STOCHASTIC GAMES
WITH PARTIAL AND ASYMMETRIC INFORMATION

COLLEGIO CARLO ALBERTO (ONLINE) TORINO, 6TH–7TH JULY 2021

List of Abstracts

Invited talks (alphabetical order)

Speaker: Luciano Campi, University of Milano
Title: Correlated equilibria and mean field games: a simple model
Abstract: In the context of simple finite-state discrete time systems, we introduce a generalization of mean field game solution, called correlated solution, which can be seen as the mean field game analogue of a correlated equilibrium. Our notion of solution is justified in two ways: We prove that correlated solutions arise as limits of exchangeable correlated equilibria in restricted (Markov open-loop) strategies for the underlying N-player games, and we show how to construct approximate N-player correlated equilibria starting from a correlated solution to the mean field game. The new concept of correlated solution will be illustrated through an explicitly solvable example. The talk is based on a joint work with Markus Fischer (Padua University).

Speaker: Doruk Cetemen, Collegio Carlo Alberto
Title: Exit Dilemma: The Role of Private Learning on Firm Survival
Abstract: We study exit decisions of duopolists from a stochastically declining market. Over time, firms privately learn about market conditions from observing the stochastic arrival of customers. Exit decisions are publicly observed, so the model features both observational and private learning. A larger firm is more likely to have customers, and hence has better information about market conditions than a smaller rival. We provide sufficient conditions for either the smaller or the larger firm to be the first to exit from the market in the unique equilibrium. Uniqueness follows from iterated conditional dominance: because of observational learning, exiting may be a firm's dominant action because continuing operation brings too much of a good news to the rival and leads the competitor to further postpone exit. Based on joint work with Chiara Margaria.

Speaker: Bualem Djehiche, KTH Stockholm
Title: Weakly interacting Snell envelopes and related mean-field reflected BSDEs
Abstract: We show a propagation of chaos result for weakly interacting Snell envelopes (through both the unit time instantaneous rate and the barrier) and characterize the limit Snell envelope as the unique solution to a mean-field BSDE

Speaker: Fabien Gensbittel, Toulouse School of Economics
Title: Investment Timing and Technological Breakthroughs
Abstract: We study the optimal investment policy of a firm facing both technological and cash-flow uncertainty. At any point in time, the firm can decide to invest in a standalone technology or to wait for a technological

breakthrough. Breakthroughs occur when market conditions become favorable enough, exceeding a certain threshold value that is ex-ante unknown to the firm. A microfoundation for this assumption is that a breakthrough occurs when the share of the surplus from the new technology accruing to its developer is high enough to cover her privately observed cost. We show that the relevant Markov state variables for the firm's optimal investment policy are the current market conditions and their current historic maximum, and that the firm optimally invests in the stand-alone technology only when market conditions deteriorate enough after reaching a maximum. Empirically, investments in new technologies requiring the active cooperation of developers should thus take place in booms, whereas investments in state-of-the-art technologies should take place in busts. Moreover, the required return for investing in the stand-alone technology is always higher than if this were the only available technology and can take arbitrarily large values following certain histories. Finally, a decrease in development costs, or an increase in the value of the new technology, makes the firm more prone to bear downside risk and to delay investment in the stand-alone technology. The talk is based on a joint work with Jean-Paul Décamps (TSE) and Thomas Mariotti (TSE).

Speaker: Dino Gerardi, Collegio Carlo Alberto
Title: Delegation with endogeneous states
Abstract: We present a model of delegation with moral hazard. A principal selects a set of possible actions that an agent must choose from. Before choosing an action, the agent can exert costly effort that affects the distribution of an uncertain state of the world. The principal wants the agent to exert high levels of effort. The parties' optimal action depends on the state and they may agree or disagree on it. In the benchmark model, the agent's effort affects the expectation of the state but not the variance. We show that the optimal delegation set is convex. Low actions are excluded whenever the optimal mechanism entails positive effort. We extend the analysis to the case in which the agent's effort affects both the expectation and the variance of the state. When the variance is increasing in the effort level, the optimal delegation set contains gaps. The talk is based on a joint work with Lucas Maestri and Ignacio Monzon.

Speaker: Saïd Hamadène, University of Le Mans
Title: ε-Nash Equilibria of a multi-player Nonzero-sum Dynkin Game in Discrete Time
Abstract: In this talk, we discuss the problem of existence of ε-Nash equilibria for the nonzero-sum Dynkin game in discrete time, infinite horizon and several players. The payoffs of the players depend on the coalition which decides to stop the game. Several properties are highlighted. The talk is based on a joint work with Marie-Amélie Morlais.

Speaker: Anna Jaśkiewicz, University of Wroclaw
Title: Markov decision processes with quasi-hyperbolic discounting
Abstract: In this talk I consider Markov decision processes under quasi-hyperbolic discounting. This type of discounting nicely models human behaviour, which is time-inconsistent in the long run. The decision maker has preferences changing in time. Therefore, the standard approach based on the Bellman optimality principle fails. Within a dynamic game-theoretic framework, the existence of randomised stationary Markov perfect equilibria for a large class of Markov decision processes with transitions having a density function is proved. Moreover, under some additional conditions, this equilibrium can be replaced by a deterministic one. The results are illustrated by examples, e.g. portfolio selection models. The talk is based on joint work with A. Nowak.

Speaker: Dharma Kwon, University of Illinois
Title: Competitive Harvesting of Common Property Renewable Resources
Abstract: We examine the tragedy of the commons in the context of the harvesting of common property renewable resources. We formulate the problem as a game of stochastic impulse control problem and present a novel framework to study the effect of simultaneous harvesting. We find that the Markov perfect equilibrium does not exist, and that the equilibrium concept must be extended to account for tit-for-tat strategies.

Speaker: Gechun Liang, University of Warwick
Title: Risk-sensitive Dynkin games with heterogeneous Poisson random intervention times
Abstract: We solve constrained Dynkin games with risk-sensitive criteria, where two players are allowed to stop at two independent Poisson random intervention times, via the theory of backward stochastic differential equations. This generalizes the previous work of [Liang and Sun, Dynkin games with Poisson random intervention times, SIAM Journal on Control and Optimization, 2019] from the risk-neutral criteria and common signal times for both players to the risk-sensitive criteria and two heterogenous signal times. Furthermore, we establishe a connection of such constrained risk-sensitive Dynkin games with a class of stochastic differential games via Krylov's randomized stopping technique.

Speaker: Ignacio Monzón, Collegio Carlo Alberto
Title: The perils of friendly oversight
Abstract: In democratic societies, politicians craft reform proposals which are then subject to the scrutiny of external authorities. Politicians want their proposals approved and can work to improve their quality. Authorities have their own agendas: they may be in favor or against the reforms under

their scrutiny. We study how the authority's agenda affects the likelihood that a reform is approved and its quality. We show that an authority in favor of a reform can be detrimental towards its approval. This happens when it is easy to incentivize the politician's work and the status quo alternative is not too attractive. The talk is based on a joint work with Dino Gerardi and Edoardo Grillo.

Speaker: Catherine Rainer, University of Brest
Title: On the optimal belief processes for continuous time Markov games with asymmetric information
Abstract: We are interested in the following model: A principal privately observes the evolution of a continuous-time Markov chain and sends messages over time to an agent. The current payoff of the agent depends only on his action and on the current state of the process, while the payoff of the principal depends only on the action of the agent. The analogue discrete time model was studied by Renault-Solan-Vieille (2017) (see also Ely (2017)). They focus on the problem in small dimensions and show that there is no simple universally optimal strategy for the principal. The same holds in continuous time. However, it is possible to characterize the optimal payoff of the principal as a solution of a PDE. The novelty here is that the problem can also be formulated as a control problem over a family of partial deterministic Markov processes. This leads to a verification theorem which permits to solve explicitly several examples. The talk is based on a common work with Fabien Gensbittel from TSE Toulouse.

Speaker: Eilon Solan, University of Tel Aviv
Title: Markov games with incomplete information on one side
Abstract: The talk is based on two papers, one with Galit Ashkenazi-Golan and Catherine Rainer, and the other with Galit Ashkenazi-Golan, Penelope Hernandez, and Zvika Neeman.

Markov games are dynamic games where the stage payoff depends on the actions of the players and on the state variable, and the state variable changes according to a Markov chain. In Markov games with incomplete information on one side, Player 1 knows the current state while Player 2 is ignorant of this information, and only observes the actions of Player 1. It is well known that the discounted value exists as soon as the number of states and actions of each player are finite. Cardaliaguet, Rainer, Rosenberg, and Vieille (2015), characterized the limit of the discounted value as the time between stages goes to 0, which corresponds to the value of the game in continuous time.The characterization is by means of a viscosity solution of a certain Hamilton-Jacobi equation. We are interested in the actual calculation of the discounted value and of the optimal strategy of Player 1 in the game in continuous time. In the talk I will discuss an algorithm for calculating these objects when there are two states, and a refined characterization

of these objects in the special case that the instantaneous payoff function is piecewise constant in the belief of Player 2 and has a concave envelope.