CUHK-HKUST-NUS workshop in Financial Mathematics

January 20th 2023,

Room 222, Lady Shaw Building, The Chinese University of Hong Kong.

- 9:30 – 10:20, Nizar Touzi (CMAP, Ecole Polytechnique, France)
  - Mean field game of mutual holding and systemic risk.
- 10:20 – 11:10, Dylan Possamaï (Department of Mathematics, ETH, Switzerland)
  - Moral hazard for time-inconsistent agents and BSVIEs.
- 11:10 – 11:30, Coffee Break
- 11:30 – 12:20, Chao Zhou (Department of Mathematics, NUS, Singapore)
  - Large ranking games with diffusion control.
- 12:20 – 14:30, Lunch Break.
- 14:30 – 15:20, Cyril Bénézet (LaMME, ENSIIE, France)
  - Weak hedging problems: an optimal transport approach.
- 15:20 – 16:10, Julien Claisse (CEREMADE, PSL-Dauphine, France)
  - Mean-field Optimization regularized by Fisher Information

Organizers: Shuoqing Deng (HKUST), Xiaolu Tan (CUHK), Chao Zhou (NUS).

Abstract of the talks:

- Nizar Touzi. Mean field game of mutual holding and systemic risk.

  Abstract: We provide an explicit solution for the mean field game of mutual holding with defaultable agents modeled by absorption at zero. The optimal dynamics are defined by a Mckean-Vlasov SDE with discontinuous diffusion coefficient and nonsmooth drift coefficient. We also provide an autonomous characterization of the distribution of defaults.

- Dylan Possamaï. Moral hazard for time-inconsistent agents and BSVIEs.

  Abstract: We address the problem of Moral Hazard in continuous time between a Principal and an Agent that has time-inconsistent preferences. Building upon previous results on non-Markovian time-inconsistent control for sophisticated agents, we are able to reduce the problem of the principal to a novel class of control problems, whose structure is intimately linked to the representation of the problem of the Agent via a so-called extended Backward Stochastic Volterra Integral equation. We will present some results on the characterization of the solution to problem for different specifications of preferences for both the Principal and the Agent.

- Chao Zhou. Large ranking games with diffusion control.

  Abstract: We consider a symmetric stochastic differential game where each player can control the diffusion intensity of an individual dynamic state process, and the players whose states at a deterministic finite time horizon are among the best of all states receive a fixed prize. Within the mean field limit version of the game we compute an explicit equilibrium, a threshold strategy that consists in choosing the maximal fluctuation intensity when the state is below a given threshold, and the minimal intensity otherwise. We show that for large n the symmetric n-tuple of the threshold strategy provides an approximate Nash equilibrium of the n-player game. We also derive the rate at which the approximate equilibrium reward and the best response reward converge to each other, as the number of players n tends to infinity. Finally, we compare the approximate equilibrium for large games with the equilibrium of the two-player case. This talk is based on the joint work with Stefan Ankirchner, Nabil Kazi-Tani and Julian Wendt.

- Cyril Bénézet. Weak hedging problems: an optimal transport approach.

  Abstract : In this work, we introduce a general weak hedging problem of European options in complete nonlinear markets, generalising the problems of super-replication, quantile hedging and PnL matching. This new problem allows for an uncountable number of constraints regarding the distribution of the PnL at the terminal time of the claim. In such a nonlinear setting, we show that the problem admits a Monge representation, where the target is not a fixed distribution but rather belongs to a fixed set of distributions. We then introduce the Kantorovitch representation. Under a finite number of constraints in the weak hedging problem, we obtain the equality between the Monge and the Kantorovitch representations. In the case of a linear market, we further introduce and study the dual problem, for which we prove a duality result. This optimal transport approach allows for new numerical methods regarding the computation of weak hedging prices, by solving the dual problem by stochastic gradient descent algorithms. This is a joint work with J.-F. Chassagneux and M. Yang.

- Julien Claisse. Mean-field Optimization regularized by Fisher Information.

  Abstract: Abstract: Recently there is a rising interest in the research of mean-field optimization, in particular because of its role in analyzing the training of neural networks. In this talk, by adding the Fisher Information (in other word, the Schrodinger kinetic energy) as the regularizer, we relate the mean-field optimization problem with a so-called mean field Schrodinger (MFS) dynamics. We develop a free energy method to show that the marginal distributions of the MFS dynamics converge exponentially quickly towards the unique minimizer of the regularized optimization problem. We shall see that the MFS is a gradient flow on the probability measure space with respect to the relative entropy. Finally we propose a Monte Carlo method to sample the marginal distributions of the MFS dynamics. This is a joint work with Giovanni Conforti, Zhenjie Ren and Songbo Wang.