

NUS-CUHK Workshop in Financial Mathematics

13-14 January 2023

S17-0406, NUS

Programme

Friday, 13 January 2023	
14:00 – 14:50	Neng Wang (Columbia University)
14:50 – 15:40	René Aïd (University of Paris Dauphine, PSL)
15:40 – 16:10	Coffee Break
16:10 – 17:00	Dylan Possamaï (ETH - Zurich)
17:00 – 17:50	Julian Sester (NUS)

Saturday, 14 January 2023	
09:00 – 09:50	Xiaolu Tan (The Chinese University of Hong Kong)
09:50 – 10:40	Chenchen Mou (City University of Hong Kong)
10:40 – 11:00	Coffee Break
11:00 – 11:50	Marko Weber (NUS)
11:50 – 12:40	Min-Bin Lin (Humboldt-Universität zu Berlin)
13:00 – 14:00	Lunch

Talks: 13 January 2023

14:00 – 14:50, Neng Wang (Columbia University)

Title: Strategic Investment under Uncertainty with First- and Second-mover Advantages

Abstract: Abstract of Prof Wang Neng We analyze a duopoly real-option entry game where the second mover has a cost advantage over the first mover. The equilibrium solution features five regions. In addition to the option-value-of-waiting and competing-to-enter (first-mover-advantage) regions (Fudenberg and Tirole, 1985; Grenadier, 1996), three new regions appear due to the second-mover advantage: a waiting-to-be-Follower region and two disconnected probabilistic-entry regions. Only when market demand is very high does Follower immediately enter after Leader does. The second-mover advantage causes firms to use state-contingent mixed strategies, significantly delaying their entry timing. Our model generates new predictions, e.g., entry likelihood is non-monotonic in market demand.

14:50 – 15:40, René Aïd (University of Paris Dauphine, PSL)

Title: A Stationary Mean-Field Equilibrium Model of Irreversible Investment

Abstract: We develop a stationary mean-field model of singular control irreversible investment where production capacity is subject to random gaussian fluctuations while prices are affected by macroeconomic shocks following a two-state Markov chain (boom/burst episodes). We prove existence and uniqueness of the mean-field stationary equilibrium and we characterize it through a system of nonlinear equations. We provide several insights on the effects of crisis on the equilibrium, in particular on the firms size distribution and on the equilibrium value. Joint work with Giorgio Ferrari and Matteo Basei.

15:40 – 16:10, Coffee Break

16:10 – 17:00, Dylan Possamaï (ETH - Zurich)

Title: Moral Hazard for Time-inconsistent Agents and BSVEs

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.

17:00 – 17:50, Julian Sester (NUS)

Title: Markov Decision Processes under Model Uncertainty

Abstract: We introduce a general framework for Markov decision problems under model uncertainty in a discrete-time infinite horizon setting. By providing a dynamic programming principle we obtain a local-to-global paradigm, namely solving a local, i.e., a one time-step robust optimization problem leads to an optimizer of the global (i.e. infinite time-steps) robust stochastic optimal control problem, as well as to a corresponding worst-case measure. Moreover, we apply this framework to portfolio optimization involving data of the S&P 500. We present two different types of ambiguity sets; one is fully data-driven given by a Wasserstein-ball around the empirical measure, the second one is described by a parametric set of multivariate normal distributions, where the corresponding uncertainty sets of the parameters are estimated from the data. It turns out that in scenarios where the market is volatile or bearish, the optimal portfolio strategies from the corresponding robust optimization problem outperforms the ones without model uncertainty, showcasing the importance of taking model uncertainty into account. Moreover, we discuss a robust Q-learning algorithm in the case that ambiguity is modeled w.r.t. the Wasserstein distance. The talk is based on joint works with Ariel Neufeld and Mario Sikic.

Talks: 14 January 2023

09:00 – 09:50, Xiaolu Tan (The Chinese University of Hong Kong)

Title: A Mean-field Version of Bank-El Karoui's Representation of Stochastic Processes

Abstract: We study a mean-field version of Bank-El Karoui's representation theorem of stochastic processes. Under different technical conditions, we establish some existence and uniqueness results. As motivation and applications, our mean-field representation results provide a unified approach to study different Mean-Field Games (MFGs) in the setting with common noise and multiple populations, including the MFG of timing, the MFG with singular control, etc.

09:50 – 10:40, Chenchen Mou (City University of Hong Kong)

Title: Linear-Quadratic Mean Field Games of Controls with Non-Monotone Data

Abstract: In this talk, we study a class of linear-quadratic (LQ) mean field games of controls with common noises and their corresponding N-player games. The theory of mean field game of controls considers a class of mean field games where the interaction is via the joint law of both the state and control. By the stochastic maximum principle, we first analyze the limiting behavior of the representative player and obtain his/her optimal control in a feedback form with the given distributional flow of the population and its control. The mean field equilibrium is determined by the Nash certainty equivalence (NCE) system. Thanks to the common noise, we do not require any monotonicity conditions for the solvability of the NCE system. Beyond that, we can solve the N-player game directly by further assuming the non-degeneracy of the idiosyncratic noises. As byproducts, we prove the quantitative convergence results from the N-player game to the mean field game and the propagation of chaos property for the related optimal trajectories. This is based on a joint work with Min Li (SDU), Zhen Wu (SDU) and Chao Zhou (NUS).

10:40 – 11:00, Coffee Break

11:00 – 11:50, Marko Weber (NUS)

Title: General Equilibrium with Unhedgeable Fundamentals and Heterogeneous Agents

Abstract: We solve a general equilibrium model in which aggregate consumption has uninsurable growth shocks, rendering the market dynamically incomplete. Several long-lived agents with heterogeneous risk-aversion and time-preference make consumption and investment decisions, trading risky assets and borrowing from and lending to each other. For small growth fluctuations, we obtain closed-form expressions for stock prices, interest rates, and consumption and trading policies. Agents' stochastic discount factors depend on the history of unhedgeable shocks, agents trade assets dynamically, and the dispersion of agents' preferences impacts both the interest rate and asset prices, hence no representative agent exists.

11:50 – 12:40, Min-Bin Lin (Humboldt-Universität zu Berlin)

Title: Cross-exchange Crypto Risk: A High-frequency Dynamic Network Perspective

Abstract: Cross-exchange trading induces risk spillover in the crypto market, especially for centralized exchanges, which compound crypto volatility and counterparty risk. We propose a Multivariate Heterogeneous AutoRegression for Crypto Market (MHAR-CM) to specifically investigate interconnectedness among 9 different exchanges on Bitcoin in a high-frequency resolution via dynamic partial correlation networks. MHAR-CM accommodates the stylized facts of Bitcoin, such as trading 24/7 and the long-memory effect on returns. The monthly dependence coefficients of MHAR-CM reflect the evolution of Bitcoin returns and the persistent influence of events. We find that the scale of an exchange determines its influence towards the others, and the interconnectedness among these exchanges is stronger during a crisis. We also conclude with some remarks on FTX due to its recent bankruptcy. Furthermore, we demonstrate that a portfolio considering the dynamics of partial correlation networks offers a promising result in terms of risk diversification.

13:00 – 14:00, Lunch