

Game Theory Workshop

Politecnico di Milano

Program

May 28, 2015

14.20 Welcome

14.30 **Rosenschein** - *Multiagent Systems, and the Search for Appropriate Foundations*

15.20 **Papadaki** - *Patrolling games*

16.10 Coffee break

16.30 **Gilli** - *Signaling games in Political Economics*

17.20 **Vicini** - *Extreme Selection Unifies Evolutionary Game Dynamics in Finite and Infinite Populations*

May 29, 2015

9.30 **Guerci** - *Learning to bid in sequential Dutch auctions*

10.20 **Fagnelli** - *Integer solutions to bankruptcy problems with non-integer claims*

11.10 Coffee break

11.30 **Emmerling** - *Non-cooperative vs cooperative Solution Concepts to Climate Change*

12.20 **Basilico** - *Adversarial patrolling with spatially uncertain alarm signals*

13.10 **Cesari** - *Generalized Additive Games*

Abstracts

K. Papadaki - *Patrolling Games*

A key operational problem for those charged with the security of vulnerable facilities (such as airports or art galleries) is the scheduling and deployment of patrols. Motivated by the problem of optimizing randomized, and thus unpredictable, patrols, we present a class of patrolling games. The facility to be patrolled can be thought of as a network or graph Q of interconnected nodes (e.g., rooms, terminals), and the Attacker can choose to attack any node of Q within a given time T .

He requires m consecutive periods there, uninterrupted by the Patroller, to commit his nefarious act (and win). The Patroller can follow any path on the graph. Thus, the patrolling game is a win-lose game, where the Value is the probability that the Patroller successfully intercepts an attack, given best play on both sides. We determine analytically either the Value of the game, or bounds on the Value, for various classes of graphs, and we discuss possible extensions and generalizations.

Gilli - *Signaling games in Political Economics*

The purpose of this paper is to present signaling games and to explain their use in political economics. The paper is organized in two parts. The first part explain the main problems in analyzing signaling games and the importance of discussing out of equilibrium beliefs. The second part presents the use of signaling games to study accountability in autocratic polities, focusing on the joint work of two mechanisms that might constrain the power of dictators: the threat of a coup by the selectorate and of a revolution by citizens. The analysis of these models strongly illustrates the importance of out of equilibrium beliefs, while the results help explain a stylized fact, namely that autocracies are far more likely to be either the best or the worst performers in terms of growth and public goods policies.

Dercole, Vicini - *Extreme Selection Unifies Evolutionary Game Dynamics in Finite and Infinite Populations*

We show that when selection is allowed to be extreme---the fittest strategy always reproduces or is mimicked---the controversial unequivalence between the evolutionary game dynamics in finite and infinite populations resolves, with the three generic outcomes---dominance, coexistence, and mutual exclusion---emerging in well-mixed populations of any size. We consider the simplest setting of a 2-players-2-strategies symmetric game and the two most common microscopic definitions of strategy spreading the frequency-dependent Moran process and the pairwise imitation, in the case in which any intensity of selection is allowed. We show that of the seven generic qualitatively different invasion and fixation combinations---fixation being more or less likely to occur and rapid compared to the neutral game---only three are possible for sufficiently strong selection: (1) A to invade and quickly replace B (2) mutual invasion, A to slowly replace B (3) no one to invade and replace. Moreover (and interestingly), in the limit of extreme selection, (2) becomes mutual invasion, no one to replace, a case that is not possible for finite intensity of selection, but that better matches the deterministic case of coexistence. In the limit of extreme selection, we also derive the large population deterministic limit of the two considered stochastic processes.

E. Guerci, A. Kirman, S. Moulet - *Learning to bid in sequential Dutch auctions*

We propose an agent-based computational model to investigate sequential Dutch auctions with particular emphasis on markets for perishable goods and we take as an example wholesale fish markets. Buyers in these markets sell the fish they purchase on a retail market. The paper provides an original model of boundedly rational behavior for wholesale buyers' behavior incorporating learning to improve profits,

conjectures as to the bids that will be made and fictitious learning. We analyze the dynamics of the aggregate price under different market conditions in order to explain the emergence of market price patterns such as the well-known declining price paradox and the empirically observed fact that the very last transactions in the day may be at a higher price. The proposed behavioral model provides alternative explanations for market price dynamics to those that depend on standard hypotheses such as diminishing marginal profits. Furthermore, agents learn the option value of having the possibility of bidding in later rounds. When confronted with random buyers, such as occasional participants or new entrants, they learn to bid in the optimal way without being conscious of the strategies of the other buyers. When faced with other buyers who are also learning their behavior still displays some of the characteristics learned in the simpler case even though the problem is not analytically tractable.

V. Fragnelli, S. Gagliardo, F. Gastaldi - *Integer solutions to bankruptcy problems with non-integer claims*

We consider a bankruptcy problem with the additional constraint that the estate has to be assigned in integer unities; differently from the approaches by other authors, we allow for non-integer claims. This situation poses new questions on the existence and the uniqueness of the solution. First, we propose the “box method” that is strongly oriented towards the Constrained Equal Losses solution; uniqueness may be guaranteed by introducing a ranking on the claimants. Then, we introduce a solution oriented towards the Constrained Equal Awards solution and give three characterizations and a simple method for determining the solution. Some examples complete the paper.

Basilico – *Adversarial patrolling with spatially uncertain alarm signals*

We propose, to the best of our knowledge, the first Security Game where a Defender is supported by a spatially uncertain alarm system which non-deterministically generates signals once a target is under attack. Spatial uncertainty is common when securing large environments, e.g., for wildlife protection. We show that finding the equilibrium for this game is FNP-hard even in the zero-sum case and we provide both an exact algorithm and a heuristic algorithm to deal with it. Without false positives and missed detections, the best patrolling strategy reduces to stay in a place, wait for a signal, and respond to it at best. This strategy is optimal even with non-negligible missed detection rates.

Cesari - *Generalized Additive Games*

A Transferable Utility (TU) game with n players specifies a vector of $2^n - 1$ real numbers, i.e. a number for each non-empty coalition, and this can be difficult to handle for large n . Therefore, several models from the literature focus on interaction situations which are characterized by a compact representation of a TU-game, and such that the worth of each coalition can be easily computed. Sometimes, the worth of each coalition is computed from the values of single players by means of a mechanism describing how the individual abilities interact within groups of players. In this paper we introduce the class of *Generalized Additive Games (GAGs)*, where the worth of a coalition $S \subseteq N$ is evaluated by means of an interaction filter, that is a map M which returns the valuable players involved in the cooperation among players in S . Moreover, by making further hypothesis on M , we investigate the subclass of *basic GAGs*, where the filter M selects, for each coalition S , those players that have *friends* but not *enemies* in S . We also show that well-known classes of TU-games can be represented in terms of such basic GAGs.