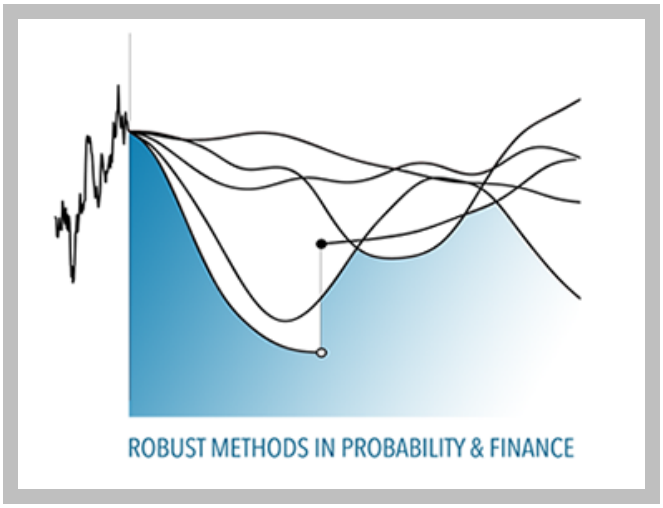
Workshop „Robust Finance“

May 14 – 18, 2018



Venue:

Monday, Tuesday:
Department of Mathematical Stochastics
Room 232
Ernst-Zermelo-Straße 1 (previously: Eckerstraße)

Wednesday, Thursday:
Freiburg Institute of Advanced Studies (FRIAS);
Seminarraum EG
Albertstraße 19

Friday:
Freiburg Institute of Advanced Studies (FRIAS);
Seminarraum EG
Albertstraße 19

Freiburg Institute of Advanced Studies (FRIAS);
Seminarraum 2. OG
Albertstr. 19

Organisation: Project Group „Model Risk“

Prof. Dr. Patrick Dondl
JProf. Dr. Philipp Harms
Prof. Dr. Eva Lütkebohmert-Holtz
Prof. Dr. Thorsten Schmidt

General Information

For more information, consult the conference webpage
https://www.frias.uni-freiburg.de/de/foerderprogramme/frias-projektgruppen/model-risk/robust-finance

Abstracts

The complete book of abstracts is available online at the conference webpage

FRIAS

Workshop „Robust Finance“
Freiburg, May 16 – 17, 2018

Program Overview

Monday	Tuesday	Wednesday	Thursday	Friday
	9:00 – 12:30	9:00 – 10:00 A. Cox	9:00 – 10:00 R. Cont	9:00 – 12:30
	discussion, collaboration	Coffee Break		discussion, collaboration
		10:30 – 11:30 L. Rüschendorf	10:30 – 11:30 M. Burzoni	
		short break		
		11:40 – 12:00 C. Birghila	11:40 – 12:00 C. Liu	
		12:00 – 12:20 J. Sester	12:00 – 12:20 T. R. Fadina	
Lunch (FRIAS)	Lunch (FRIAS)	Lunch (ind.)	Lunch (FRIAS)	Lunch (ind.)
14:00 – 18:00	14:00 – 18:00	14:00 – 14:40 A. Neufeld	14:00 – 15:00 S. Cohen	14:00 – 16:00
discussion, collaboration	discussion, collaboration	14:40 – 15:00 M. Nendel	15:00 – 15:20 D. Bartl	discussion, collaboration
		Coffee Break		
		15:30 – 15:50 C. Gerhart	15:50 – 16:10 E. Abi Jaber	
		Conference Dinner		

Discussion and collaboration:
Monday & Tuesday: room 232, Ernst-Zermelo-Str. 1 (formerly: Eckerstr. 1) AND/OR Freiburg Institute of Advanced Studies (FRIAS); Seminarraum 2. OG, Albertstr. 19;
Friday: Freiburg Institute of Advanced Studies (FRIAS); Seminarraum EG, Albertstr. 19

Conference Dinner: meet 17:15 at Stadthotel Freiburg, Karlstr. 7, walk to tram station „Bertoldsbrunnen“, take tram 3 to Vauban, walk (max. 45 minutes) to Schönberg; 18:30 Conference Dinner at Jesuitenschloss (ends 22:00)

Lunch Break: 12:30 at FRIAS on Monday, Tuesday, and Thursday; individually on Wednesday and Friday.

Program: Wednesday, May 16

Birghila, Corina
University of Vienna

16.05.18
11:40

Design of insurance contract under ambiguity. Applications in extreme events.

Insurance contracts represent an efficient management tool for reducing risk exposure. When identifying the optimal design of such contracts, the classical approach in actuarial science disregards the parameter and model risks. Moreover, especially in the case of extreme events, the uncertainty in model selection becomes crucial. Considering these sources of risk, our aim in this talk is to determine an insurance contract which is robust under possible model misspecification. Due to coverage limitations in the insurance market, we consider the limited stop-loss contract with parameters d_1 and d_2 and a payment function $I(x) = \min(\max(x - d_1), d_2)$ (see Cummins and Mahul (2004)).
Therefore, we propose an optimization problem of finding the optimal balance between the parameters of this contract that minimize some risk functional of the retained loss. To include robustness against possible model misspecification, the optimal decision is taken with respect to an ambiguity set of feasible models. This set is constructed based on a modified version of the Wasserstein distance, which is more appropriate for heavy tailed distributions. We study the dependence of the objective function as well as the deductible and cap levels of the insurance contract on the tolerance level change. As expected, the premium of such a contract increases with the size of the ambiguity set. Numerical implementations are addressed and the performance is assessed using simulation experiments.
Key-words: limited stop-loss contract, ambiguity, distance, distributionally robust optimization.
Joint work with: Georg Pflug

References:

[1] J. D. Cummins, Olivier Mahul (2004). The demand for insurance with an upper limit on coverage. *Journal of Risk and Insurance*, 71(2), 253–264

[2] G. Pflug, A. Timonina-Farkas, S. Hochrainer-Stigler. Incorporating model uncertainty into optimal insurance contract design (2017). *Insurance: Mathematics and Economics*, 73, 68–74

[3] A. V. Asimit, et al.(2017). Robust and Pareto optimality of insurance contracts. *European Journal of Operational Research*, 262(2), 720–732.

[4] Balbás, Alejandro, et al.(2015). Optimal reinsurance under risk and uncertainty. *Insurance: Mathematics and Economics*, 60, 61–74.

Cox, Alexander

16.05.18
9:00

University of Bath

Utility Maximisation with Model-Independent Trading Constraints

In this work we consider the classical utility maximisation problem for a trader who is constrained by a model-independent portfolio constraint. Specifically, the trader aims to maximise her utility subject to the constraint that her portfolio value is bounded below when any derivative contracts are valued at their intrinsic value. Here, the intrinsic value is taken to be the model-independent super/sub-hedging price of the derivative. Using ideas of El Karoui and Meziou (2006), we are able to find explicit strategies for the trader.
(Joint work with Daniel Hernandez-Hernandez).

Gerhart, Christoph

16.05.18
15:30

University of Freiburg

Empirical Analysis and Forecasting of Multiple Yield Curves

The turmoil in the money market during the financial crisis of 2007/2008 was marked by spiking interbank spreads.Even after the crisis spreads remained at high levels opening a new era of interest rate markets characterized by multiple tenor-dependent yield curves. In this paper we suggest a consistent and stable approach for bootstrapping of multiple yield curves which we apply to market data over the time period 2005–2017. Based on the resulting time series of daily tenor-dependent yield curves we provide an in-depth empirical analysis of pre- and post-crisis term structures of interest rates. In particular, we determine principal components characterizing the shape of yield curves and interest rate spreads. Finally, we develop tractable dynamic factor models to forecast tenor-dependent term structures of interest rates. Our methodology takes into account cross-tenor dependencies and generates extremely precise predictions for the discount as well as for the risky yield curves for various forecasting horizons. In particular, it outperforms the standard benchmark approach of random walk predictions.
Joint work with Eva Lütkebohmert (University of Freiburg).

Nendel, Max

16.05.18
14:40

University of Konstanz

A semigroup approach to nonlinear Lévy processes

Nonlinear expectations, as introduced by S. Peng, are closely related to monetary risk measures. Nonlinear expectations naturally appear in the context of pricing under model uncertainty, e.g. drift uncertainty (g-expectation) or volatility uncertainty (G-expectation). In this talk, we demonstrate how Lévy processes under nonlinear expectations arise from solutions to certain fully nonlinear PDEs, where the Knigthian uncertainty is in the Lévy triplet. This is done using nonlinear semigroups and a nonlinear version of Kolmogorov's extension theorem. We provide a sufficient condition for families of Lévy tiplets that guarantees the solvability of the related fully nonlinear partial integro-differential equation, and show that the solution admits a representation by means of a nonlinear Lévy process.

Neufeld, Ariel

16.05.18
14:00

ETH Zürich

Super-replication in fully incomplete markets

In this talk we introduce the notion of fully incomplete markets. We provide two families of fully incomplete models: stochastic volatility models and rough volatility models. We prove that for fully incomplete markets the super-replication price coincide with the model-free super-replication price. Namely, the knowledge of the model does not reduce the super-replication price. In addition, if the claim is Markovian, then the optimal super-replication in fully incomplete markets is of buy-and-hold type. Then, to reduce the super-replication price, we introduce the concept of prediction sets. Finally, we discuss some possible extensions to jump processes.
This talk is based on joint works with Yan Dolinsky as well as Daniel Bartl and Michael Kupper.

Rüschendorf, Ludger

16.05.18
10:30

University of Freiburg

Risk bounds with additional structural and dependence information

We review several approaches to improve risk bounds for aggregated portfolios of risks based on marginal information. By a series of recent papers it has become clear that the dependence uncertainty on the aggregated risks based on marginal information only is typically too wide to be acceptable in applications.

Several approaches to reduce DU-uncertainty have been developed recently to include structural and partial dependence information in order to reduce the model uncertainty. These include higher order marginals, global variance or higher order moment bounds, positive or negative dependence restrictions and structural information given by common risk factors (partially specified risk factor models) or by models with subgroup structures. Also an effective two-sided variant of the method of improved standard bounds has been developed. Several applications show that these improved risk bounds may lead to results acceptable in praxis.
The talk is based on joint work with P. Embrechts, G. Puccetti, C. Bernard, S. Vanduffel, R. Wang, D. Small, T. Lux, D. Manko and J. Witting.

Sester, Julian

University of Freiburg

16.05.18
12:00

Optimal Martingale Transport with Information on the Variance of Returns

We investigate the optimal transport problem with martingale constraints and its application to model-independent price bounds for financial derivatives when including information about the variance of returns on the underlying security. This additional information can be extracted from prices of certain exotic derivatives traded on OTC markets. Our theoretical results comprise a dual version of the modified transport problem. The numerical results indicate that tighter price bounds can be obtained when taking into account such additional information on the variance of returns. In this respect, our results have important implications for the practical applicability and relevance of model-independent price bounds.
Joint work with Eva Lütkebohmert (University of Freiburg).

Program: Thursday, May 17

Abi Jaber, Eduardo

17.05.18
15:50

Université Paris Dauphine

Lifting the Heston model

How to reconcile the classical Heston model with its rough counterpart? We introduce a lifted version of the Heston model with n multifactors sharing the same Brownian motion but mean reverting at different speeds. Our model nests as extreme cases the classical Heston model (when $n = 1$) and the rough Heston model (when n goes to infinity). We show that the lifted model enjoys the best of both worlds: markovianity and satisfactory fitting of implied volatility smiles for short maturities. Further, our approach speeds up the calibration time and opens the door to time-efficient simulation schemes.
(Based on joint work with Omar El Euch.)

Bartl, Daniel

17.05.18
15:00

University of Kontanz

Computational aspects of robust optimized certainty equivalents

In this talk we first discuss ambiguity modeled by a Wasserstein neighborhood around some baseline distribution (e.g. the empirical measure) for future loss. We show that the infinite dimensional problem of computing the sup of expectation w.r.t. all measures in the neighborhood has a finite dimensional dual problem. Later on this is applied to the robust optimized certainty equivalent (which includes average value at risk) and in some cases closed-form formulas are presented.
Based on joint work with Samuel Drapeau and Ludovic Tangpi.

Burzoni, Matteo

17.05.18
10:30

ETH Zürich

Robust Martingale Selection Problem and its Connections to the No-Arbitrage Theory

Given a collection of random sets V=(Vt) the martingale selection problem consists in finding a stochastic process S taking values in V and such that S is a martingale under a measure Q. We derive conditions for the solvability of this problem in a pointwise (robust) framework and show how this is related to the no-arbitrage theory. We obtain robust versions of the Fundamental

Theorem of Asset Pricing in examples spanning frictionless, proportional transaction cost and illiquidity markets with possible trading constraints.
This is a joint work with Mario Sikic.

Cohen, Samuel

17.05.18
14:00

University of Oxford

Uncertainty for Filtering and Portfolio Selection

Statistical uncertainty is a common problem in many problems in finance and control. In this talk, we will consider how approaches to statistical uncertainty through nonlinear expectations (as discussed at the previous meeting at Brown U) can be applied in a simple nonlinear filtering context. In addition, we shall see how this can be applied in practice, for a portfolio selection problem with model estimation.

Cont, Rama

17.05.18
9:00

Imperial College London

Pathwise Ito calculus for continuous paths with arbitrary regularity

We construct a pathwise integration theory and higher-order pathwise Ito calculus for smooth function(al)s of continuous paths with arbitrary regularity defined in terms of the notion of p-th variation along a sequence of time partitions, where p is any even integer. For paths with finite p-th variation along a sequence of time partitions, we derive a change of variable formula for p-times continuously differentiable functionals and show pointwise convergence of appropriately defined compensated Riemann sums; these results extend Hans Follmer's pathwise Ito calculus to paths with lower regularity.
The pathwise integral is shown to satisfies an "isometry" formula in terms of p-th order variation and obtain a "signal plus noise" decomposition for regular functionals of paths with strictly increasing p-th variation. For less regular functions we obtain a pathwise Tanaka-type formula using an appropriately defined notion of "p-th order local time". These results extend to multi-dimensional paths; the corresponding pathwise integral does not involve the specification of any rough-path superstructure but coincides with a rough-path integral for a canonical "reduced rough path".
Joint work with Nicolas Perkowski (Humboldt).

Fadina, Tolulope Rhoda
University of Freiburg

17.05.18
12:00

An application of non-linear affine processes

We develop a one-dimensional notion of affine processes under parameter uncertainty, which we call *non-linear affine processes*. To be more precise, given a set Θ of parameters, we construct a corresponding non-linear expectation on the path space of continuous processes. By a general dynamic programming principle we link this non-linear expecation to a variational form of the Kolmogorov equation, where the generator of a single affine process is replaced by the supremum over all corresponding generators of affine processes with parameters in Θ. This non-linear affine process yields a tractable model for Knightian uncertainty, especially for modelling interest rate under ambiguity. As an application, we develop, a non-linear version of the Itô-formula.
This is a joint work with Ariel Neufeld (ETH Zürich) and Thorsten Schmidt (University of Freiburg.)

Liu, Chong
ETH Zürich

17.05.18
11:40

Stochastic Euler–Lagrangian condition in semimartingale optimal transport

In the semimartingale optimal transport problem we have the following objects:

- $\Omega = D([0,1], \mathbb{R}^d)$ or $C([0,1], \mathbb{R}^d)$ the space of càdlàg paths or continuous paths;
- $X = (X_t)_{t\in[0,1]}$ the canonical process on Ω;
- μ_0, μ_1 two distributions on $\mathbb{R}^d$;
- $\Theta \subset \mathbb{R}^d \times \S_+^d \times \mathcal{L}$ a convex subset;
- $\mathfrak{P}_{sem}^{ac}(\Theta)(\mu_0, \mu_1)$ the collection of all laws on Ω under which X is a semimartingale with absolutely continuous characteristics and has marginals μ_0 resp. μ_1 at time 0 resp. 1; moreover, the differential characteristics $(b_t, c_t, F_t) \in \Theta$ almost everywhere;
- $L(t, \omega, \theta)$ is a real-valued function on $[0,1] \times \Omega \times \Theta$.

Then, we want to minimize the stochastic Lagrangian $\mathfrak{J}$ defined on $\mathfrak{P}_{sem}^{ac}(\Theta)(\mu_0, \mu_1)$:

$$\inf_{\mathbb{P}\in\mathfrak{P}_{sem}^{ac}(\Theta)(\mu_0,\mu_1)} \mathfrak{J}(\mathbb{P}) = \inf_{\mathbb{P}\in\mathfrak{P}_{sem}^{ac}(\Theta)(\mu_0,\mu_1)} \mathbb{E}^{\mathbb{P}}\left[\int_0^1 L(t, X, b_t^{\mathbb{P}}, c_t^{\mathbb{P}}, F_t^{\mathbb{P}})\, dt\right].$$

The existence of a minimizer under some appropriate conditions on Θ and L has been studied in [3] (for $\Omega = C([0,1],\mathbb{R}^d)$) and in [2] (when $\Omega = D([0,1],\mathbb{R}^d)$). However, the problem regarding how to characterize the support of the minimizer $\hat{\mathbb{P}}$ is still open. As we have known so far, the only related reference is [1], where the variational calculus plays an essential rôle. By considering the variational family consisting of (deterministic) Cameron–Martin function h with vanishing endpoints, the authors of [1] established a stochastic Euler–Lagrangian condition for semimartingale optimal transport problem with $\Theta = \mathbb{R}^d \times \mathbb{S}_+^d \times \{0\}$, which gave some information about the support of minimizers for the first time.
Motivated by this variational calculus approach, we want to perform the same type of calculus for *martingale* optimal transport problem. In particular, instead of only considering perturbations in the drift term as in [1], we try to find a nice variational family for volatility, and then obtain the stochastic Euler–Lagrangian condition for martingale laws. In this talk we will give a first simple example related to this topic, where the variational family is induced by time-changes; and then we will introduce some potential problems that are needed to be solved.
This is joint work with Philipp Harms (Uni Freiburg) and Ariel Neufeld (ETH Zürich).

References:

[1] R. Lassalle and A. B. Cruzeiro. Weak calculus of variations for functionals of laws of semimartingales. Preprint, 2015.

[2] C. Liu and A. Neufeld. Compactness criterion for semimartingale laws and semimartingale optimal transport. Preprint, 2016.

[3] X. Tan and N. Touzi. Optimal transportation under controlled stochastic dynamics. Ann. Probab, 41(5):3201–3240, 2013.

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