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The hard membrane process and transport barriers of turbulent flows

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In confined fusion plasma devices like tokamaks, turbulence is always present to some degree and it has the bad effect of dispersing heat and particles from the central very hot and dense region to the boundary and then to the surrounding areas and walls. Sometimes barriers arise in intermediate regions, which reduce this dispersion. These barriers, also called zonal flows, are thin layers of plasma where the fluid velocity is not turbulent as everywhere else but ordered, roughly laminar, directed perpendicularly to the direction of dispersion. There is still active research to understand how these barriers arise, whether they can be triggered, how they evolve, the precise links with other plasma dynamical features and parameters. Our aim here is not to contribute to these difficult questions but only to rigorously define a mathematical model of a sharp heat-diffusion barrier.

*Speaker

From hyper-roughness to jumps as $H \rightarrow -1/2$: the affine case and beyond

Elie Attal ^{*} ¹, Eduardo Abi Jaber ¹, Mathieu Rosenbaum ¹, Andreas Sojmark ²

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Motivated by recent literature on scaling limits of continuous processes to jump limits in mathematical finance, we introduce a class of non-decreasing hyper-rough processes, extending the affine square-root case through a non-linear time change. We investigate the limit of such processes as the Hurst index H goes to $-1/2$, corresponding to the fractional kernel losing integrability. We establish the convergence of these processes to jump processes, defined as first hitting times of a drifted, time-changed Brownian motion. In the affine case, the limit is identified as an Inverse Gaussian Lévy process. This unveils the existence of a continuum in H , connecting hyper-rough continuous models and jump processes, and extending beyond the affine framework. The proof relies on a delicate topological framework, specifically designed for time-changed processes, involving both the M1 Skorokhod topology and the non-Skorokhod S topology. Based on joint works with Eduardo Abi Jaber, Mathieu Rosenbaum and Andreas Sojmark.

*Speaker

Self-fictitious-play for Potential Monotone Mean-field Games

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We study long-time learning in ergodic, potential, monotone mean-field games (MFG) via a self-fictitious-play (SFP) dynamics that couples an optimally controlled diffusion with a slowly updated belief. At each time, the state follows the optimal feedback for the current belief; the belief itself tracks the running occupation measure. For monotone potential MFGs on the torus, we show that the SFP system is contractive and admits a unique stationary law. We then prove that this stationary distribution is quantitatively close to the MFG Nash equilibrium: after an exponentially fast transient, the gap scales on the order of the square root of the belief-update rate. A linear-quadratic case confirms sharpness of this rate. The analysis combines uniform regularity for the ergodic Hamilton–Jacobi–Bellman equation, a Lipschitz bound on the induced optimal drift, and a reflection-coupling argument that transports the Lasry–Lions divergence into Wasserstein-distance control. Together, these results provide the first rigorous convergence guarantees for SFP in this setting and quantify how slow belief updates ensure accurate approximation of the mean-field equilibrium.

^{*}Speaker

Mean-field games of speedy information access with observation costs

Dirk Becherer ^{*} ¹, Christoph Reisinger ², Jonathan Tam ²

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² Mathematical Institute [Oxford] – United Kingdom

We investigate mean-field games (MFG) in which agents can actively control their speed of access to information. Specifically, the agents can dynamically decide to obtain observations with reduced delay by accepting higher observation costs. Agents seek to exploit their active information acquisition by making further decisions to influence their state dynamics so as to maximise rewards. In a mean-field equilibrium, each generic agent solves individually a partially observed Markov decision problem in which the way partial observations are obtained is itself subject to dynamic control actions, while no agent can improve unilaterally given the actions of all others. We formulate the mean-field game with controlled costly information access as an equivalent standard mean-field game on an augmented space, by utilizing a parameterisation of the belief state by a finite number of variables. With sufficient entropy regularisation, a fixed point iteration converges to the unique MFG equilibrium. Moreover, we derive an approximate ϵ -Nash equilibrium for a large but finite population size and small regularisation parameter. We illustrate our (extended) MFG of information access and of controls by an example from epidemiology, where medical testing results can be procured at different speeds and costs. (joint work with Christoph Reisinger and Jonathan Tam, Oxford: <https://arxiv.org/pdf/2309.07877>)

*Speaker

Liquidity structure model for optimal strategies in a decentralized exchange

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² Vega Institute Foundation – Russia

The talk describes the behavior of liquidity providers (LPs) in a decentralized exchange with concentrated liquidity. We consider the structure of liquidity deposited into a pool and show that within the class of tau-reset strategies the accumulated trading fees can be approximated using a single liquidity curve. Taking the historical data from ETH-USDT pools on different networks we show that non-symmetric strategies outperform uniform and symmetric strategies and use the liquidity deposit and withdrawal transactions to make a more accurate approximation of the liquidity curve form.

*Speaker

Mean-field stochastic Volterra equations: Existence of weak solutions and stability

Martin Bergerhausen * ¹, David J. Prömel ¹

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Stochastic Volterra equations have gained significant attention in mathematical finance, particularly in the modelling of rough volatility. These equations generalize standard stochastic differential equations by incorporating memory effects, making their analysis both challenging and rich.

In this talk, we extend results on the existence of solutions of stochastic Volterra equations and McKean–Vlasov SDEs. We establish a suitable local martingale problem and prove the existence of weak solutions to the above mean-field stochastic Volterra equation under mild assumptions on the kernels and non-Lipschitz coefficients following the idea of Skorokhod’s existence theorem. Moreover, we discuss several properties of the solutions.

This talk is based on a joint work with David J. Prömel.

*Speaker

Reverse Optimal Stopping in Finite and Infinite Horizon with Reinforcement Learning Applications

Elena Boguslavskaya * ¹

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We develop a reverse (inverse) optimal stopping theory for Markov processes in both finite and infinite horizon. For a strong Markov process on \mathbb{R}^d , we start from an upper semicontinuous “driver” \widehat{f} and define the expected-supremum functional

$$\Phi(t, x) = \mathbb{E}_{t,x} \left(\sup_{s \in (t, T)} \widehat{f}_+(s, X_{-s}) \right) \quad (\text{finite horizon}),$$

and similarly in the infinite-horizon case under natural integrability conditions. It appears that if the stopping region is defined as those values where \widehat{f} is greater or equal to zero, it is possible to define payoff G through \widehat{f} for which the first entrance into the stopping region will solve the conventional stopping problem. This yields a multidimensional, multi-sided reverse optimal stopping principle: starting from \widehat{f} one constructs both the payoff and an optimal stopping rule, in finite or infinite horizon. As a by-product, we obtain an expected-supremum verification theorem of classical type, used here mainly as a tool. We then connect this theory to reinforcement learning methods for high-dimensional optimal stopping, and show on several examples how multidimensional optimal stopping problems in finite and infinite horizons can be solved via reinforcement learning.

*Speaker

A Statistical Learning Perspective on Semi-dual Adversarial Neural Optimal Transport Solvers

Evgeny Burnaev * ¹

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Neural network-based optimal transport (OT) is a recent and fruitful direction in the generative modeling community. It finds its applications in various fields such as domain translation, image super-resolution, computational biology and others. Among the existing OT approaches, of considerable interest are adversarial minimax solvers based on semi-dual formulations of OT problems. While promising, these methods lack theoretical investigation from a statistical learning perspective. Our work fills this gap by establishing upper bounds on the generalization error of an approximate OT map recovered by the minimax quadratic OT solver. Importantly, the bounds we derive depend solely on some standard statistical and mathematical properties of the considered functional classes (neural nets). While our analysis focuses on the quadratic OT, we believe that similar bounds could be derived for general OT case, paving the promising direction for future research.

*Speaker

Beyond Analytic Sets in Robust Finance: New Measurability Approaches

Laurence Carassus * ¹

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In mathematical finance, one is often led to establish the existence of measurable strategies. In the 1990s, the first proof of the Fundamental Theorem of Asset Pricing (FTAP) in discrete time with finite Omega was established by Dalang, Morton, and Willinger using measurable selection techniques. The use of such techniques, considered difficult by the community, led to many alternative proofs of this theorem. The development of non-dominated quasi-sure robust (or Knightian) finance has brought these techniques back to the forefront: a measurable selection theorem is required already at the stage of model construction.

In the classical framework of Bouchard and Nutz, prices are assumed to be Borel measurable, derivatives to be upper semianalytic, while the graphs of the random sets of beliefs are analytic sets. The class of analytic sets allows the use of the Jankov–von Neumann measurable selection theorem. This class is also closed under projection. However, it is not closed under complementation and therefore does not form a sigma-algebra. As a result, one obtains strategies that are only analytically measurable, despite the stronger assumptions made on the model.

In this talk, we propose alternatives to analytic sets. The first approach involves using projective sets for the graphs of beliefs and projectively measurable prices and derivatives, and going beyond Zermelo–Fraenkel set theory with the Axiom of Choice (ZFC) by additionally assuming the Axiom of Projective Determinacy (PD). Projective sets and functions enjoy good properties (stability under projection and under complementation for the former, and stability under composition and difference for the latter). The use of the projective hierarchy makes it possible to overcome the fact that the class of projective sets is also not a sigma-algebra. Measurable selection then allows, starting from projective prices and projective graphs of beliefs, to obtain projective strategies.

In this context, it is possible to prove existence results for a robust portfolio choice problem in which the utility function is no longer assumed to be concave. The (geometric) characterization of no-arbitrage in terms of the robust support of price increments has also been established, while the characterization via martingale measures and the dual representation are works in progress.

Another approach, also currently under investigation, involves considering the set of Suslin kernels on a particular product sigma-algebra, which would make it possible, while remaining within ZFC, to simplify the proofs.

*Speaker

A class of Markov processes with resetting and applications to cybersecurity

Umut Cetin * ¹

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We construct a class of piecewise deterministic Markov processes with resetting inspired by self-exciting cyber attacks. The construction provides a framework to study the optimal intervention mechanism in practical situations with sufficient generality. In particular we analyse the ergodic behaviour of this Markov process under some hypothesis reminiscent from ruin theory. Joint work with G. Callegaro and B. D'Auria.

*Speaker

Global universal approximation with Brownian signatures

Mihriban Ceylan ^{*}, David J. Prömel ¹

¹ University of Mannheim – Germany

In recent years, signature based methods have been very successfully applied in mathematical finance. At the very heart of these methods are universal approximation theorems, establishing that continuous functionals can be approximated arbitrary well on compact sets by linear maps acting on signatures. However, in the context of mathematical finance, the restriction to compact sets causes a lack of theoretical justification for the use of signature based methods. In this talk, we provide various global universal approximation theorems in the L^p -sense with respect to the Wiener measure. In particular, we demonstrate that functionals on rough path space can be approximated globally in the L^p -sense w.r.t. the Wiener measure. This allows, for instance, to approximate solutions to stochastic differential equations driven by Brownian motions by signature based models, leading to a certain universality of signature based models for financial markets.

^{*}Speaker

AIP condition in continuous time

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A general framework is developed for continuous-time financial market models defined from simple strategies through conditional topologies that avoid stochastic calculus and do not necessitate semimartingale models. We then compare the usual no-arbitrage conditions of the literature, e.g. the usual no-arbitrage condition NFL and the recent AIP condition. With appropriate pseudo-distance topologies, we show that they hold in continuous time if and only if they hold in discrete time. Moreover, the super-hedging prices in continuous time coincide with the discrete-time super-hedging prices, even without any no-arbitrage condition.

*Speaker

Cooperative pricing for insurance claims with insolvency risk

Delia Coculescu * ¹

¹ University of Zurich – Switzerland

I will present the pricing of insurance contracts in the presence of insolvency risk through the lens of cooperative game theory. Assuming agents can choose among a given class of insurance contracts—such as partial and full insurance— and under minimal assumptions on preferences, namely that agents prefer to pay the lowest possible cost for identical payoffs, we can build a cooperative game. Core allocations of this game give rise to a family of *pricing measures*. This framework is closely related to the capital allocation problem in the setting of convex risk measures. However, the explicit incorporation of insolvency risk renders the associated cooperative game non-convex, so the existence of solutions is no longer guaranteed a priori. We establish existence and provide a characterization of solutions for a class of non-convex functionals. This leads to simple valuation formulas: in equilibrium, insurance premia coincide with the expected value of defaultable payoffs under some absolutely continuous pricing measure. (based on past and ongoing work with Philippe Artzner, Freddy Delbaen)

*Speaker

On the hedging problem for general diffusion market models

David Criens * ¹

¹ University of Freiburg – Germany

The talk deals with the pricing and hedging PDE methodology in the context of market models that remain Markovian but no longer admit an SDE representations, Namely, we consider a two-asset market model comprised of one risky asset whose price is a general diffusion (in the sense of Ito and McKean) and one riskless asset with constant deterministic interest rate. We discuss pricing equations, the existence of equivalent local martingale measures, the minimal hedging capital as well as corresponding hedging strategies. The results are illustrated by numerical experiments.

The talk is based on joint work with Alexis Anagnostakis and Mikhail Urusov.

*Speaker

Dynamic universal approximation via signature controlled and stochastic differential equations

Christa Cuchiero * ¹

¹ University of Vienna – Austria

Among the different methods proposed to lift path-dependent dynamics to infinite-dimensional Markovian frameworks, the use of signatures appears especially natural, as linear functionals of the signature can approximate any continuous path functional (with respect to suitable Hölder/variation topologies) arbitrarily well. While such universal approximation results at the level of the vector fields are well established, we go further and consider solutions of generic path-dependent controlled and stochastic differential equations (CDEs/SDEs). We then show that, under mild regularity assumptions, any such path-dependent system can be approximated by a suitable signature CDE / SDE. To this end we first establish well-posedness and stability of path-dependent systems for Hölder continuous paths. We then transfer these results to signature CDEs/SDEs, deriving in particular well-posedness conditions and a dynamic universal approximation theorem when the vector fields are real-analytic functions of the signature. This talk is based on joint works with Tomas Carrondo, Paul Hager, Fabian Harang and Sara Svaluto-Ferro.

*Speaker

Order routing and market quality: who benefits from internalization?

Albina Danilova *¹, Umut Cetin¹

¹ LSE – United Kingdom

Does retail order internalization benefit (via price improvement) or harm (via reduced liquidity) retail traders? To answer this question, we compare two market designs that differ in their mode of liquidity provision: In the setting capturing retail order internalization, liquidity is provided by market makers (whole-salers) competing for the retail order flow in a Bertrand fashion. Instead, in the open exchange setting, price-taking competitive agents act as liquidity providers. We discover that, when liquidity providers are risk averse, routing of marketable orders to wholesalers is preferred by all retail traders: informed, uninformed, and noise. Furthermore, most measures of liquidity are unaffected by the market design. We also identify a universal parameter that allows comparison of market liquidity, profit and value of information across different markets.

*Speaker

Dynkin games with partial and asymmetric information

Tiziano De Angelis * ^{1,2}

¹ University of Turin – Italy

² Collegio Carlo Alberto – Italy

In this talk I will consider zero-sum Dynkin games in continuous time when players have access to different filtrations. In a general non-Markovian setting I will illustrate results about the existence of the value and of a saddle point in randomised strategies, along with a dynamic characterisation of the value process and of the equilibrium strategies. Then, I will apply those results to derive a closed-form equilibrium in a game with foresight. The talk is based on joint and ongoing work with D. Hobson, N. Merkulov, J. Palczewski, J. Smith

*Speaker

”A Market Design to Trade Bundles of Securities and Applications to Options”

Bruno Dupire * ¹

¹ Bloomberg L.P. – United States

Exchanges have a function of facilitating trades by allowing for buyers and sellers of a security to meet and trade. However many strategies require the trade of not only one security but simultaneous execution of several legs, involving several securities. Examples include pair trading, equity portfolios, multi-maturities Futures strategies and options combinations. We call these multi-legs trades bundles. Not executing the various legs at the same time creates a risk of adverse price movement before the full completion. It can be eliminated by crossing the spreads and posting market orders but it incurs a high cost. We present a mechanism that allows for market participants to post one-sided orders on arbitrary bundles and then the matching engine computes (case of buy order) the cheapest super-replication of the posted bundle by a portfolio of other already posted bundles. So the features of the algorithm are that 1) it does not match security by security but rather a bundle with a collection of other bundles and 2) it can be a ”super-match” in the sense that the super-replication may give the additional benefit of a positive residual. We detail the algorithm and apply this methodology to show how it can in certain cases improve the price of option combinations. It can be applied even in the current market organization. There is no duality gap: the infimum of the expectation of a claim over all measures that respect the bids and the asks of a Bundles LOB (generalized Limit Order Book) is the lower bound of its price: buying it at a lower price leads to an arbitrage. This approach has an economic value as it allows for more trades to occur at mutually desirable prices.

*Speaker

Asset Pricing with Time-Consistent Mean-Variance Preferences

Christoph Czichowsky ¹, Aron Fulop * ¹

¹ Department of Mathematics London School of Economics – United Kingdom

The topic of the talk is the existence of mean-variance market equilibria with time-consistent trading strategies in continuous time. We consider a general market setting with multiple risky assets, where investors are trading in a time-consistent way according to their mean-variance preferences. Our main contribution is proving the existence of an equilibrium price process in a general semimartingale space, allowing for prices with or without jumps. The formula for the asset prices is given explicitly. We also extend previous results on the optimal time-consistent investment problem for a single agent with mean-variance preferences by the inclusion of random endowments for the investors. These non-tradable random endowments are the main motivation for trading to occur in the market, and play an important role in the definition of the equilibrium price.

*Speaker

Irregular/stochastic paths for deterministic control problems

Paul Gassiat * ¹

¹ Université Gustave Eiffel – Laboratoire d’analyse et de mathématiques appliquées (LAMA) – France

In deterministic control theory, it is often the case that, while generic controls have ”good” properties (the precise meaning depending on the problem), there exists a nonempty subset of possible controls which possess pathological properties. We investigate the idea of purposefully choosing our controls as paths with low regularity (such as paths of stochastic processes), and show in several contexts how this allows us to prove that we avoid the pathological set, and leads to an improved behaviour of the systems under consideration. More precisely, we consider on one hand the problem of solving motion planning by gradient methods, and on the other hand the problem of stabilizing a partially observed system. Based on joint works with Florin Suci (TU Berlin) and Lucas Brivadis (L2S, Centrale Supélec, Paris).

*Speaker

A Variational Approach to Portfolio Choice

Paolo Guasoni * ¹, Emmet Lawless ¹, Ho Man Tai ¹

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We develop a variational approach to solve infinite-horizon consumption-investment problems for isoelastic investors in complete markets with any number of assets and stochastic investment opportunities driven by a scalar diffusion. We identify a strictly convex functional whose unique minimiser coincides with the optimal wealth–consumption ratio and yields the optimal portfolio explicitly. We demonstrate the method’s effectiveness by computing optimal consumption-investment policies through gradient-descent in models featuring nonlinear predictability, stochastic volatility and interest-rate risk. The method combines verification with numerical tractability and yields accurate solutions in analytically intractable models.

*Speaker

Fourier-Laplace Transform Discontinuities and Computation in the Volterra Stein-Stein Model: A Fredholm–Wishart Approach

Eduardo Abi Jaber ¹, Maxime Guellil * ^{1,2}

¹ Centre de Mathématiques Appliquées - Ecole Polytechnique – Ecole Polytechnique – France

² Laboratoire de Probabilités, Statistique et Modélisation – Université Paris Cité – France

We investigate analytical and numerical challenges arising in the computation of the Fourier-Laplace transform for the Volterra Stein-Stein model, where the volatility is driven by a Volterra-type Gaussian process. A key difficulty stems from the complex square root of a Fredholm determinant, which becomes discontinuous when the determinant crosses the negative real axis. We characterize these crossings and provide a corrected expression for the joint Fourier-Laplace transform of the log-price and integrated variance. Furthermore, we propose a new derivation of the transform by interpreting the joint law of the integrated variance and log-price as the infinite-dimensional limit of a Wishart distribution. This novel approach naturally yields a convergent numerical method, for which we establish a convergence rate. Applying our algorithms to Fourier-based pricing in the rough Stein-Stein model, we achieve a significant increase in accuracy while drastically reducing computational cost compared to existing methods. This presentation is based on (1) and an ongoing working paper. (1). Abi Jaber E., Guellil M., “Complex discontinuities of the square root of Fredholm determinants in the Volterra Stein–Stein model,” , arXiv:2503.02965 (2025).

*Speaker

Path-dependent affine processes

Boris Günther ^{*} ¹, Thomas Kruse ², Ludger Overbeck ¹, Thorsten Schmidt ³

¹ Justus-Liebig-Universität Gießen – Germany

² Bergische Universität Wuppertal – Germany

³ University of Freiburg – Germany

We extend the notion of affine processes to the case of path-dependent coefficients and provide analytic formulas for their Fourier–Laplace transform in terms of generalized Riccati-type equations. This framework generalizes the classical Markovian affine theory to a path-dependent context. More precisely, we define path-dependent affine processes through their exponential–affine Fourier–Laplace transform on the path space and establish a characterization theorem. In particular, we show the equivalence between affine path-dependent coefficients and the exponential-affine structure of the conditional Fourier-Laplace transform of the past trajectory. Moreover, we derive a condition ensuring non-negativity of the path-dependent diffusion coefficient, guaranteeing well-posedness of the model. Finally, we apply these results to a path-dependent volatility extension of the Heston model, encompassing a delayed Heston model as a special case.

*Speaker

Discrete time Stochastic Impulse Control with Delay

Said Hamadene * ¹, Djehiche Boualem ²

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² KTH - Department of Mathematics, Stockholm – Sweden

The talk is related to a class of infinite-horizon impulse control problems with execution delay in discrete time. Using probabilistic methods, particularly the notion of the Snell envelope of processes, we construct an optimal strategy among all admissible strategies for both risk-neutral and risk-sensitive utility functions. Furthermore, we establish the existence of bounded ε -optimal strategies. This framework provides a robust approach to handling execution delays in discrete-time stochastic systems. The model can be used for pricing swing options in markets of commodities when the price of the commodity depends on the amounts of demand.

*Speaker

Portfolio Game with Heterogenous Universe

Lin Haowei * ¹, Jia Yanwei ², Zhou Chao ³

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³ QRT – Singapore

We develop a comprehensive game-theoretic framework for portfolio selection in competitive financial markets where investors exhibit both absolute and relative performance concerns. Our model accommodates heterogeneous agents with different investment universes—each agent has access to a potentially different subset of tradable securities due to regulatory constraints, investment mandates, or informational advantages. We characterize three distinct classes of equilibria: pure strategy Nash equilibria, mixed strategy Nash equilibria with entropy regularization (capturing exploration), and correlated equilibria (allowing for strategic coordination through public signals or mediators). Our analysis spans both static (one-period) and dynamic (continuous-time) settings. In the static framework, equilibrium strategies are characterized through systems of linear equations involving market parameters and agent characteristics. In the dynamic setting, equilibria are characterized via coupled forward-backward stochastic differential equations (FBSDEs). Our results reveal that heterogeneity in investment opportunities generates strategic complementarities and asymmetries in equilibrium portfolios. Dynamic equilibrium strategies decompose into myopic Markowitz, intertemporal hedging, and strategic adjustment components. Notably, we establish a unified hierarchy among equilibrium concepts: as the exploration parameter vanishes, mixed strategy equilibria converge to pure strategy Nash equilibria, and correlated equilibria degenerate to Nash equilibria under fully rational behavior. Explicit comparative statics illustrate how equilibrium allocations respond to changes in expected returns, volatilities, correlations, risk aversion, and competition intensity.

Keywords: Portfolio selection · Game theory · Nash equilibrium · Correlated equilibrium · Mean-variance optimization · Heterogeneous agents · FBSDE · Relative performance
JEL Classification: C72, C73, G11, G23 MSC 2020: 91A10, 91A25, 91G10, 93E20

*Speaker

CARA Mean-Field Portfolio Games: Structural Decomposition of Equilibria and Limiting Mean-Field Games

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This talk concerns Nash equilibria in portfolio games with finite and infinite populations, where common noise dynamics are described by integer-valued random measures (e.g., Poisson random measures) in addition to Brownian motions. Within this framework, we analyze optimal investment and hedging under relative performance concerns with exponential (CARA) preferences. We characterize mean-field equilibria via McKean-Vlasov backward SDEs with jumps and prove existence and uniqueness.

A key contribution is a structural decomposition of the mean-field equilibrium strategy into investment, hedging, and interaction components. Based on this decomposition, numerical computations illustrate the impact of common noise on the mean-field equilibrium strategies in a Markovian framework using PDE methods. Moreover, building on this decomposition, we show how a new mean-field game of quadratic hedging with relative performance concerns emerges as risk aversion vanishes (i.e., as risk tolerance tends to infinity), without imposing a Markovian restriction.

The talk builds on the preprint arXiv:2408.01175 but extends version 1 by adding the game of finite population, the decomposition of the Nash-equilibria, PDE-based numerical examples and the new mean-field game which emerges for vanishing risk aversion.

*Speaker

Model Risk Management for AI/Gen AI in Banking

Odile Hounkpatin * ¹

¹ Independent Consultant – United Kingdom

As AI/Gen AI transform the banking business and risk landscape, this talk introduces key AI use cases in banks and explores how they are implemented in practice- mainly the use of foundation models and fine tuning with proprietary data.

The session then outlines OECD expectations for the ethical and responsible use of AI/Gen AI models, and concludes with a practical blueprint for AI/Gen AI model governance in banking.

*Speaker

Ambiguity-Averse Deep Hedging with Feature Clustering

Adam C. Jones * 1,2

¹ Mathematical Institute [Oxford] – United Kingdom

² J.P. Morgan – United Kingdom

The uncertainty in future market dynamics is an important consideration when developing strategies for hedging derivatives, particularly data driven strategies such as deep hedging. Deep market generators can produce higher fidelity training data than classical models, but, like those, typically require frequent recalibration to new market data. The resulting strategies are thus susceptible to underperformance if there is a mismatch (distributional shift) between training data and live data. We present a framework to train a modified deep hedger which displays a form of ambiguity aversion, henceforth termed an *Ambiguity-Averse Deep Hedger* (AADH). The modeller has full control over exactly which aspects of distributional shifts the AADH is to be robust to, through selection of features relevant to the trading strategy which are used to cluster the training data, allowing for the evaluation of a loss function motivated by the theory of smooth ambiguity aversion. We demonstrate that for forward start options with transaction costs, our AADH with feature clustering *always* outperforms the standard deep hedger in out-of-distribution tests, emphasising the need to prepare for future uncertainty, and the effectiveness of ambiguity aversion in achieving this. For plain vanilla options with transaction costs, our AADH also outperforms the standard deep hedger in the overwhelming majority of out-of-distribution scenarios. Our findings are supported by numerical experiments involving (i) synthetic data with standard stochastic models, as well as (ii) real data experiments on equity indices over extensive periods of time, as well as (iii) a period of significant distributional shifts, the COVID period.

*Speaker

On modelling of and statistical inference for option price surfaces

Jan Kallsen * ¹

¹ Universität Kiel

A major challenge in mathematical finance is to come up with reasonable models for assets as for example stocks, indices, currencies etc. along with all the liquid options on these assets. Ideally, they should allow for parameter estimation with tractable effort, fit real data sufficiently well, and at the same time be consistent with absence of static as well as dynamic arbitrage. In this talk I will focus on statistical inference in a class of affine multifactor models using Heyde-optimal estimating functions.

*Speaker

A Gibbs Sampler for Financial Network Models with multiple CCPs

Markus Karl * ¹

¹ Department Mathematics [London] – United Kingdom

We consider a network reconstruction problem for markets with multiple central counterparties (CCPs) that are subject to bilateral netting. Assuming that clearing memberships are known, we propose a Gibbs sampler to reconstruct bilateral cleared amounts from aggregate information. We prove its irreducibility, and apply the method to stylized networks and apply it to compute the distribution of risk measures in stylized networks.

*Speaker

Dimension-free error estimate for diffusion model and optimal scheduling

Anna Kazeykina * ¹

¹ Université Paris Saclay – Université Paris Sud, Université Paris Saclay, Université Paris-Sud -
Université Paris-Saclay – France

Diffusion generative models synthesize data by simulating the reverse-time dynamics of a diffusion process, using a neural-network approximation of its unknown score function. Multiple error sources—statistical error, score approximation, finite-time simulation, and time discretization—affect the fidelity of generated samples. Prior error analyses rely on KL divergence or Wasserstein distance which impose restrictive assumptions or yield dimension-dependent bounds. We instead derive an explicit, dimension-free discrepancy bound using a weaker metric defined through higher regularity test functions. We apply our result to derive an optimal time-discretization scheduler, offering a new theoretical justification for a scheme previously proposed in practical applications.

*Speaker

Asset-liability management with Epstein-Zin utility under stochastic interest rate and unknown market price of risk

Wilfried Kuissi Kamdem * 1,2,3

¹ University of Rwanda – Rwanda

² Mathematisches Institut [Freiburg] – Germany

³ African Institute for Mathematical Sciences – Ghana

This paper solves a consumption-investment choice problem with Epstein–Zin recursive utility under partial information- unobservable market price of risk. The main novelty is the introduction of a terminal liability constraint, a feature directly motivated by practical portfolio management and insurance applications but absent from the recursive-utility literature. Such constraint gives rise to a coupled forward–backward stochastic differential equation (FBSDE) whose well-posedness has not been addressed in earlier work. We provide an explicit solution to this FBSDE system-contrasting with the typical existence and uniqueness results with no closed-form expressions in the literature. Under mild additional assumptions, we also establish the Malliavin differentiability of the solution allowing the optimal investment strategy to be expressed as a conditional expectation of random variables that can be efficiently simulated. These results allow us to obtain the explicit expressions of the optimal controls and the value function. Finally, we quantify the utility loss from ignoring learning about the market price of risk, highlighting the economic significance of partial information.

*Speaker

Pathwise stochastic integrals invariant with respect to the choice of the partition sequence

Purba Das ¹, Anna Kwossek * ², David Prömel ³

¹ King's College London – United Kingdom

² University of Vienna – Austria

³ University of Mannheim – Germany

In this talk, we take a model-free approach to mathematical finance and study a pathwise construction of stochastic integrals: Using the concepts of quadratic variation and Lévy area of a continuous path along a sequence of time partitions, we construct a pathwise integral as a limit of (left-point) Riemann sums. In a probabilistic framework, when the underlying process is a semimartingale, this notion of integration is consistent with stochastic (Itô) integration. Furthermore, we state necessary and sufficient conditions for the quadratic variation and Lévy area of a continuous path to be invariant with respect to the choice of the partition sequence.

*Speaker

Optimal investment under capital gains taxes

Alexander Dimitrov ¹, Christoph Kühn * ¹

¹ Goethe University Frankfurt = Goethe-Universität Frankfurt am Main – Germany

We generalize classic results on the existence of optimal portfolios in discrete time frictionless models to models with capital gains taxes. We consider the realistic but mathematically challenging rule that losses do not trigger negative taxes but can only be offset against potential gains in the future. Central to the analysis is a well-known phenomenon from arbitrage-free markets with proportional transaction costs that does not exist in arbitrage-free frictionless markets: an investment in specific quantities of stocks that is completely riskless but may provide an advantage over holding cash in the bank account.

As a by-product, we provide a proof that in discrete time frictionless models with random polyhedral cone constraints, no arbitrage implies that the set of attainable terminal wealth is closed in probability—even if there are redundant stocks.

*Speaker

ODEep Signature Approach for McKean-Vlasov FBSDEs in a Random Environment

Mathieu Lauriere¹ *

¹ NYU Shanghai

Mean-field games with common noise provide a powerful framework for modeling the collective behavior of large populations subject to shared randomness, such as systemic risk in finance or environmental shocks in economics. These problems can be reformulated as McKean-Vlasov forward-backward stochastic differential equations (MV-FBSDEs) in a random environment, where the coefficients depend on the conditional law of the state given the common noise. Existing numerical methods, however, are largely limited to cases where interactions depend only on expectations or low-order moments, and therefore cannot address the general setting of full distributional dependence. In this work, we introduce a deep learning-based algorithm for solving MV-FBSDEs with common noise and general mean-field interactions. Building on fictitious play, our method iteratively solves conditional FBSDEs with fixed distributions, where the conditional law is efficiently represented using signatures, and then updates the distribution through supervised learning. Deep neural networks are employed both to solve the conditional FBSDEs and to approximate the distribution-dependent coefficients, enabling scalability to high-dimensional problems. Under suitable assumptions, we establish convergence in terms of the fictitious play iterations, with error controlled by the supervised learning step. Numerical experiments, including a distribution-dependent mean-field game with common noise, demonstrate the effectiveness of the proposed approach. Joint work with Ruimeng Hu (UCSB), Botao Jin (UCSB), and Jiacheng Zhang (CUHK)

*Speaker

Risk aversion of insider and dynamic asymmetric information.

Albina Danilova ¹, Valentin Lizhdvoy * ²

¹ LSE – United Kingdom

² Higher School of Economics – Russia

We study a Kyle-Back model with a risk-averse insider possessing exponential utility and a dynamic stochastic signal about the asset's terminal fundamental value. While the existing literature considers either risk-neutral insiders with dynamic signals or risk-averse insiders with static signals, we establish equilibrium when both features are present. Our approach imposes no restrictions on the magnitude of the risk aversion parameter, extending beyond previous work that requires sufficiently small risk aversion. We employ a weak conditioning methodology to construct a Schrödinger bridge between the insider's signal and the asset price process, an approach that naturally accommodates stochastic signal evolution and removes risk aversion constraints. We derive necessary conditions for equilibrium, showing that the optimal insider strategy must be continuous with bounded variation. Under these conditions, we characterize the market-maker pricing rule and insider strategy that achieve equilibrium. We obtain explicit closed-form solutions for important cases including deterministic and quadratic signal volatilities, demonstrating the tractability of our framework. This is joint work with Dr Albina Danilova (LSE).

*Speaker

Markov Chains in Random Environments: Theory, Mixing Properties, and Applications

Attila Lovas * ^{1,2}, Lionel Truquet ³

¹ Alfréd Rényi Institute of Mathematics – Hungary

² Budapest University of Technology and Economics [Budapest] – Hungary

³ Centre de Recherche en Economie et Statistique [Bruz] – Ecole Nationale de la Statistique et de l'Analyse de l'Information [Bruz] – France

Markov Chains in Random Environments (MCREs) provide a mathematical framework for modeling information-processing systems with finite memory, whose dynamics are influenced by an external random factor. Many practical models-ranging from machine learning and queueing systems to econometrics-can be naturally expressed as MCREs. This talk offers an accessible introduction to MCREs, focusing on recent key results, including the transition of mixing properties and their consequences, such as the law of large numbers and the central limit theorem. We then illustrate the broad applicability of these results in areas like time series analysis and stochastic gradient Langevin dynamics, often under weaker assumptions than those typically required in existing literature.

*Speaker

Characterising Risk Averse Mean-Field Equilibria via Weighted Occupation Measures

Nils Matti * ¹, Dirk Becherer ²

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² Institut fr Mathematik [Humboldt Universitt zu Berlin] – Germany

In this talk we present a complete characterisation for all mean field equilibria (MFE) of risk-averse Mean Field Games (MFGs) in discrete time. For risk-averse Markov decision processes (MDPs) we show equivalence of Bellman equations to a linear problem. The respective dual problem is posed over weighted occupation measures (WOMs) and its attained optimisers directly relates to optimal MDP strategies. In the risk neutral case the feasible set of the dual problem is known to be the set of (non-weighted) occupation measures (see Xin Guo et al, 2024, SIAM). For risk-averse MFG the key problem is to combine the prior results with the consistency condition of MFEs: To this end we prove a 1 to 1 relation between WOMs, OMs, and strategies, which allows us to fuse the consistency condition with Karush Kuhn Tucker conditions for optimality in the linear problem and thus proving easily verifiable necessary and sufficient conditions for MFE. We establish numerically feasible necessary conditions for

*Speaker

Transversality Condition Matters: Ensuring Uniqueness of Deep Learning Solutions in Continuous-Time Economics and Finance

Aleksei Minabutdinov * ¹

¹ Department of Management, Technology, and Economics [ETH Zürich] – Switzerland

Transversality conditions are essential for uniqueness in infinite-horizon economic and financial models. Without them, the Hamilton–Jacobi–Bellman (HJB) equation admits a continuum of solutions, and numerical methods may converge arbitrarily to economically meaningless ones. In practice, deep learning–based solvers such as Deep Galerkin and physics-informed neural networks often ignore transversality, relying on ”implicit regularization” to avoid explosive solutions. We show analytically and numerically that this mechanism can fail in endogenous growth models. In the canonical log-utility AK–Ramsey model, the HJB admits a one-dimensional manifold of well-behaved solutions on any compact set, and neural networks trained only on HJB residuals may converge arbitrarily along this manifold, leading to large value-function and policy errors despite small residuals.

We propose a functional transformation approach that maps the unbounded state space to a bounded domain and embeds the transversality condition as an amenable boundary condition. The transformed HJB equation can be solved by standard Deep Galerkin or PINNs methods, and an explicit inverse transform recovers the initial problem solution uniquely in one step. We derive conditions under which small residuals in the transformed problem imply small errors in the original HJB, and we illustrate the approach on deterministic and stochastic AK models and on a Ramsey model with asymptotically linear production. The results show that the approach restores uniqueness and yields accurate value and policy functions in settings where current methods might fail.

*Speaker

Long Time Behavior, Stabilization and Turnpike for Displacement Monotone Mean Field Games

Alpár Mészáros * ¹

¹ Durham University – United Kingdom

In this talk we will study the long time behavior of Nash equilibria in Mean Field Games within the framework of displacement monotonicity. We first show that any two equilibria defined on the time horizon $(0, T)$ must be close as T tend to infinity, in a suitable sense, independently of initial/terminal conditions. The way this stability property is made quantitative involves the L^2 distance between solutions of the associated Pontryagin system of FBSDEs that characterizes the equilibria. Therefore, this implies in particular the stability in the 2-Wasserstein distance for the two flows of probability measures describing the agent population density and the L^2 distance between the co-states of agents, that are related to the optimal feedback controls. We then prove that the value function of a typical agent converges as T tends to infinity, and we describe this limit via an infinite horizon MFG system, involving an ergodic constant. All of our convergence results hold true in a unified way for deterministic and idiosyncratic noise driven Mean Field Games, in the case of strongly displacement monotone non-separable Hamiltonians. All these are quantitative at exponential rates. The talk is based on a recent joint work with Marco Cirant (Padova).

*Speaker

Deep BSDE method for Quantile Hedging

Cyril Nefzaoui Blanchard * ¹, Cyril Bénézet , Sergio Pulido ²

¹ Université Paris-Saclay – LaMME – France

² ensIE – LaMME, LaMME – France

We consider the popular Deep BSDE method of E–Han–Jentzen and tailor it to the quantile hedging problem in the weak stochastic-target framework initiated by Bouchard–Élie–Touzi and Bouchard–Élie–Réveillac. The success-probability state is modeled as a constrained martingale with square-integrable unbounded controls. We combine piecewise-constant controls with a projected Euler time discretization and an endogenous stopping rule to preserve the constraint, yielding an implementable discrete-time control problem. Within the policy-timestep framework of Krylov - Jakobsen–Picarelli–Reisinger , we provide a convergence study tailored to the state constraint, unbounded controls, and BSDE-type criteria with convex drivers.

Unlike previous works that focus mainly on pricing, our approach outputs both the value function and the associated quantile hedging strategy within the same solver. On classical benchmarks, numerical experiments are consistent with the Föllmer–Leukert results and confirm the accuracy and interpretability of the method. This is a joint work with Cyril Bénézet and Sergio Pulido.

*Speaker

Upper comonotonicity and risk aggregation under dependence uncertainty

Corrado De Vecchi ¹, Max Nendel * ², Jan Streicher ³

¹ University of Verona – Italy

² University of Waterloo – Canada

³ Landesbank Baden-Württemberg – Germany

In this talk, we study dependence uncertainty and the resulting effects on tail risk measures. To that end, we introduce the notion of a regular dependence measure, defined on multi-marginal couplings, as a generalization of well-known correlation statistics such as the Pearson correlation. The first main result states that even an arbitrarily small positive dependence between losses can result in perfectly correlated tails beyond a certain threshold and seemingly complete independence before this threshold. In a second step, we focus on the aggregation of individual risks with known marginal distributions by means of arbitrary nondecreasing left-continuous aggregation functions. In this context, we show that under an arbitrarily small positive dependence, the tail risk of the aggregate loss might coincide with the one of perfectly correlated losses. A similar result is derived for expectiles under mild conditions. In a last step, we discuss our results in the context of credit risk, analyzing the potential effects on the value at risk for weighted sums of Bernoulli distributed losses.

*Speaker

Propagation of chaos for mean-field Langevin dynamics and its application to model ensemble

Atsushi Nitanda * ^{1,2}

¹ A*Star – Singapore

² Nanyang Technological University – Singapore

Mean-field Langevin dynamics (MFLD) is an optimization method derived by taking the mean-field limit of noisy gradient descent for two-layer neural networks in the mean-field regime. Recently, the propagation of chaos (PoC) for MFLD has gained attention as it provides a quantitative characterization of the optimization complexity in terms of the number of particles and iterations. Remarkable progress in a recent study showed that the approximation error due to finite particles remains uniform in time and diminishes as the number of particles increases. By refining the defective log-Sobolev inequality a key result from earlier work an improved PoC result is established for MFLD, which removes the exponential dependence on the regularization coefficient from the particle approximation term of the optimization complexity. As an application, a PoC-based model ensemble strategy with theoretical guarantees is proposed.

*Speaker

Stable measure transformations for affine jump-diffusions

Claudio Fontana ¹, Beatrice Ongarato ^{* 2}

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² TU Dresden – Germany

Affine processes are Markov processes whose characteristic functions admit an exponentially affine dependence on the initial state. This structural property underlies their widespread use in applications, as it ensures a balance between model flexibility and analytical tractability. This naturally raises the question of whether the affine property is stable under changes to equivalent probability measures. In this work, we provide a full characterization of the class of locally equivalent probability measures that preserve the affine structure in a general affine jump–diffusion setting. Building on the methodological framework developed for general Markov processes, we exploit the additional affine structure to derive necessary and sufficient conditions on admissible transformations. Our results yield an explicit and verifiable criterion, enhancing the applicability of our work across multiple areas.

*Speaker

Convergence properties of stochastic volatility models

Attila Lovas , Miklos Rasonyi * ¹, Lionel Truquet

¹ HUN-REN Alfred Renyi Institute of Mathematics – Hungary

We consider mean-reverting asset price processes (baskets, long-term safe assets, commodities) with stochastic, possibly non-Markovian volatility. We recall the result that such processes always converge to a limiting law. We present new results about convergence speed, based on general considerations about Markov chains in random environment.

*Speaker

Short rate models with stochastic discontinuities: a PDE approach

Simona Sanfelici * ¹, Alessandro Calvia ², Marzia De Donno ³, Chiara Guardasoni ¹

¹ University of Parma – Italy

² Politecnico di Milano – Italy

³ Università Cattolica di Milano – Italy

In the ongoing reform of interest rate benchmarks, risk-free rates (RFRs), such as the Secured Overnight Financing Rate (SOFR) in the U.S. or the Euro Short-Term Rate (EUSTR) in Europe, play a pivotal role. An observed characteristic of RFRs is the occurrence of jumps and spikes at regular intervals, due to regulatory and liquidity constraints.

In this paper, we consider a general short-rate model featuring discontinuities at fixed times with random sizes. Within this framework, we introduce a PDE-based approach to price interest rate derivatives. For affine models, we also derive (quasi) closed-form solutions. Finally, we develop numerical methods to price interest rate derivatives in general cases.

Joint work with Alessandro Calvia, Marzia De Donno and Chiara Guardasoni.

*Speaker

Neural operator methods for the inverse double phase problem

Philipp Schmocker * ¹

¹ ETH Zurich – Switzerland

In this talk, we use neural operators to learn both the solution map and the associated Calderón inverse problem for the class of non-uniformly elliptic double phase equations. By extending the theory of generative equilibrium operators (GEOs) - originally developed over Hilbert spaces - to the setting of reflexive, strictly convex, and smooth Banach spaces, we derive an universal approximation theorem for the corresponding coefficient-to-solution (CS) map. We show that a reconstruction strategy based on small, non-degenerate boundary data, when coupled with GEO-based numerical approximations, yields accurate recovery of the coefficient a from the Dirichlet-to-Neumann map Λ_a . Furthermore, we establish a universal approximation theorem for neural operators learning the inverse map $\Lambda_a \mapsto a$ using synthetic data generated by GEOs. Numerical experiments validate the method and indicate strong performance even without explicit regularization.

*Speaker

Bayesian estimation with set-valued observations

Pavarana Simone * ¹, Thorsten Schmidt ¹, Cagin Ararat ²

¹ Abteilung für Mathematische Stochastik, Albert-Ludwigs-Universität Freiburg – Germany

² Bilkent University [Ankara] – Turkey

In this work, we develop a Bayesian estimation framework in which the observable quantity is a random set rather than a classical random vector. The motivation comes from expert-opinion modeling in highly uncertain environments—such as robotic risk management—where experts typically provide confidence intervals or other set-valued assessments for key risk factors. We first show that, under suitable assumptions, the standard Bayesian update formula remains valid and does not require substantial modification compared to the classical setting where both signal and observation take values in Polish spaces. However, whereas these assumptions (such as absolute continuity of the conditional distribution of the observation given the signal) are straightforward to verify for vector-valued observations, the set-valued case requires a more delicate, case-by-case analysis. We then establish that the required regularity conditions indeed hold for a broad class of random sets, including random intervals, finite sets, polytopes, and more generally convex compact sets. Particular attention is devoted to finite-valued random sets, which appear in Bayesian filtering within the FISST (Finite Set Statistics) framework introduced by Ronald P. S. Mahler in the mid-1990s. We generalize FISST results and also employ them to address the case of polytope-valued observations, which are given as convex hulls of finite sets.

*Speaker

Chasing Stationarity: Exponentially Fading Memory Signature

Dimitri Sotnikov *^{1,2}, Eduardo Abi Jaber³

¹ Centre de Mathématiques Appliquées de l'Ecole polytechnique – CNRS- LULI, Ecole Polytechnique, Palaiseau, France, Engie Global Markets – France

² ENGIE – Engie Global Markets – France

³ Centre de Mathématiques Appliquées - Ecole Polytechnique – Ecole Polytechnique – France

We introduce the exponentially fading memory (EFM) signature, a time-invariant transformation of an infinite (possibly rough) path that serves as a mean-reverting analogue of the classical path signature. We construct the EFM-signature via rough path theory, carefully adapted to accommodate improper integration from minus infinity. The EFM-signature retains many of the key algebraic and analytical properties of classical signatures, including a suitably modified Chen identity, the linearization property, path-determinacy, and the universal approximation property. From the probabilistic perspective, the EFM-signature provides a "stationarized" representation, making it particularly well-suited for time-series analysis and signal processing overcoming the shortcomings of the standard signature. In particular, the EFM-signature of time-augmented Brownian motion evolves as a group-valued Ornstein–Uhlenbeck process. We establish its stationarity, Markov property, and exponential ergodicity in the Wasserstein distance, and we derive an explicit formula à la Fawcett for its expected value in terms of Magnus expansions. We also study linear combinations of EFM-signature elements and the computation of associated characteristic functions in terms of a mean-reverting infinite dimensional Riccati equation. This is joint work with Eduardo Abi Jaber.

*Speaker

Pricing Corporate Securities under Incomplete Information with Predictable Jump Times

Felix Barrez Tambe Ndonfack * ¹

¹ University of Freiburg, Department of Mathematical Stochastics, Mathematical Institute – Germany

We extend the structural credit-risk framework of *Rüdiger Frey and Thorsten Schmidt (2009)* to incorporate predictable jump times under incomplete information. Investors observe noisy signals of firm value (dividends, rating, public news) so that the asset pricing is driven by investors' filtered beliefs rather than true fundamentals, and valuation reduces to a nonlinear filtering problem. We enrich the model by allowing for state-dependent jumps at scheduled events including coupon payments and earnings announcements, and by permitting noisy observations of these jump. Jump magnitudes depend on the history of market observation, which allows the model to capture asymmetric reactions to bad versus good news, especially during periods of weak sentiment.

We derive explicit Bayesian update rules via a Kushner-Stratonovich equation and show how predictable jump risk alters the default compensator by combining a continuous default intensity with additional default risk concentrated at scheduled dates. This modified default risk feeds directly into equity and credit pricing formulas. Particle filter simulations demonstrate that scheduled events generate sawtooth-shaped credit spreads, clustering of default risk around announcement dates, and stronger downside asymmetry, features that are consistent with observed market behavior.

Rüdiger Frey and Thorsten Schmidt. Pricing corporate securities under noisy asset information. Mathematical Finance: An International Journal of Mathematics, Statistics and Financial Economics, 19(3):403–421, 2009.

*Speaker

On the absence of arbitrage in general diffusion markets with reflection and skewness

Alexis Anagnostakis ¹, David Criens ², Mikhail Urusov * ³

¹ Université de Lorraine – Institut Elie Cartan de Lorraine (IECL) – France

² University of Freiburg – Germany

³ University of Duisburg-Essen – Germany

We are interested in the absence of arbitrage for single asset financial market models whose asset price process is modelled by a one-dimensional general diffusion (captured via scale function and speed measure). In recent work, Criens and Urusov proved precise characterizations of NA, NUPBR and NFLVR in terms of scale and speed. In particular, it was shown that these notions are violated in the presence of skewness effects or reflecting boundaries (that reflection entails such arbitrage opportunities is rather intuitive). It remained open whether weaker notions of no arbitrage can hold in the presence of skewness or reflection. The literature suggests that this is not the case. Indeed, Rossello (Insur. Math. Econ., 2012) had observed that the weaker "no increasing profit" (NIP) condition fails for an exponential skew Brownian motion model (i.e., the scale function has a kink), and Buckner, Dowd and Hulley (Finance & Stochastics, 2024) showed that increasing profits exist in a reflected geometric Brownian motion model. In this talk, we explain the surprising observation that there are diffusion markets that satisfy NIP in the presence of irregularities in the scale function and with reflecting boundaries.

*Speaker

On Lévy preservation property by f-divergence minimal equivalent martingale measure (MEMM).

Lioudmila Vostrikova * ¹, Lioudmila Vostrikova

¹ Laboratoire Angevin de Recherche en Mathématiques (LAREMA) – Centre National de la Recherche Scientifique : UMR6093, Université d'Angers : UMR6093 – France

We consider utility maximisation approach for exponential Lévy models. As known, this maximisation can be transformed in f-divergence minimisation over the set of all equivalent martingale measures (EMM). The Lévy preservation property by f-divergence MEMM, studied by Esche and Schweizer for relative entropy, was not completely investigated for all f-divergences corresponding to HARA utilities. Using the predictable information processes, we prove that the existence of any f-divergence MEMM implies the existence of the one preserving Lévy property. This measure is in addition scale and time invariant. The mentioned approach permits us to get the expressions of the Girsanov parameters and to construct such measure.

*Speaker

Entropic Optimal Transport Problem with Convex Functional Cost

Xiaozhen Wang ^{*} ¹, Anna Kazeykina ², Zhenjie Ren ³, Yufei Zhang ⁴

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³ LaMME, Universite Evry Paris-Saclay, France – LaMME – France

⁴ Department of Mathematics, Imperial College London, United Kingdom – United Kingdom

We study an entropic optimal transport problem in which the transport plan is penalized by a nonlinear convex functional acting on the coupling. We establish existence, uniqueness, and uniform a priori bounds for minimizers, and we show that each minimizer satisfies a fixed-point first-order optimality system associated with an exponentially tilted reference measure. Building on this variational structure, we introduce the Sinkhorn-Frank-Wolfe (SFW) flow, prove its global well-posedness, and derive an energy-dissipation inequality yielding exponential convergence toward the unique optimal transport plan. As an application, we implement the SFW algorithm to solve an optimal routing problem for unmanned aerial vehicles with congestion aversion.

*Speaker

A conditional view on mean-field limits

Songbo Wang * ¹

¹ Laboratoire Jean Alexandre Dieudonné – Université Nice Sophia Antipolis (1965 - 2019), Centre National de la Recherche Scientifique, Université Côte d’Azur – France

In this talk I will introduce a quantitative approach to mean-field particle systems which considers conditional particle distributions. Especially, functional inequalities for particles are established by constructing a martingale on the space of probability measures. These functional inequalities leads to near-optimal concentration and relaxation estimates for gradient-type particle systems. In the end I discuss some future directions, including especially applications to convergence of path-dependent mean-field controls.

*Speaker

On the long-time behavior of mean field game systems with a common noise

Wenbin Yan * ¹, Pierre Cardaliaguet ¹, Raphaël Maillet ²

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² Capital Fund Management – Université Paris Dauphine - Paris IX – France

In this paper, we study the long-time behavior of mean field game (MFG) systems influenced by a common noise. While classical results establish the convergence of deterministic MFG towards stationary solutions under suitable monotonicity conditions, the introduction of a common stochastic perturbation significantly complicates the analysis. We consider a standard MFG model with infinitely many players whose dynamics are subject to both idiosyncratic and common noise. The central goal is to characterize the asymptotic properties as the horizon goes to infinity. By employing quantitative methods that replace classical compactness arguments unavailable in the stochastic context, we prove that solutions exhibit exponential convergence toward a stationary regime. Specifically, we identify a deterministic ergodic constant and demonstrate the existence of stationary random processes capturing the limiting behavior. Further, we establish almost sure long-time results thanks to a detailed analysis of the ergodic master equation, which is the long-time limit of the master equation. Our results extend known deterministic convergence phenomena to the stochastic setting, relying on novel backward stochastic PDE estimates.

*Speaker

Schrödinger Bridges with jumps for time series generation

Davide Zanni * ¹

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We explore the applications of entropic optimal transport, and precisely the technology of Schrödinger bridges, to the problem of time series generation, aiming to extend the approach of (M. Hamdouche, P. Henry-Labordère, H. Pham, Generative modeling for time series via Schrödinger bridge, 2023) to jump-diffusion dynamics. Starting from a Schrödinger bridge type criterion, we reformulate the problem as a stochastic control problem, whose solution yields the dynamics of an optimal jump-diffusion process. When discretized at fixed time points, this process generates synthetic time series that share the same joint distribution of the original data. The optimal dynamics is fully data-driven, as both the drift and the jump intensity can be approximated using kernel methods based on the initial dataset. We then discuss the implementation of the generative algorithm, which relies on a jump-adapted scheme for simulating the generative process. Finally, we address the calibration of the model hyperparameters and present numerical experiments on both simulated stochastic data and real datasets, with a focus on financial or related time series (Equity returns, energy consumption). Joint work with Stefano De Marco and Huyên Pham (École Polytechnique).

*Speaker

A Dynamic Competitive Equilibrium Model of Irreversible Capacity Investment with Stochastic Demand and Heterogeneous Producers

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We formulate a continuous-time competitive equilibrium model of irreversible capacity investment in which a continuum of heterogeneous producers supplies a single non-durable good subject to exogenous stochastic demand. Each producer optimally adjusts both output and capacity over time in response to endogenous price signals, while investment decisions are irreversible. Market clearing holds continuously, with prices evolving endogenously to balance aggregate supply and demand through a constant-elasticity demand function driven by a stochastic base component. The model admits a mean-field interpretation, as each producer's decisions both influence and are influenced by the aggregate behaviour of all others. We show that the equilibrium price process can be expressed as a nonlinear functional of the exogenous base demand, leading to a three-dimensional singular stochastic control problem for each producer. We derive an explicit solution to the associated Hamilton-Jacobi-Bellman equation, including a closed-form characterisation of the free-boundary surface separating investment and waiting regions.

*Speaker

Fear and Anxiety in Optimal Stopping: A Behavioral Model of Asset Liquidation

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This paper develops a continuous-time optimal stopping model to analyze the asset liquidation decisions of a behavioral investor influenced by fear and anxiety. We model these emotions as functions of an asset's price history, specifically its proximity to its historical peak. The problem is formulated as a two-dimensional free-boundary problem where the state variables are the current price and its historical running maximum. We define anxiety as an increased psychological discount rate when the asset has experienced a significant drawdown from its peak. Fear is about the probability that whether the price can recover to the peak. We solve the model numerically using a robust Gauss-Seidel iterative method on the discretized Hamilton-Jacobi-Bellman variational inequality. The results reveal a rich, path-dependent optimal strategy characterized by a continuation region bounded by non-trivial stop-loss. Our model provides a theoretical framework that endogenously generates complex selling behaviors consistent with observed market phenomena, such as the disposition effect and panic selling at the price top, driven by the interplay between past performance and future expectations.

*Speaker