ADVANCES IN STOCHASTIC ANALYSIS FOR RISK MODELING

CIRM, LUMINY, NOVEMBER 13 - 17, 2017

Abstracts

ACCIAIO, Beatrice

McKean–Vlasov control problems and non-anticipative optimal transport

Abstract: I will present a new approach to McKean–Vlasov control problems based on a mass transport perspective. I will consider the case where the cost function depends on the joint law of state and control, and provide a characterization of the weak solutions to the control problem via dynamic optimal transport of non-anticipative nature. The talk is based on ongoing projects with J. Backhoff, R. Carmona and P. Wang.

BANK, Peter

Proactive and reactive trading: optimal control with Meyer sigma-fields

Abstract: In many financial optimization problems the way new information is revealed is crucial for the optimal strategy. When executing a large order, for instance, there may be moments when new counterparties can be expected to come to the market, but it may be unclear how much demand exactly will materialize. In such a situation, it seems reasonable to take a certain position right before the counterparties' arrival to be able to profit from their demand and afterwards react again immediately, e.g. when actutal demand was disappointing. We propose to model such phenomena in a general continuous time setting by using Meyer sigma-fields which allow one to interpolate between "uninformed" predictable and "frontrunning" optional strategies in a systematic manner. This is illustrated in a Lévy process setting by an irreversible investment problem with inventory risk where the controller may obtain different signals about impending jumps. Using a significant extension of a representation result for stochastic processes (Bank and El Karoui 2004), we explicitly construct the làdlàg optimal control policies and provide some closed-form solutions illustrating the usefulness of Meyer sigma-fields for modelling information flow.
This is joint work with David Beßlich.

BAYRAKTAR, Erhan

Mini-flash crashes, model risk, and optimal execution

Abstract: Oft-cited causes of mini-flash crashes include human errors, endogenous feedback loops, the nature of modern liquidity provision, fundamental value shocks, and market fragmentation. We develop a mathematical model which captures aspects of the first three explanations. Empirical features of recent mini-flash crashes are present in our framework. For example, there are periods when no such events will occur. If they do, even just before their onset, market participants may not know with certainty that a disruption will unfold. Our mini-flash crashes can materialize in both low and high trading volume environments and may be accompanied by a partial synchronization in order submission. Instead of adopting a classically-inspired equilibrium approach, we borrow ideas from the optimal execution literature. Each of our agents begins with beliefs about how his own trades impact prices and how prices would move in his absence. They, along with other market participants, then submit orders which are executed at a common venue. Naturally, this leads us to explicitly distinguish between how prices actually evolve and our agents opinions. In particular, every agents beliefs will be expressly incorrect. As far as we know, this setup suggests both a new paradigm for modeling heterogeneous agent systems and a novel blueprint for understanding model misspecification risks in the context of optimal execution.
Based on a joint work with my former Ph.D. student Alexander Munk.

BECHERER, Dirk

Good deal hedging and valuation under combined uncertainty about drift and volatility

Abstract: We derive robust good-deal hedges and valuations under combined model ambiguity about the drift and volatility of asset prices for incomplete markets. Good-deal valuations are determined such that not just opportunities for arbitrage but also for overly attractive reward-to-risk ratios are excluded. From a finance point of view, this permits for hedges and valuation bounds than are less extreme (respectively expensive) than those from the more fundamental approach of almost-sure superhedging and its corresponding no-arbitrage bounds. In mathematical terms, it demands however that not just ambiguities about the volatility but also about the drift become relevant. For general measurable contingent claims, possibly path-dependent, the solutions are fully characterized by 2nd-order backward stochastic differential equations with non-convex drivers. Examples illustrate, how combined uncertainty makes the solution more complex than just either drift or volatility uncertainty alone.

BEIGLBÖCK, Mathias

A Benamou–Brenier type problem for martingale transport

Abstract: In classical optimal transport, the contributions of Benamou–Brenier and McCann regarding the time-dependent version of the problem are cornerstones of the field and form the basis for a variety of applications in other mathematical areas. We suggest a Benamou–Brenier type formulation of the martingale transport problem for given d-dimensional distributions μ, ν in convex order. The unique solution M of this problem turns out to be a Markov-martingale which has several notable properties: In a specific sense, it mimics the movement of a Brownian particle as closely as possible subject to the conditions $M_0 \sim \mu$, $M_1 \sim \nu$. Similar to McCann's displacementinterpolation, it provides a time-consistent interpolation between μ and ν. For particular choices of the initial and terminal law, it recovers archetypical martingales such as Brownian motion, geometric Brownian motion, and the Bass martingale. Furthermore, it yields a natural approximation to the local vol model and a new approach to Kellerer's theorem.
(Joint work with J. Backhoff, M. Huesmann and S. Källblad)

BILAREV, Todor

Superhedging with transient impact

Abstract: We consider a market model with a large trader whose actions influence the price of a risky asset in a transitive way, meaning that past trades influence the future price but their effect lessens in time. To ensure positivity of prices, we postulate the evolution of the risky asset process in a multiplicative way, where the large trader's impact is on the relative perturbation from a reference unaffected price process that follows Black–Scholes dynamics. In this model, we define the gains from general (càdlàg) trading strategies by continuity considerations, here the Skorokhod M1 topology being crucial, and study the problem of superhedging of European options. We characterize the minimal superhedging price as the viscosity solution of a non-linear Black–Scholes PDE, where the transient nature of impact plays a key role.

BION-NADAL, Jocelyne

Characterization of a Wasserstein type distance in terms of a stochastic control problem

Abstract: Motivated by the construction of robust methods for calibration in the setting of diffusion models, we introduce a Wasserstein type distance $\widetilde{W}^2$ on the set of laws $P^{\mu,\sigma}_{s,x}$ of d-dimensional diffusion models. The probability measure $P^{\mu,\sigma}_{s,x}$ denotes the unique solution to the martingale problem with drift coefficient μ, diffusion coefficient σ and initial condition x at time s (μ and σ are assumed to be Hölder continuous and $\sigma\sigma^T$ uniformly strongly elliptic). We prove that the distance $\widetilde{W}^2$ metrizes the weak topology. The distance $\widetilde{W}^2(P^{\mu,\sigma}_{s,x}, P^{\overline{\mu},\overline{\sigma}}_{s,\overline{x}})$ is characterized in terms of a stochastic control problem. In the case $d = 1$ we can constuct an explicite solution. In the multi-dimensional case, to solve the Hamilton–Jacobi–Bellmann equation associated to this control problem one faces several technical difficulties: the control is involved in the diffusion coefficient, the source term is unbounded and, an even more critical issue, the differential operator is degenerate. Thus classical results cannot apply. Nevertheless, we prove that this HJB equation admits a regular solution V and that $V(s,x,\overline{x}) = \widetilde{W}^2(P^{\mu,\sigma}_{s,x} P^{\overline{\mu},\overline{\sigma}}_{s,\overline{x}})$. In addition, we prove that the distance $\widetilde{W}^2(P^{\mu,\sigma}_{s,x} P^{\overline{\mu},\overline{\sigma}}_{s,\overline{x}})$ is realized by the law of a 2d-dimensional diffusion process.
This talk is based on a work in progress with Denis Talay and Inria Sophia Antipolis.

BURZONI, Matteo

Viability and Arbitrage under Knightian Uncertainty

Abstract: We provide a general framework to study viability and arbitrage in models for financial markets. Viability is intended as the existence of a preference relation with the following properties: It is consistent with a set of preferences representing all the plausible agents trading in the market; An agent with such a preference is in equilibrium, namely, he or she prefers to stay at the initial endowment respect to trade. We extend the original framework of Kreps ('79) and Harrison-Kreps ('79) to accommodate for Knightian Uncertainty: preferences of plausible agents are not necessarily determined by a single probability measure. The relations between arbitrage, viability, and existence of (non-)linear pricing rules are investigated.
This is a joint work with Frank Riedel and Mete Soner.

CARDALIAGUET, Pierre

Mean field games of control

Abstract: Mean field games of control are a class of optimal control problems with infinitely many (small) controllers who interact not only through their position, but also through their control. After presenting some examples of applications, we will discuss the existence/uniqueness of the Nash equilibria, learning procedures and variational methods for this class of problems.

CERREIA-VIOGLIO, Simone
Orthogonal decompositions in Hilbert A-modules

Abstract: Pre-Hilbert A-modules are a natural generalization of inner product spaces in which the scalars are allowed to be from an arbitrary algebra. In this perspective, submodules are the generalization of vector subspaces. The notion of orthogonality generalizes in an obvious way too. In this paper, we provide necessary and sufficient topological conditions for a submodule to be orthogonally complemented. We present four applications of our results. The most important ones are Doob's and Kunita–Watanabe's decompositions for conditionally square-integrable processes. They are obtained as orthogonal decomposition results carried out in an opportune pre-Hilbert A-module. Second, we show that a version of Stricker's Lemma can be also derived as a corollary of our results. Finally, we provide a version of the Koopman–von-Neumann decomposition theorem for a specific pre-Hilbert module which is useful in Ergodic Theory.

CHASSAGNEUX, Jean-François
Obliquely reflected BSDEs

Abstract: I will present in this talk new existence and uniqueness results for obliquely reflected BSDEs. We relax structural condition on the reflection and the domain that where needed before. I will also comment on some applications to stochastic control problem.
This is a joint work with Adrien Richou (Université de Bordeaux).

CHONG, Carsten
Volatility estimation for stochastic PDEs

Abstract: High-frequency volatility estimation for processes like semimartingales or stationary moving averages are well studied in the literature. By contrast, apart from very particular examples, there is no systematic work on estimating the volatility in tempo-spatial processes such as stochastic PDEs based on high-frequency observations. In this talk, we discuss work in progress about laws of large numbers and central limit theorems for the realized power variations of stochastic PDEs. In particular, we show that the limiting power variations heavily depend on whether the underlying equation is, for example, of parabolic or hyperbolic type.

CLAISSE, Julien
Branching diffusion representation of semi-linear elliptic PDEs and numerical applications

Abstract: We study semi-linear elliptic PDEs with polynomial non-linearity and provide a probabilistic representation of their solution using branching diffusion processes. When the non-linearity involves the unknown function but not its derivatives, we extend previous results in the literature by showing directly that our probabilistic representation provides a solution to the PDE. In the general case, we derive a new representation of the solution by using marked branching diffusion processes and automatic differentiation formulas to account for the non-linear gradient term. As an application, we consider several examples including multi-dimensional semi-linear elliptic PDEs and estimate their solution by using the Monte Carlo method.

COX, Alexander

Robust hedging of options on a leveraged exchange traded fund

Abstract: A leveraged exchange traded fund (LETF) is an exchange traded fund that uses financial derivatives to amplify the price changes of a basket of goods. In this paper, we consider the robust hedging of European options on a LETF, finding model-free bounds on the price of these options. To obtain an upper bound, we establish a new optimal solution to the Skorokhod embedding problem (SEP) using methods introduced in Beiglboeck–Cox–Huesmann. This stopping time can be represented as the hitting time of some region by a Brownian motion, but unlike other solutions of e.g. Root, this region is not unique. Much of this paper is dedicated to characterising the choice of the embedding region that gives the required optimality property. Notably, this appears to be the first solution to the SEP where the solution is not uniquely characterised by its geometric structure, and an additional condition is needed on the stopping region to guarantee that it is the optimiser. An important part of determining the optimal region is identifying the correct form of the dual solution, which has a financial interpretation as a model-independent superhedging strategy.
(Joint with Sam Kinsley).

CUCHIERO, Christa

Rough volatility from an affine point of view

Abstract: We represent Hawkes process and their Volterra long term limits, which have recently been used as rough variance processes, as functionals of infinite dimensional affine Markov processes. The representations lead to several new views on affine Volterra processes considered by Abi-Jaber, Larsson and Pulido. We also discuss possible extensions to rough covariance modeling via Volterra Wishart processes.
The talk is based on joint work with Josef Teichmann.

DOLINSKY, Yan

Market delay and* G*-expectations

Abstract: We study duality and asymptotic of super–replication with market delay. Our main result is the link between scaling limits of delayed markets and the G-expectation of Peng.

FREI, Christoph

Stochastic analysis in games with imperfect monitoring: new questions and new results

Abstract: In games with imperfect monitoring, players do not directly observe each other's actions and see only noisy signals depending on the chosen actions. Interaction happens repeatedly and each player attempts to maximize expected discounted payoffs, which are functions of chosen actions and signal realizations. Such games have been studied in economics for a long time, but only recently, new techniques from stochastic analysis allowed for a continuous-time formulation and novel results. A central question deals with the equilibrium payoff set, which consists of all expected discounted payoffs that are attainable in equilibrium. In this talk, we show how the dynamics of the expected discounted payoffs is characterized as the solution to a stochastic differential equation (SDE), depending on the players' chosen actions. This SDE characterization allows us to study the influence of different types of information flows and the asymptotic behaviour of the equilibrium payoff set when players become arbitrarily patient as discount rates tend to zero. Relating optimal actions and incentives to the boundary of the equilibrium payoff set, the SDE characterization yields a characterization of the curvature of the equilibrium payoff set as the solution to a differential equation. The talk is based on recent and ongoing joint work with Benjamin Bernard (University of California, Los Angeles).

FRITTELLI, Marco

Disentangling price, risk and model risk: V&R measures

Abstract: We propose a method to assess the intrinsic risk carried by a financial position when the agent faces uncertainty about the pricing rule assigning its present value. Our approach is inspired by a new interpretation of the quasiconvex duality in a Knightian setting, where a family of probability measures replaces the single reference probability and is then applied to value financial positions. Diametrically, our construction of Value&Risk measures is based on the selection of a basket of claims to test the reliability of models. We compare a random payoff X with a given class of derivatives written on X, and use these derivatives to test the pricing measures. We further introduce and study a general class of Value&Risk measures $R(p, X, P)$ that describes the additional capital that is required to make X acceptable under a probability P and given the initial price p paid to acquire X.

FUKASAWA, Masaak

Perfect hedging under endogenous permanent market impacts

Abstract: We model a nonlinear price curve quoted in a market as the utility indifference curve of a representative liquidity supplier. As the utility function, we adopt a g-expectation. In contrast to the standard framework of financial engineering, a trader is no more price taker as any trade has a permanent market impact via an effect to the supplier's inventory. The P&L of a trading strategy is written as a nonlinear stochastic integral. Under this market impact model, we introduce a completeness condition under which any derivative can be perfectly replicated by a dynamic trading strategy. In the special case of a Markovian setting the corresponding pricing and hedging can be done by solving a semi-linear PDE.

GOBET, Emmanuel

McKean FBSDE applied to the management of microgrid

Abstract: I will present a stochastic control arising from the optimal management of the electricity consumption of a building equipped with solar panels and battery. The objective is to minimize the risks over the public grid. The cost functions involve the distribution of both the state space variable X and the control u. Derivation of stochastic maximum principle will be performed and under some convexity assumptions, the optimal control will be identified as solution of Forward-Backward SDE with McKean interaction (both on the state X and the control u). The existence and uniqueness are given owing to a fixed argument.
Joint work with M. Grangereau, with the support of Siebel Energy Institute.

GUASONI, Paolo

Market integration and asset prices

Abstract: Agents with equal preferences live in two regions that yield two respective dividend streams, cointegrated with each other, but with uncorrelated fluctuations. We find equilibrium asset prices and total welfare both in isolation, when each region holds its own asset and consumes its dividend, and in integration, when both regions trade both assets and consume both dividends. Integration always increases welfare. Asset prices may increase or decrease, depending on the time of integration, but decrease on average. Correlation in assets returns is negligible before integration, but significantly positive afterwards, partially explaining financialization effects. (Joint work with Kwok-Chuen Wong).

GUO, Gaoyue

Numerical computation of martingale optimal transportation

Abstract: We provide a numerical method for solving the martingale optimal transport problem. The scheme considers the approximation of marginal distributions, through which the primal problem could be approximated by a LP problem with the relaxation of martingale constraint.

HOBSON, David

Robust hedging of American puts

Abstract: Suppose we are given a family of European put prices, and we wish to find the model which is consistent with the European put prices for which the price of an American put is maximised. Using the special structure of the payoff of the American put we find the best model, the best stopping time and the cheapest superhedge. Throughout, the emphasis is on finding the right lines to draw on the right pictures.

JACOD, Jean

Modeling asset prices: small scale versus large scale

Abstract: A typical model for the price of a financial asset, allowing for explicit or numerical computation of option prices, hedging, calibration, etc... describes the price with an horizon of months or years. In contrast, a very active topic now is concerned with models for tick prices or order books. The structure of the price at the microscopic level is very different from the structure of the usual (often continuous) semimartingales used at a macroscopic level. In particular the microscopic prices evolves on the tick grid, usually going up or down by one tick only. Our aim is to see how it is possible to reconcile the two viewpoints, using a scaling limit of tick-level price models. We will see that this question (going back to the thesis of Bachelier, in a sense) raises a number of non trivial questions if we want a reasonably simple microscopic model, together with a macroscopic model exhibiting stochastic volatility or jumps or a drift.
This is a joint work with Yacine At-Sahalia.

KÄLLBLAD, Sigrid

Measure-valued martingales and optimality of Bass-type solutions to the Skorokhod embedding problem

Abstract: We consider (probability-)measure valued processes, which we call MVMs, which have a natural martingale structure. Following previous work of Eldan and Cox–Källblad, these processes are known to have a close connection to the solutions to the Skorokhod Embedding Problem. Here, we consider properties of these processes, and in particular, we are able to show that the MVMs connected to the Bass and Root embeddings have natural measure-valued analogues which also possess natural optimality properties.
Based on joint work with M. Beiglböck, A.M.G. Cox and M. Huesmann.

KALLSEN, Jan

Ornstein–Uhlenbeck equivalents of polynomial processes

Abstract: The talk is devoted to filtering of and statistical inference on partially observed polynomial processes in discrete and continuous time. These problems are known to allow for an explicit solution for the simpler class of linear Gaussian state space models. The key insight underlying the present piece of research is that for any polynomial process one can find an explicit linear Gaussian model sharing its first two moments. This opens the door to deriving optimal linear filters for such processes, which in turn can be applied to parameter estimation.

KARDARAS, Kostas
Projections of stochastic discount factors

Abstract: We analyse the structure of stochastic discount factors (SDFs) projected on smaller filtrations. Via use of a Bayesian filtering approach, we demonstrate the exact mechanism of how updates on the possible class of models under less information result in the strict supermartingale property of projections of SDFs. In a general continuous-path setting, we show that the local martingale part in the multiplicative Doob–Meyer decomposition of projected SDFs are themselves SDFs in the smaller information market. Finally, we demonstrate that these projections are unable to span all possible SDFs in the smaller information market, by means of an interesting example where market completeness is not retained under filtration shrinkage.
(Based on joint work with Johannes Ruf, LSE).

KELLER-RESSEL, Martin
Semi-static and sparse variance-optimal hedging

Abstract: We consider hedging of a contingent claim by a "semi-static" strategy composed of a dynamic position in one asset and a static (buy-and-hold) position in other assets. We give general representations of the optimal strategy and the hedging error under the criterion of variance-optimality and provide tractable formulas using Fourier-integration in case of the Heston model. We also consider the problem of optimally selecting a sparse semi-static hedging strategy, i.e., a strategy which only uses a small subset of available hedging assets. The developed methods are illustrated in an extended numerical example where we compute a sparse semi-static hedge for a variance swap using European options as static hedging assets.
Joint work with Paolo Di Tella and Martin Haubold.

LARSSON, Martin
Affine Volterra processes and models for rough volatility

Abstract: Motivated by recent advances in rough volatility modeling, we introduce affine Volterra processes, defined as solutions of certain stochastic convolution equations with affine coefficients. Classical affine diffusions constitute a special case, but affine Volterra processes are neither semimartingales, nor Markov processes in general. Nonetheless, their Fourier–Laplace functionals admit exponential-affine representations in terms of solutions of associated deterministic integral equations, extending the well-known Riccati equations for classical affine diffusions. Our findings generalize and simplify recent results in the literature on rough volatility.

LOEPER, Grégoire
Reconstruction by optimal transport: applications in cosmology and finance

Abstract: Following the seminal work by Benamou and Brenier on the time continuous formulation of the optimal transport problem, we show how optimal transport techniques can be used in various areas, ranging from "the reconstruction problem" cosmology to a problem of volatility calibration in finance.

MAGGIS, Marco

Looking forward to a forward-looking approach for the theory of rational choices

Abstract: The classical backward approach to utility maximization has recently been argued in a series of paper by Musiela and Zariphopoulou (2006) and a novel forward theory has been proposed: the utility function is stochastic, time dependent and moves forward. In this theory, the forward utility (which replaces the indirect utility of the classic case) is built through the underlying financial market and must satisfy some appropriate martingale conditions. Inspired by this idea, Frittelli and Maggis (2011) studied the conditional version of the classical notion of certainty equivalent. The preliminary object is a stochastic dynamic utility $u(x,t,w)$ - i.e. a stochastic field - representing the evolution of the preferences of the agent. We therefore propose an axiomatic approach which economically motivates the representation of dynamic preferences in terms of a stochastic utility function. Our construction is recursive and based on inter-temporal preference relations, whose representation is related to the original intuition given by Debreu's State Dependent utilities (1960).

MUHLE-KARBE, Johannes

Equilibrium asset pricing with transaction costs

Abstract: We consider a risk-sharing equilibrium where trading is subject to quadratic transaction costs. In this context, equilibrium asset prices can be characterized by coupled systems of quadratic forward-backward SDEs. Some concrete examples can be solved explicitly, allowing to assess the impact of trading costs on volatility.
(Joint work in progress with Martin Herdegen. This is the continuation of our work with Masaaki, where we have now managed to endogenize the volatility as well.)

OBŁÓJ, Jan

The value of information for pricing and hedging

Abstract: We explore the difference of pricing and hedging problems for agents with different information. We propose an abstract setup which encompasses both classical and model-free (robust) settings. The notion of information is naturally linked with sigma-algebras which is make operational by looking at subsets of feasible paths.
This is a joint work with Anna Aksamit.

REN, Zhenjie

Mean field games with branching

Abstract: In the classic study, the mean field game is the limit of the equilibriums of the N-player games. In the N-player game, the number of the players is fixed (as constant N) throughout the game. However, in many popular applications of mean field games, for instance, the dynamic of population and the economic models, the number of the players can differ along the time. In order to catch this important feature, we introduce the branching mechanism into the probabilistic model and obtain a new formulation of mean field games, namely the mean field games with branching. In the talk, we will show that the equilibrium in the new sense can be studied through both PDE methods and probabilistic methods.

ROSENBAUM, Mathieu

Rough volatility, market impact and no-arbitrage

Abstract: It has been recently established that a quasi-universal law of financial markets is that volatility is rough. In this talk, we wish to understand how this stylized fact can be related to the notions of market impact and no-arbitrage. More precisely, we show that rough volatility naturally emerges as a consequence of a no-statistical arbitrage principle.

SÎRBU, Mihai

Sensitivity analysis of the utility maximization problem with respect to model perturbations

Abstract: We study the sensitivity of the expected utility maximization problem in a continuous semi-martingale market with respect to small changes in the market price of risk. Assuming that the preferences of a rational economic agent are modeled with a general utility function, we obtain a second-order expansion of the value function, a first-order approximation of the terminal wealth, and construct trading strategies that match the indirect utility function up to the second order. If a risk-tolerance wealth process exists, using it as a numeraire and under an appropriate change of measure, we reduce the approximation problem to a Kunita–Watanabe decomposition.
Joint work with Oleksii Mostovyi.

TAN, Xiaolu

Super-replication with proportional transaction cost under model uncertainty

Abstract: We consider a discrete time financial market with proportional transaction cost under model uncertainty, and study a super-replication problem. We recover the duality results that are well known in the classical dominated context. Our key argument consists in using a randomization technique together with the minimax theorem to convert the initial problem to a frictionless problem set on an enlarged space. This allows us to appeal to the techniques and results of Bouchard and Nutz (2015) to obtain the duality result.

TANGPI, Ludovic

Computational aspects of robust optimized certainty equivalent

Abstract: Accounting for model uncertainty in risk management leads to infinite dimensional optimization problems which are both analytically and numerically untractable. In this talk we present when this hurdle can be overcome for the so-called optimized certainty equivalent risk measure (OCE) – including the average value-at-risk as a special case. Our main result draws from optimal transport theory.
The talk is based on a join work with D. Bartl and S. Drapeau.

TANKOV, Peter

Pricing and hedging in log-normal stochastic volatility models

Abstract: We study stochastic volatility models where the log-volatility follows a Gaussian Volterra process and derive explicit martingale representations, asymptotic expansions and fast Monte Carlo algorithms for computing option prices and hedge ratios in such models.

TEICHMANN, Josef

Machine learning in mathematical finance

Abstract: We present several areas where machine learning might contribute relevant solutions to Finance and we show several interesting mathematical problems in field: in all cases deep neural networks are applied to solve pricing, hedging, filtering or calibration questions.

XING, Hao

Optimal contracting with unobservable managerial hedging

Abstract: We develop a continuous-time model where a risk-neutral principal contracts with a CARA agent to initiate a project. Protected by the limited liability, the agent can increase the expected return of the project by exerting costly hidden effort. In addition, the agent can trade the market portfolio and a risk-free bond with an unobservable private account. This unobservable managerial hedging behaviour partially offsets the incentive that agent receives. The agents limited liability protection induces the possibility of inefficient liquidation, and generates endogenous risk aversion for the principal. In the optimal contract, the principal uses the absolute performance evaluation and the relative performance evaluation at the same time. In order to share the market risk optimally, the optimal contract does not filter out the market risk completely from the compensation. Our model provides support for empirical analysis on relative performance evaluation contracts.
Joint work with Nengjiu Ju and Yu Huang.

ZHANG, Yuchong

Mean field game analysis of tournaments

Abstract: We discuss a natural game of competition and solve the corresponding mean field games when agents' rewards depend on the rank of their completion times which are modeled as the first passage time of their respective controlled diffusions. We show the existence and uniqueness of Nash equilibrium for a large class of reward schemes, and use the mean field game solution to construct an approximate Nash equilibrium for the corresponding N-player game. When the population is homogeneous, the equilibrium turns out to be fairly explicit, and we discuss its properties and dependence on the reward scheme.
(Ongoing joint work with Erhan Bayraktar and Jakša Cvitanić).