

13th Annual

# Risk and Stochastics Conference 2019

**1 April 2019**

**Arundel House, Temple Place,  
London WC2R 2PG**



This conference is organised by the Probability in Finance and Insurance group within the Department of Statistics at LSE. Speakers from the UK, Europe and overseas will present current advances in the areas of insurance mathematics, financial mathematics, and their interface.

The conference is an annual event, with the purpose of disseminating current research in quantitative modelling in finance, insurance, and risk management.

This year's conference will focus on market microstructure research with speakers from mathematical finance and economics communities. Our goal is to enhance collaboration and exchange of knowledge between applied and theoretical researchers, as well as practitioners in mathematical finance, insurance and statistics.

**Scientific Organiser:**

Professor Umut Cetin  
Probability in Finance and  
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**Conference Organisers:**

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# Timetable

Monday 1 April 2019

<b>9-9.25am</b>	Registration and Coffee
9.25-9.30am	Welcome and introduction
9.30-10.20am	<b>Giorgia Callegaro, University Of Padova</b> Fast Hybrid Schemes for Fractional Riccati Equations (Rough is not so Tough)
10.20-11.10am	<b>Johannes Muhle-Karbe, Imperial College London</b> Equilibrium asset pricing with transaction costs
<b>11.10-11.40am</b>	Coffee break
11.40am – 12.30pm	<b>Hansjoerg Albrecher, University of Lausanne</b> On optimal dividend problems in risk theory
<b>12.30-1.30pm</b>	Lunch
1.30-2.20pm	<b>Thierry Foucault, HEC Paris</b> Inventory Management, Dealers' Connections, and Prices in OTC Markets
2.20-3.10pm	<b>Frank Riedel, Bielefeld University</b> Viability and Arbitrage under Knightian Uncertainty
<b>3.10-3.40pm</b>	Coffee break
3.40-4.30pm	<b>Tauhid Zaman, MIT Sloan School of Management</b> Picking Winners: From Venture Capital to Fantasy Sports
4.30-5.20pm	<b>Katia Colaneri, University of Leeds</b> Value adjustment and dynamic hedging of reinsurance counterparty risk
<b>5.20-5.30pm</b>	Closing remarks

# Speakers

**Hansjoerg Albrecher**, University of Lausanne

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## On optimal dividend problems in risk theory



We present 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.

**Hansjoerg Albrecher** is Professor of Actuarial Science at the Faculty of Business and Economics, University of Lausanne and a Faculty Member of the Swiss Finance Institute. After studying in Graz, Limerick and Baltimore, he held faculty and visiting positions in Graz, Leuven, Aarhus and the Radon Institute of the Austrian Academy of Sciences in Linz before moving to Lausanne in 2009. He is also Honorary Professor of the University of Hong Kong. He has published extensively in the field of insurance modelling and finance, and has served on the editorial board of numerous journals, including *Insurance: Mathematics and Economics* (Editor 2010-2017) and the *European Actuarial Journal* (Editor-in-Chief since 2019).

**Giorgia Callegaro**, University Of Padova

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## Fast Hybrid Schemes for Fractional Riccati Equations (Rough is not so Tough)



We solve a family of fractional Riccati differential equations with constant (possibly complex) coefficients. These equations arise, eg, in fractional Heston stochastic volatility models, that have received great attention in the recent financial literature thanks to their ability to reproduce a rough volatility behavior. We first consider the case of a zero initial value corresponding to the characteristic function of the log-price. Then we investigate the case of a general starting value associated to a transform also involving the volatility process. The solution to the fractional Riccati equation takes the form of power series, whose convergence domain is typically finite. This naturally suggests a hybrid

numerical algorithm to explicitly obtain the solution also beyond the convergence domain of the power series representation. Our numerical tests show that the hybrid algorithm turns out to be extremely fast and stable. When applied to option pricing, our method largely outperforms the only available alternative in the literature, based on the Adams method.

**Giorgia Callegaro** has expertise in stochastic control under partial information, enlargement of filtrations theory and numerical probability. Before joining academia, she worked as a risk management quantitative analyst at UniCredit. She has ongoing research partnerships with colleagues in Europe and in the financial industry.



# Speakers

**Katia Colaneri**, University of Leeds

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## Value adjustment and dynamic hedging of reinsurance counterparty risk



We study value adjustments and hedging for reinsurance counterparty risk, that is the risk that a reinsurer is unable to fulfil his contractual obligations towards the insurer. 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 risk-minimisation approach. For this we derive regularity results for backward equations for self-exciting doubly stochastic point processes.

The presentation is based on joint work with Rüdiger Frey and Claudia Ceci.

**Katia Colaneri** is Lecturer in Financial/Actuarial Mathematics at the University of Leeds in the School of Mathematics.

She graduated in Mathematics at the University of Roma 3 and received the PhD in Mathematics in 2013 from the University of Pescara (Italy) where she also held a 2-year postdoctoral fellowship. She was Assistant Professor at the University of Perugia (Italy) from 2016 to 2017.

Her research interests cover stochastic filtering, stochastic control problems (under full and partial information), backward SDEs, valuation and hedging of financial/insurance derivatives in incomplete markets (under full and partial information) and portfolio optimisation.

**Thierry Foucault**, HEC Paris

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## Inventory Management, Dealers' Connections, and Prices in OTC Markets



We propose a new model of interdealer trading. Dealers trade together to reduce their inventory holding costs. Core dealers provide liquidity to peripheral dealers, who have heterogeneous access to core dealers. We derive predictions about the effects of peripheral dealers' connectedness to core dealers and the allocation of aggregate inventories between core and peripheral dealers on the distribution of interdealer prices, the efficiency of interdealer trades, and trading costs for the dealers' clients. For instance, the dispersion of interdealer prices is higher when fewer peripheral dealers are connected to core dealers or when their aggregate inventory is higher.

This paper was co-authored with Jean Edouard Colliard, HEC, and Peter Hoffman, ECB.

**Thierry Foucault** is Professor of Finance at HEC Paris where he holds a chair from the HEC Foundation and is a research fellow of the Centre for Economic Policy (CEPR). He has a PhD in Finance from HEC and has taught in various international institutions (eg, Universitat Pompeu Fabra, Carnegie Mellon University, Ecole Polytechnique Fédérale de Lausanne, Studienzentrum Gerzensee, Saïd Business School in Oxford, the Tinbergen Institute etc.).

His research focuses on the determinants of financial markets liquidity, the industrial organisation of these markets, and their effect on the real economy. He has received research awards from the Louis Bachelier Institute, the HEC Foundation, and the Analysis Group award for the best paper on Financial Markets and Institutions presented at the 2009 Western Finance Association (WFA) meetings. He is currently an Editor of *The Review of Asset Pricing Studies* (RAPS), and an Associate Editor of *The Journal of Economic Theory* and *The Journal of Finance*.

He serves or has served on the scientific committees of the Autorité des Marchés Financiers (AMF), the Norwegian Finance Initiative (NFI), the Research Foundation of the Banque de France, the Group of Economic Advisors of the Committee of Economic and Markets Analysis of the European Securities and Markets Authority (ESMA) and was a member of the executive committee of the European Finance Association (EFA).

# Speakers

**Johannes Muhle-Karbe**, Imperial College London

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## Equilibrium asset pricing with transaction costs



In the first part of the talk, we study risk-sharing equilibria where heterogeneous agents trade subject to quadratic transaction costs. The corresponding equilibrium asset prices and trading strategies are characterised by a system of nonlinear, fully-coupled forward-backward stochastic differential equations. We show that a unique solution generally exists provided that the agents' preferences are sufficiently similar. In a benchmark specification, the illiquidity discounts and liquidity premia observed empirically correspond to a positive relationship between transaction costs and volatility.

In the second part of the talk, we discuss how the model can be calibrated to time series of prices and the corresponding trading volume, and explain how extensions of the model with general transaction costs, for example, can be solved numerically using the deep learning approach of Han, Jentzen, and E (2018).

This talk is based on joint work with Martin Herdegen and Dylan Possamai, as well as with Lukas Gonon and Xiaofei Shi.

**Johannes Muhle-Karbe** is a Chair in Mathematical Finance at Imperial College London, where he directs the CFM-Imperial Institute of Quantitative Finance. Previously, he held faculty positions at Carnegie Mellon, Michigan, and ETH Zurich. Johannes' research lies at the interface of optimal control, stochastic calculus, and their applications to finance. In particular, he studies the effect of "frictions" on optimal trading strategies, asset prices, and liquidity.

**Frank Riedel**, Bielefeld University

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## Viability and Arbitrage under Knightian Uncertainty



We reconsider the microeconomic foundations of financial economics under Knightian Uncertainty. We do not assume that agents (implicitly) agree on a common probabilistic description of the world. We rather base our analysis on a common ordering of contracts, a much weaker requirement. The economic viability of asset prices and the absence of arbitrage are equivalent; both are closely related to the existence of nonlinear pricing measures. We show how the different versions of the Efficient Market Hypothesis are related to the assumptions we are willing to impose on the market's ordering of contracts. Our approach also unifies recent versions of the Fundamental Theorem of Asset Pricing under a common framework.

**Frank Riedel** is the Director of the Center for Mathematical Economics at the Bielefeld University. After studying mathematics and philosophy in Freiburg, Germany, he received his doctoral degree in the graduate program "Applied Microeconomics" at Humboldt University in Berlin.

After postdoctoral positions at the University of California, Berkeley and at Stanford University, Frank Riedel became Professor of Economic Theory at Bonn University. Since 2007, he has been Professor of Mathematics and Economics at the University of Bielefeld.

He has been a visiting professor in Princeton, Paris 1 (Sorbonne) and 9 (Dauphine) and is currently Distinguished Visiting Professor at the University of Johannesburg in South Africa.

# Speakers

**Tauhid Zaman**, MIT Sloan School of Management

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## Picking Winners: From Venture Capital to Fantasy Sports



We consider the problem of selecting a portfolio of items of fixed cardinality where the goal is to have at least one item achieve a high return, which we refer to as winning. This “picking winners” framework is very general and can be used to model a variety of problems ranging from venture capital firms investing in startup companies to fantasy sports players building lineups. We first frame the construction of a portfolio as a combinatorial optimisation problem with objective function given by the probability of having at least one item in the selected portfolio win. We then develop models for the probability of winning for different applications. To model the success of a startup company we use

Brownian motion first passage times. For fantasy sports, we utilise structural correlations mixed with expert predictions. Using our models and the picking winners framework, we are able to “win” in multiple domains. For startup companies, we construct out-of-sample portfolios which achieve exit rates as high as 60 per cent, which is nearly double that of top venture capital firms. For fantasy sports, we are able to win contests with tens of thousands of competitors multiple times in multiple sports.

**Tauhid Zaman** is an Associate Professor of Operations Management at the MIT Sloan School of Management. He received his BS, MEng, and PhD degrees in electrical engineering and computer science from MIT.

His research focuses on solving operational problems involving social network data using probabilistic models, network algorithms, and modern statistical methods. Some of the topics he studies in the social networks space include predicting the popularity of content, finding online extremists, and geo-locating users.

His broader interests cover data driven approaches to investing in startup companies, non-traditional choice modeling, algorithmic sports betting, and biometric data.

His work has been featured in *The Wall Street Journal*, *Wired*, *Mashable*, *LA Times*, and *Time Magazine*.



# Probability in Finance and Insurance group

The Probability in Finance and Insurance Group (PFI) was founded at the London School of Economics and Political Science in 2004 and is based in the School's Department of Statistics. It represents the Department's increasingly prominent role as a hub of research and education in probability and its applications in insurance and finance.

The PFI group is an international network with core members from the Department of Statistics and external experts brought together for academic collaboration. Members have an academic interest in the research and application of probability in risk, and in the dissemination of results through education and contact with relevant industry partners, regulators and bodies representing the public interest. The group has close links with the Institute of Actuaries, LSE's Financial Markets Group, and with similar groups in other universities.

Probability and Risk, idea and language, are inseparable. Scientific inquiry into risk could not happen without the sophisticated concepts, vocabulary, and analytical tools of Probability Theory. Advances in Probability Theory could not happen without the cross-fertilisation of its applications in Risk Theory and countless other areas. Probability Theory enables the analysis of risk management through financial and insurance operations of ever increasing complexity and sophistication.

Research drives and influences any academic enterprise. The research activities of the PFI group reflect both its unifying leitmotif and diversity of scope, ranging from basic to applied research over a vast list of topics.

Academic education emanates from and is inextricably related to research. The teaching activities of the PFI group provides specialist training of immediate social utility, and equips students with the skills to advance and expand their knowledge.

# Academic staff in the Probability in Finance and Insurance group

## **Dr Beatrice Acciaio**

Associate Professor

Research interests: stochastic processes and their application to finance and insurance; dynamic games; robust finance and optimal transport.

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## **Professor Pauline Barrieu**

Professor and Head of Department of Statistics

Research interests: model uncertainty; insurance-linked securitisation; contract designing; environmental economics; financial mathematics.

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## **Dr Erik Baudoux**

Associate Professor and Deputy Head of Department of Statistics

Research interests: optimal stopping; optimal control; stochastic processes; Lévy processes; financial and insurance mathematics.

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## **Dr Luciano Campi**

Associate Professor

Research interests: stochastic processes with applications to finance; mean-field games; equilibrium with asymmetric information; energy and commodities market models.

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## **Professor Umut Cetin**

Professor

Research interests: stochastic calculus; theory of martingales and Markov processes; liquidity risk and credit risk modelling; asymmetric information in financial markets; carbon finance.

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## **Professor Angelos Dassios**

Professor

Research interests: stochastic processes: theory and application of piecewise deterministic Markov processes; risk theory; insurance and financial applications of stochastic processes. Monte Carlo methods in applied probability.

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## **Professor Kostas Kardaras**

Professor

Research interests: stochastic analysis; martingales and the general theory of stochastic processes; foundations of mathematical finance and economics; stochastic control and optimisation; Monte Carlo methods.

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## **Professor Hao Xing**

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Research interests: stochastic analysis, analysis of differential equations, stochastic control and their applications to finance and insurance; economic models of interacting agents.

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