and Zeng in a one-period model.

WEDNESDAY 09:15–09:40

Robust Utility Maximization and Asymptotic Behaviour of the Optimal Strategy

Dorothee Westphal

TU Kaiserslautern

Joint work with Jörn Sass

When modelling financial markets one is frequently confronted with model uncertainty. This is meant in the sense that parameters of the model, e.g. the drift of a stock, or the distributions of some factors in the model are only known up to a certain degree. Risk-averse investors in such a market try to maximize their worst-case expected utility. This naturally leads to considering robust optimization problems.
We investigate optimal trading strategies for a robust utility maximization problem in a continuous-time Black-Scholes type financial market and impose a constraint that prevents a pure bond investment. The optimal strategy of an investor depends on how uncertain the parameters in the market are. We deduce a duality result for our robust optimization problem and show that as the degree of model uncertainty increases the uniform portfolio diversification strategy outperforms more sophisticated strategies. This carries over results from Pflug et al. (2012) from discrete time to continuous time. We also investigate the influence of the investor's risk aversion on the performance of the robust strategies.

WEDNESDAY 09:40–10:05

A Multi-Asset Worst-Case Approach for Optimal Portfolios Facing Crash Scenarios

Elisabeth Leoff

Fraunhofer ITWM Kaiserslautern

Joint work with Ralf Korn

We generalize the worst-case portfolio approach of Korn/Wilmott (2002), where the risky asset may have jumps downward, to a multi-asset setting. The main challenges arising in this setting are the nonuniqueness of indifference strategies and finding the optimal indifference strategy. For this, we employ a Lagrangian multiplier approach that makes use of the characterization of indifference strategies. We further analyze various examples in the case of both logarithmic and power utility.

WEDNESDAY 10:05–10:30

Optimal timing for governmental control of the debt-to-GDP ratio

Neofytos Rodosthenous

Queen Mary University of London

Joint work with Giorgio Ferrari

We study the problem of a government wishing to control the country's debt-to-GDP ratio. The debt-to-GDP ratio evolves stochastically and the interest on debt is affected by an N-state continuous-time Markov chain, representing the country's credit ratings. The debt-to-GDP ratio can be reduced through fiscal interventions or increased by public investments. The government aims to choose a policy minimising the total expected cost of having debt and fiscal interventions counterbalanced by the gain from public investments. The problem is modelled by a bounded-variation stochastic control problem, that we explicitly solve through the analysis of an associated Dynkin game.

WEDNESDAY 11:00–11:45

Optimal make-take fees for market making regulation

Nizar Touzi

École Polytechnique, Palaiseau

We address the mechanism design problem of an exchange setting suitable make-take fees to attract liquidity on its platform. Using a principal-agent approach, we provide the optimal compensation scheme of a market maker in quasi-explicit form. This contract depends essentially on the market maker inventory trajectory and on the volatility of the asset. We also provide the optimal quotes that should be displayed by the market maker. The simplicity of our formulas allows us to analyze in details the effects of optimal contracting with an exchange, compared to a situation without contract. We show in particular that it improves liquidity and reduces trading costs for investors. We extend our study to an oligopoly of symmetric exchanges and we studied the impact of such common agency policy on the system.

WEDNESDAY 11:45–12:10

Nonzero-Sum Submodular Monotone-Follower Games: Existence and Approximation of Nash Equilibria

Jodi Dianetti

Bielefeld University

Joint work with Giorgio Ferrari

We consider a class of N-player stochastic games of multi-dimensional singular control, in which each player faces a minimization problem of monotone-follower type with submodular costs. We call these games *monotone-follower games*. In a not necessarily Markovian setting, we establish the existence of Nash equilibria. Moreover, we introduce a sequence of approximating games by restricting, for each $n \in \mathbb{N}$, the players' admissible strategies to the set of Lipschitz processes with Lipschitz constant bounded by n. We prove that, for each $n \in \mathbb{N}$, there exists a Nash equilibrium of the approximating game and that the sequence of Nash equilibria converges, in the Meyer-Zheng sense, to a weak (distributional) Nash equilibrium of the original game of singular control. As a byproduct, such a convergence also provides approximation results of the equilibrium values across the two classes of games. We finally show how our results can be employed to prove existence of open-loop Nash equilibria in an N-player stochastic differential game with singular controls, and we propose an algorithm to determine a Nash equilibrium for the monotone-follower game.

References:
Dianetti, Jodi & Ferrari, Giorgio (2018): Nonzero-Sum Submodular Monotone-Follower Games: Existence and Approximation of Nash Equilibria, Preprint ArXive: 1812.09884.

WEDNESDAY 12:10–12:35

Stationary Equilibria of Mean Field Games with Finite State and Action Space

Berenice Anne Neumann

University of Hamburg

Mean field games formalize dynamic games with a continuum of players and explicit interaction, where the players can have heterogeneous states. As they additionally yield approximate equilibria of corresponding N-player games, they are of great interest for socio-economic applications. However, the techniques used for mean field games crucially rely on the assumption that for each population distribution the individual agent has a unique optimal response. For finite action spaces, this assumption will only hold for trivial models. Thus, the techniques used so far are not applicable. We propose a model with finite state and action space, where the dynamics are given by a time-inhomogeneous Markov chain that might depend on the current population distribution. We show existence of stationary mean field equilibria under mild assumptions and propose techniques to compute all these equilibria. More precisely, our results allow – given that the generators are irreducible - to characterize the set of stationary mean field equilibria as the set of all fixed points of a map that is completely characterized by the transition rates and rewards for deterministic strategies. For the case of non-irreducible generators, we propose several partial results.

WEDNESDAY 12:35–13:00

Full Characterization of the Policy of a Central Bank

Patrick Schuhmann

Bielefeld University

Joint work with Giorgio Ferrari, Salvatore Federico

We consider a central bank which can adjust the (deterministic) key interest rate in order to influence the dynamics of the inflation rate. The inflation rate is modeled as an *Ornstein-Uhlenbeck process* in which the key interest rate affects the mean-reversion level. The problem is modeled as a degenerate two-dimensional singular stochastic control problem, in which the central bank aims at minimizing the total expected cost of having an inflation rate not aligned with an exogenous given target value, plus the total expected costs of interventions on the key interest rate (due to e.g. administration costs). We solve the problem by using a viscosity solutions approach. We find that the optimal solution is is triggered by two curves which separates three different regions corresponding to increasing respectively decreasing the key interest rate and an inaction region. We are able to prove a C^2 smooth fit property, which gives a full characterization of the value function and the corresponding curves.

THURSDAY 09:00–09:45

Dynamic Hedging of Reinsurance Counterparty Credit Risk

Rüdiger Frey

Vienna University of Economics and Business

We study value adjustments and hedging for reinsurance counterparty risk (the risk that a reinsurer is unable to fulfill his contractual obligations towards the insurere). We propose a novel model that takes contagion effects between the default of the reinsurer and the price of the reinsurance contract into account. To compute the optimal strategy we apply the (local) risk-minimization approach. For this we derive regularity results for backward equations for self-exciting doubly stochastic point processes that are of general interest.

THURSDAY 09:45–10:10

Optimal dividends and capital injection under dividend restrictions

Kristoffer Lindensjö

Department of Mathematics, Stockholm University

Joint work with Filip Lindskog

We study a singular stochastic control problem faced by the owner of an insurance company that dynamically pays dividends and raises capital in the presence of the restriction that the surplus process must be above a given *dividend payout barrier* b_r in order for dividend payments to be allowed. Bankruptcy occurs if the surplus process becomes negative and there are proportional costs k for capital injection. We show that one of the following strategies is optimal: (i) Pay dividends and inject capital in order to reflect the surplus process at an upper barrier and at 0, implying bankruptcy never occurs. (ii) Pay dividends in order to reflect the surplus process at an upper barrier and never inject capital — corresponding to absorption at 0 — implying bankruptcy occurs the first time the surplus reaches zero. We show that if the costs of capital injection k are *low*, then a sufficiently high dividend payout barrier b_r will change the optimal strategy from type (i) (without bankruptcy) to type (ii) (with bankruptcy). Moreover, if the costs k are *high*, then the optimal strategy is of type (ii) regardless of the dividend payout barrier b_r. The uncontrolled surplus process is a Wiener process with drift.

THURSDAY 10:10–10:35

A Term Structure Interest Rate Model with the Exit Time from the Quantitative Easing Policy

Kentaro Kikuchi

Shiga University

For several years, the Bank of Japan has implemented the quantitative easing policy (QE). Against this backdrop, Japanese short- and medium-term interest rates have stayed negative. In this study, we model the short rate as the sum of the positive part and the lower bound in order to capture negative yields. We model the former part as the quadratic form of the Gaussian process. For the latter part, we model it as the Brownian bridge on the random interval pinning at 0 on the end date of the QE where the Brownian bridge on random intervals was introduced by Bedini et al. (2017). For this setting, we derive the zero coupon bond price representation by imposing the no-arbitrage condition. Furthermore, we conduct an empirical analysis based on this proposed model. Using Japanese yield curve data, we calibrate model parameters and estimate an implied exit time from the Bank of Japan's quantitative easing.

References:
Bedini, M. L., Buckdahn, R., and Engelbert, H.-J. (2017): "Brownian Bridges on Random Intervals", Theory of Probability and Its Applications, 61 (1): 15–39.

THURSDAY 11:05–11:50

Stochastic differential equations with multiple invariant measures: beyond ergodic theory?

Michela Ottobre

Heriot Watt University, Edinburgh

In 1968 Hörmander introduced a sufficient condition to ensure hypoellipticity of second order partial differential operators. As is well known, this seminal work of Hormander had deep repercussions both in the analysis of PDEs and in probability theory and the ergodic theory for hypoelliptic SDEs is by now well developed. In this talk we will first review the significance of the Hormander condition in analysis, probability and control theory. We then present the UFG condition, which is weaker than the Hormander condition. Such a condition was introduced by Kusuoka and Strook with probabilistic motivations, and, independently, by Sussman, Hermann and Lobry, this time in the field of control theory. In particular, Kusuoka and Strook showed that it is still possible to build a solid PDE theory for diffusion semigroups even in absence of the Hörmander condition. We will present new results (the first of this type) on control-theoretical aspects and long time behaviour of diffusion semigroups that do not satisfy the Hormander condition and that do not admit just a single invariant measure (i.e., the Markov process is not irreducible). We will highlight how, loosely speaking, UFG diffusions constitute a large class of SDEs which exhibit multiple equilibria (invariant measures) and such that it is possible to determine in a systematic way the basin of attraction of each equilibrium state.

THURSDAY 11:50–12:15

Energy estimates and model order reduction for stochastic bilinear systems

Martin Redmann

WIAS Berlin

In this talk, we investigate a large-scale stochastic system with bilinear drift and linear diffusion term. Such high dimensional systems appear for example when discretizing a stochastic partial differential equations in space. We study a particular model order reduction technique called balanced truncation (BT) to reduce the order of spatially-discretized systems and hence reduce computational complexity. We introduce suitable Gramians to the system and prove energy estimates that can be used to identify states which contribute only very little to the system dynamics. When BT is applied the reduced system is obtained by removing these states from the original system. In this talk, we present an L^2-error bound for BT for stochastic bilinear systems. This result is new even for deterministic bilinear equations. In order to achieve it, we develop a new technique which is not available in the literature so far.

THURSDAY 12:15–12:40

On Numerical Analysis of Stochastic Differential Equation

Patrice Takam Soh

University of Yaounde I

Joint work with Ramiyou Karim Mache

In this talk we propose a new symmetrized version of the classical Euler scheme for the Cox-Ingersoll-Ross (CIR) process with jumps.We analyse the convergence of weak and strong errors of this scheme. We also use the simulation study to analyse the effect of jumps on the error term.

THURSDAY 14:15–15:00

Markov decision processes with quasi-hyperbolic discounting

Anna Jaskiewicz

Wroclaw University of Technology

The standard theory in Markov control processes that assumes a use of a constant discount rate contradicts strong empirical evidence that people apply larger discount rates in the short run than in the long run. Such a behavior exhibits a time inconsistency, a situation in which the preferences of the decision maker may change over time. To circumvent these serious problems associated with time inconsistency, a dynamic game solution is proposed. In this view, an individual is modelled as a sequence of autonomous temporal selves playing a dynamic game between one's current self and each one's future selves. We show that for a model on a Borel state space there exists a solution in stationary strategies and under additional assumptions this solution can be replaced by a deterministic stationary strategy. Moreover, in case of countable state space, there exists a solution in deterministic Markov strategies.

THURSDAY 15:00–15:25

Dynamic reinsurance in discrete time minimizing the insurer's cost of capital

Alexander Glauner

Karlsruhe Institute of Technology

In the classical static optimal reinsurance problem the cost of capital for the insurer's risk exposure determined by a monetary risk measure is minimized over the class of reinsurance treaties represented by increasing Lipschitz retained loss functions. We consider a dynamic extension of this reinsurance problem in discrete time which can be viewed as a risk-sensitive Markov Decision Process. The model allows for both insurance claims and premium income to be stochastic and operates with general risk measures and premium principles. We derive the Bellman equation and show the existence of an optimal reinsurance policy. The result is illustrated with an example where the optimal policy can be determined explicitly.

THURSDAY 15:25–15:50

Estimating the Optimal Interest on Microfinance for Small Scale Businesses

Perpetual Saah Andam

University of Ghana

Joint work with Olivier Menoukeu Pamen

Credit is the cost-effective tool for fighting against poverty. It serves as an agitator in the development of our socio-economic conditions for the poor people who can not borrow from the banking institutions because majority of them do not have any collaterals. If the poor can get financial resources based on some terms and conditions that are reasonable and appropriate, then the millions of these small people with their small pursuit can create a significant increment in the development of the country. From these small millions of people, majority are women usually from Sub-Saharan region in Africa which is one of the poorest regions in the world, where only 5% to 25% of people have access to financial services. It is substantially under-served by micro-finance, with only 2% of the world's micro-finance institutions. It is the aim for every company to make profit thereby increasing their interest rate which makes it unfavorable for the poor people and they default. The aim of this research is to provide a suitable model for a micro-finance company, estimate the optimal interest rate needed to charge the borrowers and also put measures in place for borrowers who default to make the company sustainable.

References:
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THURSDAY 16:20–17:05

Risk-based optimal portforlio of an insurer with regime switching and noisy memory

Rodwell Kufakunesu

University of Pretoria

Joint work with Calisto Guambe, Lesedi Mabitsela

We consider a risk-based optimal investment problem of an insurer in a regime-switching jump diffusion model with noisy memory. Using the model uncertainty modeling, we formulate the investment problem as a zero-sum, stochastic differential delay game between the insurer and the market, with a convex risk measure of the terminal surplus and the Brownian delay surplus over a period $[T - \varrho; T]$. Then by the BSDE approach, the game problem is solved. Finally, we derive semi-analytical solutions of the game problem, for a particular case of a quadratic penalty function.

THURSDAY 17:05–17:30

Optimal Installation of Solar Panels under Price Impact

Torben Koch

Bielefeld University

Joint work with Tiziano Vargiolu

In this talk we consider a price-maker company which produces energy and sells it in the spot market. The company can increase its level of installed power by irreversible installations of solar panels. In absence of any actions of the company, the energy's spot price evolves as an *Ornstein-Uhlenbeck process*, and therefore it has a mean-reverting behavior. The current level of the company's installed power has a permanent impact on the energy's price and affects its mean-reversion level. The company aims at maximizing the total expected profits from selling energy in the market, net of the total expected proportional costs of installation. This problem is modeled as a two-dimensional singular stochastic control problem in which the installation strategy is identified as the company's control variable. We follow a *guess-and-verify approach* to solve the problem. We find that the optimal installation strategy is triggered by a curve which separates the *waiting region*, where it is not optimal to install additional panels, and the *installation region,* where it is. Such a curve is a strictly increasing function which depends on the current level of the company's installed power. Finally, our study is complemented by a numerical analysis of the dependency of the optimal installation strategy on the model's parameters.

THURSDAY 17:30–17:55

Existence of stochastic optimal control for G-SDE

Redjil Amel

Badji Mokhtar University Annaba, Algeria

Joint work with Salah Eddine Choutri

In the G-framework, we establish existence of an optimal stochastic relaxed control for stochastic differential equations driven by a G-Brownian motion. The purpose of this work is to study optimal control of systems subject to model uncertainty or ambiguity due to incomplete or inaccurate information, or vague concepts and principles. We prove the regularity conditions realized by this control.

References:

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S. Peng, Nonlinear expectations and stochastic calculus under uncertainty, arXiv preprint arXiv, (2010)1002.4546.

FRIDAY 08:30–09:15

Optimal and Epsilon-Optimal Control Problems for Stochastic Equations of Schrödinger Type

Hannelore Lisei

Babes-Bolyai University Cluj-Napoca

We study some optimal and epsilon-optimal control problems which involve the solution of stochastic Schrödinger type equations, considered in a variational formulation. We use Galerkin approximations.

FRIDAY 09:15–09:40

An Optimal Control Problem for a Fractional Linear Stochastic Schrödinger Equation

Wilfried Grecksch

Martin-Luther-University Halle-Wittenberg

We consider a controlled linear stochastic Schrödinger equation driven by a linear multiplicative cylindrical fractional Brownian motion and introduce an optimal control with quadratic objective functional where the incoming operators are diagonalizable. The admissible controls are defined by time dependent potentials. An optimality condition of maximum principle type is proved by using of the theory of stochastic backward equations.

References:
Cialenko, Igor (2010): Parameter estimation for SPDEs with multiplicative fractional noise, Stoch. Dyn., 10 (4): 561-576.

FRIDAY 09:40–10:05

Stochastic Calculus on Finite Dimensional Projections of Trajectories and Absolute Continuity under Time Shift

Jörg-Uwe Löbus

University of Linköping and Martin-Luther-University Halle-Wittenberg

The talk is concerned with a class of two-sided stochastic processes of the form $X = W + A$. Here W is a two-sided Brownian motion with random initial data at time zero and $A \equiv A(W)$ is a function of W. Elements of the related stochastic calculus are introduced. In particular, the role of finite dimensional projections arising from the Lévy-Ciesielski representation of the Brownian motion are discussed. The calculus is adjusted to the case when A is a jump process.
Absolute continuity of $(X, P_{\boldsymbol{\nu}})$ under time shift of trajectories is investigated. For example under various conditions on the initial density with respect to the Lebesgue measure, $m = d\boldsymbol{\nu}/dx$, and on A with $A_0 = 0$ we verify

$$\frac{P_{\boldsymbol{\nu}}(dX_{\cdot-t})}{P_{\boldsymbol{\nu}}(dX_\cdot)} = \frac{m(X_{-t})}{m(X_0)} \cdot \prod_i |\nabla_{W_0} X_{-t}|_i$$

a.e. where the product is taken over all coordinates. Here $\sum_i (\nabla_{W_0} X_{-t})_i$ is the divergence of X_{-t} with respect to the initial position. Crucial for this is the *temporal homogeneity* in the sense that $X\,(W_{\cdot+v} + A_v 1) = X_{\cdot+v}(W)$, $v \in \mathbb{R}$, where $A_v 1$ is the trajectory taking the constant value $A_v(W)$.
An application is relative compactness of sequences of processes of the form $X^n = W + A^n$, $n \in \mathbb{N}$.

References:
Löbus, Jörg-Uwe (2017): Absolute Continuity under Time Shift of Trajectories and Related Stochastic Calculus, Memoirs of the American Mathematical Society, 249 (1185).

FRIDAY 10:35–11:00

Is the optimal control deterministic?

Thomas Bernhardt

Heriot-Watt University

In the literature, it is a recurring feature that explicit solutions to stochastic optimization problems are linked to deterministic controls. In this talk, we raise the question if it is possible to state the nature of the optimal control before solving the problem.
In standard power utility problems, we observe that changing the wealth at a given time changes the value function by a constant only. Hence, any amount leads to the same optimal controls. This indicates that the optimal controls are independent of the optimal wealth process and therefore deterministic.
We are going to explore this idea further and determine consequences and areas of future research. For example, we replace the HJB equation with a quadratic equation and a Calculus of Variations problem.
This is a work in progress.

FRIDAY 11:00–11:25

Financial asset bubbles in banking networks

Andrea Mazzon

Ludwig Maximilians Universität München

Joint work with Francesca Biagini, Thilo Meyer-Brandis

We study the consequences of the burst of an asset price bubble in a financial system. We model the *robustness* of banks in a financial network by a system of stochastic differential equations coupled by their drift. We assume that the attractiveness of a node depends on its "fitness", and that a group of banks happen to hold a bubbly asset.
We see that, due to this preferential attachment mechanism, the bubble causes a distortion in the network: the banks holding the bubble have a bigger influence on the system, so that they are the biggest propagators of a possible shock.
Supposing that the number of banks holding the bubble remains constant, but that their impact on the periphery does not vanish when the total number of the banks goes to infinity, we also study the case of large networks: the influence of the bubble, through the action of the banks in the core, results in a term which does not average out in the drift of the diffusions. Because of this term, also the banks of the periphery are indirectly affected when the bubble bursts.
This results in a riskier system, as shown in simulations where we investigate how the burst of a bubble impacts systemic risk.

FRIDAY 11:25–12:10

Ambiguity and Timing

Luis Alvarez Esteban

University of Turku

According to conventional wisdom, ambiguity accelerates optimal timing by decreasing the value of waiting in comparison with the unambiguous benchmark case. We extend the analysis focusing on the stopping of linear diffusions to a multifactor setting and investigate the joint impact of ambiguity and the volatility of the driving stochastic dynamics in a multidimensional setting.

Participants

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Notes