# Advances in Decision Making Workshop

PROGRAM

## *Wednesday 3rd of February 2016*

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| 11.00 **Freixas** | *A new approach on citation indices* |
| 11.45 **Fragnelli** | *Remarks on the Integer Talmud Solution for Integer Bankruptcy Problems* |
| 12.30 **De Vito** | *Epistemic foundations of Iterated Admissibility in finite games* |

*13.00 Lunch*

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| 14.15 **Battigalli** | TBA |
| 15.00 **Moretti** | *On social ranking and their properties* |
| 15.45 **Amgoud** | *Evaluation of arguments: Axioms and Semantics* |
| *16.30 Coffee break* | |
| 17.00 **Panebianco** | *Peer Effects and Local Congestion in Networks* |
| 17.30 **Kroupa** | *Intermediate set for coalitional games* |

20.00 *Social dinner*

## *Thursday 4th of February 2016*

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| 9.30 **Facchinei** | *Multi-agent optimization over networks in the Dictionary Learning problem* |
| 10.15 **Villa** | *Convergence of stochastic forward-backward algorithm* |
| *11.00 Coffee break* | |
| 11.30 **Sagratella** | *New solution methods for bilevel problems* |
| 12.00 **De Nittis** | *Multi-resource Defending Strategies for Patrolling Games with Alarm Systems* |

*13.00 Lunch*

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| 14.00 **Ferraioli** | *Logit Dynamics: a model for bounded rationality* |
| 14.45 **Trovò** | *Multi-Armed Bandit for Pricing* |

Title: A new approach on citation indices

*Josep Freixas and William Zwicker*

Abstract: A number of citation indices have been proposed for measuring and ranking the research publication records of scholars. Some of the best known indices are designed to reward most highly those records x that strike some balance between impact I and productivity P; a large number of publications with few citations per paper will not score well, nor will a very small number of heavily cited papers. Implicit in a number of the best-known indices, however, is a single optimal trade-off ratio r of productivity to impact. In terms of the P × I graph of x, we can think of r as a fixed scale factor relating the size of a unit on the I axis to one on the P axis. We argue that scholars, or entire disciplines, are assigned higher index values if their publication records have better "fit" with r, and that this effect can scramble the relative ordering of scholars within a discipline, in an undesirable way. We propose a class of scale-free indices, two of which are variants of known indices, the Hirsh and Woeginger indices. While preserving some degree of impact-productivity balance, these indices in effect adjust r on a case-by-case basis, to best fit the publication record of each scholar. We argue that these indices have certain advantages, and discuss axioms intended to capture the ideal of scale-freeness in precise form.

Title: "Remarks on the Integer Talmud Solution for Integer Bankruptcy Problems"

*Vito Fragnelli and Fabio Gastaldi*

Abstract: In Fragnelli et al. (2014 and 2015), we considered a bankruptcy problem with the additional constraint that the estate has to be assigned in integer unities, allowing for non-integer claims; we dealt with the extention to our setting of the constrained equal losses solution and of the constrained equal awards solution. Here, we analyse the possibilities of extending the Talmud solution to the integer situation, starting from the existing approaches for the non-integer case; some of these approaches are compatible with the non-integer claims, but in order to comply with as much as possible of the approaches it is necessary to switch to integer claims.

Title: "On social ranking and their properties"

*Stefano Moretti and Meltem Öztürk*

Abstract: Several real-life complex systems, like human societies or economic networks, are formed by interacting units characterized by patterns of relationships that may generate a group-based social hierarchy. In this paper, we address the problem of how to rank the individuals with respect to their ability to "influence" the relative strength of groups in a society. We also analyse the effect of basic properties in the computation of a social ranking within specific classes of (ordinal) coalitional situations.

Title: "*Evaluation of arguments: Axioms and Semantics*"

*Leila Amgoud*

Abstract: An argument is a reason or justification of a claim. It has an intrinsic strength and may be attacked by other arguments. Hence, the evaluation of its overall strength becomes mandatory, especially for judging the reliability of its claim. Evaluation is done by acceptability semantics.

We present via a set of axioms, the foundations of acceptability semantics. Foundations are important not only for a better understanding of the evaluation process in general, but also for clarifying the basic assumptions underlying semantics, and for comparing different (families of) semantics. Then, we present some semantics that satisfy some of the axioms

Title: “Peer Effects and Local Congestion in Networks”

*Sergio Currarini, Elena Fumagalli and Fabrizio Panebianco*

Abstract: We study linear quadratic games played on a network where social contact generates both peer effects and congestion at the neighborhood level. Our aim is to study how the network topology determines equilibrium behavior by shaping both local complementarities (between neighbors) and indirect substitution effects (between agents at distance-two). Equilibrium behavior differs from a model of peer effects only, both at the individual and at the aggregate levels. First, the adoption of large behavior prevails at the periphery of the network. Second, network density affects aggregate behavior in a non-monotonic way. Third, network segregation has a non-monotonic effect on the polarization of behavior. We relate these patterns to evidence from networks of smokers, industrial districts and ethnically fragmented societies. We then discuss implications for the identification of peer effects.

Title: “Intermediate set for coalitional games”

*Tomáš Kroupa*

Abstract: We will discuss an approach to solutions of TU coalitional games based on non-smooth analysis. Both the core and the Weber set of a coalitional game can be recovered as certain superdifferentials for the Lovász extension of the game. In the joint work with L. Adam we introduced a new solution concept using the limiting superdifferential, the so-called intermediate set. From the game-theoretic point of view, the intermediate set is a non-convex polyhedron containing the Pareto optimal payoff vectors, which depend on some ordered partition of the players and the marginal coalitional contributions. We will compute the intermediate set on the selected classes games, including simple games.

Title: “Multi-agent optimization over networks in the Dictionary Learning problem”

*Francisco Facchinei*

Abstract: We consider the Dictionary Learning problem and analyze it in the fairly common case in which data are distributed across a large number of multi-core computational nodes connected by a communication network with arbitrary topology and time varying links. In this scenario a new distributed optimization method is proposed which is based on a convexification-decomposition technique coupled with a dynamic average consensus procedure. The convergence properties of the proposed method will be discussed and compared to available results in the literature, showing its potential.

Title: “Convergence of stochastic forward-backward algorithm”

*Silvia Villa*

Abstract: I will present convergence results for a novel stochastic forward-backward splitting algorithm for solving monotone inclusions given by the sum of a maximal monotone operator and a single-valued maximal monotone cocoercive operator. This latter framework has a number of interesting special cases, including variational inequalities and convex minimization problems, while stochastic approaches are practically relevant to account for perturbations in the data. The algorithm I will discuss is the natural stochastic extension of the classical deterministic forward-backward method, possibly with inertial terms, and is obtained considering the composition of the resolvent of the maximal monotone operator with a forward step based on a stochastic estimate of the single-valued operator.

Title: “New solution methods for bilevel problems”

*Sagratella*

Abstract: Bilevel programming, including Stackelberg games, is a fruitful modeling framework that is widely used in many fields, ranging from economy and engineering to natural sciences. This problem has a

hierarchical structure involving two decision, upper and lower, levels. In the more general and challenging case in which the lower level program is not assumed to have a unique solution, the definition itself of the bilevel program is ambiguous, so optimistic and pessimistic approaches are usually considered.
In spite of their modeling power, relatively few studies have been devoted to the numerical solution of Optimistic Bilevel Problems (OBP) or of Pessimistic Bilevel Problems (PBP).
We propose a new Generalized Nash Equilibrium Problem (GNEP) that is closely related to the OBP and is inspired by the optimal value approach. When passing from the vertical structure of the OBP to the horizontal format of the GNEP, we exploit the value function idea to mimic the original relationship between the agents. Thus, despite its one-level structure, the latter GNEP incorporates some taste of hierarchy.
By exploiting our GNEP model, we develop a new algorithm to compute stationary points of the OBP. Multi-Leader-Follower models for electricity markets are also considered.
Moreover we propose an new solution method for the more challenging PBP. In particular, by using our GNEP approach, we show that the PBP can be reformulated as a well-known Mathematical Problem with Equilibrium Constraints (MPEC).

Title: “Multi-resource Defending Strategies for Patrolling Games with Alarm Systems”

*Giuseppe De Nittis*

Abstract: Security games employ game theoretical tools to derive resource allocation strategies in security domains. Recent models considered the presence of alarm systems providing additional knowledge about attacks and showed how such knowledge can increase the expected utility of a defending agent controlling a single resource.
We introduce a defending agent entitled to multiple resources and we tackle the novel security game with a resolution approach composed of different contributions. First, we address the problem of providing non--null protection to every potential target with the minimum number of resources. Then we focus on the problem of computing multi-resource allocation strategies with different degrees of coordination among resources. For each considered problem we provide a computational analysis, propose algorithmic methods, and experimentally evaluate them.

Title: “Logit Dynamics: a model for bounded rationality”

*Diodato Ferraioli*

Abstract: The logit choice function is a family of randomized best response functions parametrized by beta, the inverse noise level, which is used to model players with limited rationality and knowledge [D. McFadden - Frontiers in Econometrics, 1974]. We study the behavior of a game when players update their strategies according to the logit choice function. We focus on two extremal case: when at each step only one randomly chosen player is allowed to update and when at each time step players concurrently update. We study properties of these dynamics mainly in the context of local interaction games, a class of games that has been used to model complex social phenomena, including the spread of information and norms in social networks, and physical systems, like the Ising model for spin systems.

Title: “Multi-Armed Bandit for Pricing”

*Francesco Trovò*

Abstract: The design of efficient bandit algorithms for learning prices is a problem of extraordinary importance (specially on Internet), allowing companies to increase dramatically their profits. We exploited the pricing structure to improve the performance of state-of-the-art bandit algorithms. More precisely, the monotonicity of customer demands in the price suggests that the conversion rate is monotonically decreasing with the price. Furthermore, in many scenarios, companies have a-priori information about the order of magnitude of the conversion rate that is usually (at least in online settings) very low. We design techniques exploiting these two standard features that can be applied, in principle, to any bandit algorithm. We applied them to Upper Confidence Bound policies in stationary and nonstationary settings. We also provide theoretical justifications for the use of such algorithms and a regret bound analysis, showing that asymptotic bounds of our algorithms are of the same order of that of the classical bandit algorithms. Finally, we present a thorough experimental evaluation of our algorithms, showing that they significantly outperform original bandit policies in most of the configurations thanks to a better exploitation in the early stages of the learning process and that the improvement increases as the number of arms increases.