



# 16th EUROPEAN MEETING ON GAME THEORY

GRANADA, JUN 30 – JULY 2, 2021

**BOOK OF  
ABSTRACTS**



UNIVERSIDAD  
DE GRANADA



FACULTAD DE  
CIENCIAS ECONÓMICAS  
Y EMPRESARIALES



UNIVERSIDAD  
DE GRANADA

Departamento de Teoría e Historia Económica



# FOREWORD

Dear Colleagues,

We want to welcome you all to the 16th European Meeting on Game Theory (SING16). The conference takes place on June 30 – July 2, 2021 hosted by the Department of Economics of the Universidad de Granada. Considering the development of the COVID-19 pandemic around the globe, we have decided to organize the Meeting as a virtual event. We have made this decision to protect the safety and well-being of participants and the general public. The Meeting will be held virtually via Zoom.

We have received 155 abstract submissions, and 179 researchers will participate in the conference. The scientific program consists of 142 talks and 4 plenary lectures. We would like to thank the authors and the invited speakers for their contributions, and all the participants for taking part in this event.

Ricardo Martínez  
(on behalf of the Organizing Committee)

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# **ABSTRACTS**

(Ordered by title)

**Title.** 1-convex extensions of partially defined cooperative games and their solution concepts

**Authors.** Martin Černý, Jan Bok

**Session.** July 2, 14:00 - 15:30

**Abstract.** Partially defined cooperative games are a generalisation of classical cooperative games in which payoffs for some of the coalitions are not known. The main focus of this talk is the class of 1-convex cooperative games. In the first part of the talk, a compact description of the set of 1-convex extensions of incomplete games with different structures of coalitions with known value. The description employs the extreme games and the extreme rays of the set. We further indicate the difficulty of description in general setting. In the second part of the talk, we investigate generalisations of solution concepts of complete games, namely the tau-value, the Shapley value and the nucleolus. We consider several variants of generalisations and conclude that for incomplete games with minimal information, all of the variants coincide. Thus we define the average value and present several of its axiomatisations as well as propose a method to generalise the axiomatisation of uppermentioned solution concepts to suit the average value. We also state several open questions and suggest several possible directions of future research.

**Title.** A characterization of the core for totally positive games without any consistency axiom

**Authors.** Sylvain Béal

**Session.** June 30, 16:00 - 17:30

**Abstract.** The core is one of the most well-known solution concepts for a cooperative (TU) games and has been extensively axiomatically characterized. So far, all these characterizations invoke a consistency axiom. In this article, we provide a first characterization of the core without any consistency axiom. The price is that we restrict the domain under consideration to totally positive games, i.e. games with non-negative Harsanyi dividends. Many applications of cooperative games give rise to totally positive games. Two important aspects of our characterization are that (i) the core is an additive solution concept on the class of totally positive games and (ii) we rely on a new fairness axiom: if two players are equal and if an allocation in the solution set assigns a greater payoff to one of them, then any allocation obtained by a transfer of at most this payoff difference from the richer to the poorer equal player should belong to the solution set as well.

**Title.** A claims problem approach to the cost allocation of a minimum cost spanning tree

**Authors.** José-Manuel Giménez-Gómez, Josep E. Peris, Begoña Subiza

**Session.** June 30, 9:00 - 10:30

**Abstract.** We propose to allocate the cost of a minimum cost spanning tree by defining a claims problem and using claims rules, then providing easy and intuitive ways to distribute this cost. Depending on the starting point that we consider, we define two models. On the one hand, the benefit-sharing model considers individuals' costs to the source as the starting point, and then the benefit of building the efficient tree is shared by the agents. On the other hand, the costs-sharing model starts from the individuals' minimum connection costs (the cheapest connection they can use), and the additional cost, if any, is then allocated. As we prove, both approaches provide the same family of allocations for every minimum cost spanning tree problem. These models can be understood as a central planner who decides the best way to connect the agents (the efficient tree) and also establishes the amount each agent has to pay. In so doing, the central planner takes into account the maximum and minimum amount they should pay, and some equity criteria given by a particular (claims) rule. We analyze some properties of this family of cost allocations, specially focusing in coalitional stability (core selection), a central concern in the literature on cost allocation.

**Title.** A core-partition solution for coalitional rankings

**Authors.** philippe solal, sylvain Béal, sylvain Ferrières

**Session.** July 2, 14:00 - 15:30

**Abstract.** We consider a set of agents that can cooperate by forming coalitions. The set of all (non-empty) coalitions are ranked using a weak order. This ranking forms a coalitional ranking and the pair formed by the set of agents and a coalition ranking is called a coalitional ranking problem. A social ranking is a weak order over the set of agents. A social ranking solution for a class of coalition ranking problems is a correspondence that associates a set of social rankings to each coalitional ranking in this class. In the first part of this paper, we introduce a new social ranking solution for coalitional ranking problems. To do so, given a coalitional ranking, we define a core partition as a partition of the set of agents such that no coalition can block this partition. A coalition blocks an element of the partition if, for each agent of this coalition, the element of the partition to which this agent belongs is ranked lower than this coalition according to the coalitional ranking. Each core partition induces a core-partition social ranking in the following sense: an agent is ranked higher than another agent if the element of the partition to which it belongs is ranked higher than the element of the partition to which the other agent belongs. We consider the social ranking solution which assigns to each coalitional ranking problem the set of its core-partition social rankings. In a second part of the paper, we provide an axiomatic characterization of this solution using four axioms. The first axiom is a non-emptiness principle which states that the set of social rankings is non-empty for each coalitional ranking problem. The second axiom relies on an invariance principle of the solution to some modifications of the coalitional ranking. If two coalitions have the same ranking and the coalition formed by the union of these two coalitions is ranked lower than these two coalitions, then the ranking of this new coalition can be improved up to a certain point without changing the solution. The third axiom states that when the maximal elements of the coalition ranking have a specific structure, it is possible to decompose the solution into a collection of solutions of associated problems. Each associated problem is obtained from the original one by putting a certain maximal coalition as the unique maximal coalition of the social ranking, *ceteris paribus*. The last axiom is a relational axiom. It indicates how the solution evolves when a new group of agents is placed on the top of a coalitional ranking, *ceteris paribus*. In this case, the social rankings of the solution are obtained from the social rankings of the solution without this group of agents, by adding these new agents ahead of all other agents. It turns out that these four axioms characterize the solution which assigns to each coalitional ranking problem the set of its core-partition social rankings.

**Title.** A description of the Shapley value using a binary procedure

**Authors.** Iván Téllez

**Session.** July 2, 14:00 - 15:30

**Abstract.** We introduce a binary recursive procedure to obtain the Shapley value. This procedure extends the standard solution to solve 2-player cooperative games using adjusted games and the binary total partitions of the set of players. We show that the resulting extension satisfies a recursive formula and we prove that this formula is satisfied by a solution concept if and only if the solution concept is the Shapley value.

**Title.** A Framework to Implement Cooperative Solutions

**Authors.** Héctor Hermida Rivera

**Session.** June 30, 9:00 - 10:30

**Abstract.** This paper explores the relation between the Nash program and implementation theory. Using an approach that very naturally associates an implementation problem with the set of all transferable utility games, we show that the Core is the only major cooperative solution concept that is Nash implementable (Propositions 1 to 4). Keeping this approach, we then show that all cooperative solution concepts are

virtually implementable in Nash equilibrium strategies (Propositions 5& 6). Moreover, we also show that if there are at least three agents, any cooperative solution concept is undominated Nash implementable (Propositions 3, 7&8) and subgame perfect implementable (Propositions 3& 10). Further, we prove that the Core is undominated Nash and subgame perfect implementable even if there are just two agents (Propositions 9& 11). We finally show that no major cooperative solution concept is Bayesian Nash implementable (Proposition 12).

**Title.** A game-theoretic approach to line formation during bank runs

**Authors.** Alfonso Rosa Garcia, Ismael Rodriguez Lara, Hubert Kiss

**Session.** June 30, 14:00 - 15:30

**Abstract.** We model how lines form during bank runs with a two stage game. In the first stage, depositors decide how much resources they invest in arriving to the bank as soon as possible and in the second stage they decide in a bank run game. We identify the conditions under which bank runs are not an equilibrium of the game if the line formation is introduced: bank runs may occur only if agents have limited resources available to run to the bank and depositor decision is privately communicated to the bank. If a bank run exist in equilibrium, either patient depositors arrive before impatient depositors or bot types arrive at the same time.

**Title.** A general constructive method for subgame perfect Nash equilibria in Stackelberg games

**Authors.** Francesco Caruso, Maria Carmela Ceparano, Jacqueline Morgan

**Session.** June 30, 14:00 - 15:30

**Abstract.** In one-leader one-follower Stackelberg games, multiple Subgame Perfect Nash Equilibria (henceforth SPNE) could arise when the optimal reaction of the follower to any choice of the leader is not always unique, that is when the best reply correspondence of the follower is not a single-valued map. In this presentation we introduce a general constructive method in order to select an SPNE that relieves the leader of knowing the follower's optimal reactions and that permits to overcome the difficulties deriving from the possible multiplicity of the follower's optimal reactions. More precisely, we consider a general scheme of perturbation of the Stackelberg game which allows to construct a sequence of perturbed games where the follower's best reply correspondence is single-valued and we determine the conditions which guarantee that the limit of a sequence of SPNEs associated to these perturbed games generates an SPNE of the initial game. The results incorporate those on the selection of SPNEs obtained in Morgan and Patrone 2006 (involving the Tikhonov method) and in Caruso, Ceparano and Morgan 2019 (involving the Proximal method). Moreover, we present their application to a perturbation of the Stackelberg game relying on an altruistic behavior of the players.

**Title.** A mathematical approach to law and deal modelling: legislation and agreements

**Authors.** Asier Estevan, Jon Benito-Ostolaza, María Jesús Campión

**Session.** July 2, 9:00 - 10:30

**Abstract.** The present paper presents a new and original first approach to agreement situations as well as to normative constructions. This is made by giving a mathematical formalization to the set of all possible deals or normative, such that then, the proximity between them is defined by means of a premetric. Thanks to this mathematical structure that tries to capture the problematic of agreements and normative modifications, now some questions related to game theory or law are reduced to mathematical optimization problems.

**Title.** A Probabilistic Model of Party Formation and Party Relevance

**Authors.** Dariusz Stolicki, Daria Boratyn, Wojciech S Iomczyński, Jarosław Flis

**Session.** June 30, 9:00 - 10:30

**Abstract.** On the basis of a formula for calculating seat shares and natural thresholds in multidistrict elections under the Jefferson-D'Hondt system and a probabilistic model of electoral behavior based on Pólya's urn model, we propose and prove a theorem about the relationship between the number of electoral and parliamentary parties. We use that theorem to derive a theoretical model of party formation, under which the probability of a new party forming depends on the probability that it will be relevant (i.e. obtain a positive number of seats) under conservative assumptions about its rank in the post-election ordering of parties. We then use empirical data from multiple elections to estimate party risk thresholds under different variants of the post-election ordering assumptions, and to compare our model against alternatives such as the Chinese restaurant model.

**Title.** A real Shapley value for cooperative games with fuzzy characteristic function

**Authors.** Andrés Jiménez-Losada, Hugo Galindo, José Manuel Gallardo

**Session.** June 30, 9:00 - 10:30

**Abstract.** There are cooperative situations in which the players have only imprecise expectations about the profit that can be obtained by each coalition. In order to model these situations, several families of games have been introduced in the literature. Games with fuzzy characteristic function are among them. The main problem that arises when dealing with one of these games is how to allocate among the players the total profit derived from the cooperation. In this regard it seems reasonable that the vagueness in the payments of the coalitions will cause vagueness in the payoffs of the players. In fact, the values introduced for these games assign a fuzzy payoff to each player in the game. However, in some of these situations it might be necessary to assign a precise payoff to each player. With this purpose, in this paper we use a well known ranking for fuzzy numbers to introduce a real Shapley value for games with fuzzy characteristic function.

**Title.** Advantageous Symmetric Cross-Ownership

**Authors.** Konstantinos Papadopoulos

**Session.** July 1, 9:00 - 10:30

**Abstract.** We model an industry where a subset of firms is interlinked via a mutual and symmetric share exchange agreement. A merger aiming at acquisition of market power can be reproduced by the same firms under a symmetric cross-ownership scheme. Both concentration and market power indices increase due to cross-ownership. Under linear demand, a non-controlling symmetric cross-ownership scheme is always advantageous to each members if at least  $0.59(1+n)$  firms in an  $n$ -firm industry participate. The threshold drops to  $(1+n)/2$  for relatively low levels of cross-ownership. cross-ownership schemes require fewer participants than mergers to be advantageous and can always be more profitable than mergers, unless a merger involves more than 88 per cent of industry firms.

**Title.** Algorithmic aspect of core stability

**Authors.** Dylan Laplace Mermoud, Michel Grabisch, Peter Sudhölter

**Session.** June 30, 16:00 - 17:30

**Abstract.** In 1944, von Neumann and Morgenstern developed the concept of stable sets as a solution for coalitional games. Fifteen years later, Gillies popularized the concept of the core, which is a convex polytope when nonempty. In the next decade, Bondareva and Shapley formulated independently a theorem describing a necessary and sufficient condition for the nonemptiness of the core, using the mathematical

objects of minimal balanced collections. We start our investigations of the core by implementing Peleg's (1965) inductive method for generating the minimal balanced collections as a computer program, and then, an algorithm that checks if a game admits a nonempty core or not. In 2020, Grabisch and Sudhölter formulated a theorem describing a necessary and sufficient condition for a game to admit a stable core, using several mathematical objects and concepts such as nested balancedness, balanced subsets which generalized balanced collections, exact and vital coalitions, etc. In order to reformulate the aforementioned theorem as an algorithm, a set of coalitions has to be found that, among other conditions, determines the core of the game. We study core stability, geometric properties of the core, and, in particular, such core determining sets of coalitions. Furthermore, we describe a procedure for checking whether a subset of a given set is balanced. Finally, we implement the algorithm as a computer program that allows to check if an arbitrary balanced game admits a stable core or not.

**Title.** Allocation Rules for Multi-choice Games with a Permission Tree Structure.

**Authors.** David Lowing

**Session.** June 30, 14:00 - 15:30

**Abstract.** We consider multi-choice cooperative games with a permission tree structure. Multi-choice games are a generalization of cooperative transferable utility games in which each player has several activity levels. In addition, a permission tree structure models a situation in which a player needs permission from another player to cooperate. In this framework, the influence of a permission structure on the possibility of cooperation may have several interpretations depending on the context. In this paper, we investigate several of these interpretations and introduce for each of them a new allocation rule that we axiomatically characterize.

**Title.** An allocation rule for a family of cooperative games on colored networks

**Authors.** José Manuel Gallardo, Andrés Jiménez-Losada, Antonio Carlos Alarcón Carrero

**Session.** June 30, 14:00 - 15:30

**Abstract.** We introduce a class of cooperative games on edge-colored graphs. In these games, each color represents a player, which means that each player has the right to use the set of edges with their corresponding color. Besides, each set of edges generates a profit. We propose a Shapley allocation rule for these games. An axiomatization of this rule is provided.

**Title.** An Axiom-Based Comparison of the Core and other Core Extensions

**Authors.** Anne van den Nouweland, Camelia Bejan, Juan Camilo Gomez

**Session.** June 30, 16:00 - 17:30

**Abstract.** We propose an axiomatic framework that allows a unified analysis of the core and three other related cooperative solution concepts that are applicable even when the core itself is empty. Existing axiomatizations of the core and similar concepts of a cooperative game include the desired form of feasibility (or efficiency) in the generic definition of a solution concept and/or are restricted to the domain of games for which existence is guaranteed. We dispense of both practices, thus opening up the possibility of comparing, via basic axioms, solution concepts that have different feasibility constraints and domains. Our characterization of the core can be adapted to axiomatize extensions of the core concept that generate predictions for games with empty cores. We use this avenue to provide new axiomatizations of the aspiration set, the aspiration core, and the c-core.

**Title.** An Experimental Study of an Approximate DGS Algorithm: Price Increment, Allocative Efficiency, and

Seller's Revenue

**Authors.** Naoki Watanabe, Yoichi Izunaga, Satoshi Takahashi

**Session.** July 1, 14:00 - 15:30

**Abstract.** This paper experimentally evaluates an approximate Demange-Gale-Sotomayor (DGS) algorithm for simultaneous ascending-bid auctions for multiple-item under unitary demand constraint. In this subject experiment, 2 items were auctioned off to 3 bidders, each of whom was allowed to bid on one of those items at each opportunity of bidding. For each bidder, his or her valuation for each item was determined randomly between 1 and 500, independently of the others' valuations, and it was informed privately to him or her. The asking prices were raised in increments of 10, 20, and 50 by the experimenter as an auctioneer. Our main observations were as follows. (1) The rates of allocative efficiency ranged from 95% to 98% of the theoretical value computed by using the VCG mechanism with bidders' true valuations. There was no significant difference in those rates observed between the price increments of 10 and 20, but there was a significant difference between the price increments of 20 and 50. (2) The seller's revenues were 99% to 104% of the theoretical value. There was no significant difference in those revenues observed between the price increments of 10 and 20, but there was a significant difference between the price increments of 20 and 50. (3) The frequency of sincere bidding did not depend on the difference between the valuation and the asking price for each item. Sincere bidding was more frequently observed as the price was raised more nearly up to their valuations. (4) Compared to the number of bids required to determine the item allocation under the supposition that every subject bids sincerely for every opportunity for bidding, the observed maximum number of bids is 13.5 times as many as the required number of bids for the price increments of 10, 7 times for those of 20, and 3 times for those of 50. (5) The approximation formula given by Demange et al. (1986) was satisfied at the rate of 71% for the price increments of 10 and 20, while it was satisfied at the rate of 85% for the price increments of 50. If the increase is 10, the formula was satisfied at 100% for item 1 but was satisfied at 71% for item 2. In the cases of price increments of 20 and 50, it was satisfied at the same rates for both items. It would be possible that the visual position for items on the subject's monitor influenced the subject's bidding behavior in the case of price increment of 10.

**Title.** An Implementation Approach to Rotation Programs

**Authors.** Riccardo Saulle, Ville Korpela, Michele Lombardi

**Session.** July 1, 14:00 - 15:30

**Abstract.** Rotation programs are widely used in societies. Examples are: job rotations, rotation schemes in management of common pool resources and rotation procedures in fair division problems. We study rotation programs via the implementation of Pareto efficient social choice rules under complete information. The notion of the rotation program predicts the outcomes. A rotation program is a myopic stable set whose states are arranged circularly, and agents can effectively move only between two consecutive states. We provide characterizing conditions for the implementation in rotation programs and we prove that, for social choice correspondences, our notion of rotation monotonicity is necessary and sufficient. Finally, we identify two classes of assignment problems that are implementable in rotation program.

**Title.** An Option Games Approach to value urban redevelopment projects achieving by Public-Private Partnership

**Authors.** Antonio Di Bari, Giovanni Villani

**Session.** July 1, 9:00 - 10:30

**Abstract.** This article proposes a reliable methodology to value Public-Private Partnership (PPP) investment in urban building redevelopment. This is the case in which public and private sector decide to transform out-dated building in an infrastructure that could be able to generate cash inflows. The redevelop-

opment process are characterized by sequential stages that require different amount of expected costs related to each stage to implement them. The insight on the basis of these projects is that private firms choose to invest in the future stage only if the performance of investment evolution in the previous stage is successful. Previous studies faced these type of investment using Real Option Approach (ROA). The choice to invest immediately or wait depends also on the fact that new competitor can enter the market. This is the case of strategic interactions captured by Game Theory (GT). In this paper we combine tools of ROA and GT in a merged approach called Option Games (OG) to valuate redevelopment investment projects. Finally, we provide a numerical example to implement the theoretical approach.

**Title.** Analysis of the impact of DMUs on overall efficiency in the event of a merger

**Authors.** Alejandro Saavedra-Nieves, María Gloria Fiestras-Janeiro

**Session.** July 1, 9:00 - 10:30

**Abstract.** This talk addresses several mechanisms of overall ranking Decision Making Units (DMUs) according to its contribution to the efficiency of each merger under Data Envelopment Analysis (DEA) with aggregate units. Innovatively, the organization of agents not merging also influences the joint efficiency. This fact requires the usage of games in partition function form and of specific solutions inspired on the Shapley value for ranking DMUs. Their performance is analysed through the theoretical properties that the new class of games satisfies and the computational problems that arise in exactly ranking a large amount of DMUs. As an alternative, we describe a sampling algorithm that reduces these drawbacks. Finally, we apply these proposals to analyse the influence of the efficiency in the tourism industry of the Spanish autonomous communities.

**Title.** Application Costs as a Screening Instrument in Decentralized Matching

**Authors.** Sergei Balakin

**Session.** July 1, 14:00 - 15:30

**Abstract.** I consider decentralized matching in a two-sided market of institutions (or firms) and agents (workers) with application costs and limited budgets. Agents choose whether they should take the risk of applying to a more higher-ranked institution (with some probability of rejection) or make a safe choice. I show that application costs set by institutions may be treated as a screening instrument in order to attract only strong agents or to avoid the competition. Perhaps surprisingly, the lower-ranked firm does not necessarily charge a lower application cost. Under some values of parameters, we can even observe the case when the cost implemented by the lower-ranked firm may be as high as the entire budget of a worker. Possible applications of this model include school enrollment, transport economics, online sales platforms (like eBay or Craigslist), credit card applications in the US, etc. This work differs from the vast majority of papers in matching theory literature in that I use non-cooperative game theory tools: a matching process is described as a game where all agents have their own strategies. It allows me to use Nash equilibrium in addition to the canonical notion of stability from classic matching theory. On one hand, it significantly complicates the model. On the other hand, we allow for different market frictions (incomplete information, dynamics, application costs, etc.) and, thus, get more nuanced results and better understanding of the matching process itself.

**Title.** Approximations of Absorbing Games and Sunspot Equilibria

**Authors.** Orin Munk, Eilon Solan

**Session.** July 2, 14:00 - 15:30

**Abstract.** One of the main open problems in game theory to date is the existence of a uniform epsilon-equilibrium in multiplayer stochastic games for every epsilon  $\epsilon > 0$ . The difficulty in proving this result stems

from the fact that the undiscounted payoff, which is the limit of both the discounted payoff (as the discount factor goes to 0) and the T-stage payoff (as T goes to infinity), is not continuous over the space of strategy profiles. One way to overcome this difficulty is by approximating the stochastic games with an auxiliary stochastic game, which has a continuous payoff function. Consequently, by a standard fixed point argument, the auxiliary stochastic game admits an equilibrium. Finally, taking a sequence of equilibria of the approximating games, as the approximation becomes better, one may try to construct a uniform epsilon-equilibrium in the original game. In this paper we propose a new method to approximate a multiplayer stochastic game, inspired by Solan and Solan (2019), and we apply this method to prove the existence of a sunspot uniform epsilon-equilibrium in a class of absorbing games. Instead of approximating an absorbing game by a sequence of games that possess equilibria, we define for every  $\omega$  a collection of absorbing games that approximate the original game and possess stationary equilibria, and define a continuous function, depends on  $\omega$ , whose domain is some region  $\Theta$  and whose range is the collection of absorbing games. We consider the set of all stationary equilibria of the games in the range of the function that depends on  $\omega$  as a subset of the product set of  $\Theta$  and the set of stationary strategy profiles, and, using a theorem of Browder (1960) we argue that this set contains a path-connected component whose projection on  $\Theta$  is  $\Theta$ . We then look at the limit of the paths as  $\omega$  goes to an accumulation point of  $\Omega$ , and prove the existence of a sunspot uniform epsilon-equilibrium using properties of the limit path. Since Browder's Theorem was proved when  $\Theta$  is one-dimensional, while in our case  $\Theta$  is multi-dimensional, we extend Browder's Theorem to a multi-dimensional domain, provided the set of fixed points if the function has finitely many connected components. We introduce a new class of absorbing games, which we term L-shaped games, and illustrate the new method by proving that every positive recursive L-shaped game possesses a sunspot uniform epsilon-equilibrium for every  $\epsilon > 0$ . Roughly speaking, an L-shaped game is an absorbing game where the non-absorbing entries have an L shape. Admittedly, the class of L-shaped games is quite restrictive, yet even for this class, the only proof for the existence of a sunspot uniform epsilon-equilibrium the authors are aware of is the one presented here. This application thus highlights the complexity of stochastic games and the need to develop new techniques to study them, as the one developed here. The existence result can be extended to other classes of absorbing games. We believe that our approach will be useful in proving that every absorbing game, and subsequently, every stochastic game, has a sunspot uniform epsilon-equilibrium for every  $\epsilon > 0$ .

**Title.** Assessment of the influence of features on a classification problem: an application to COVID-19 patients

**Authors.** Laura Davila Pena, Ignacio García Jurado, Balbina Casas Méndez

**Session.** July 2, 9:00 - 10:30

**Abstract.** This paper deals with an important subject in classification problems addressed by machine learning techniques: the evaluation of the influence of each of the features on the classification of individuals. Specifically, a measure of that influence is introduced using the Shapley value of cooperative games. In addition, an axiomatic characterisation of the proposed measure is provided based on properties of efficiency and balanced contributions. Furthermore, some experiments have been designed in order to validate the appropriate performance of such measure. Finally, the methodology introduced is applied to a sample of COVID-19 patients to study the influence of certain demographic or risk factors on various events of interest related to the evolution of the disease.

**Title.** Bayesian Nash Equilibrium Existence in (Almost Continuous) Contests

**Authors.** Ori Haimanko

**Session.** June 30, 9:00 - 10:30

**Abstract.** We prove the existence of a behavioral-strategy Bayesian Nash equilibrium in contests where each contestant's probability to win is continuous in efforts outside the zero-effort profile, monotone in his own effort, and greater than  $1/2$  if that contestant is the only one exerting positive effort. General type spaces, and in particular a continuum of information types, are allowed. As a corollary, the existence of a pure-strategy Bayesian Nash equilibrium is established in generalized Tullock contests, where the probability to win is strictly concave in one's own effort for any non-zero effort profile of other players.

**Title.** Belief Inducibility and Informativeness

**Authors.** Toygar Kerman, P. Jean-Jacques Herings, Dominik Karos

**Session.** June 30, 9:00 - 10:30

**Abstract.** We consider a group of receivers who share a common prior on a finite state space and who observe private correlated signals that are contingent on the true state of the world. We show that, while necessary, Bayes plausibility is not sufficient for a distribution over posterior belief vectors to be inducible, and we provide a characterization of inducible distributions. We classify communication strategies as minimal, direct, and language independent, and show that any inducible distribution can be induced by a language independent communication strategy (LICS). We investigate the role of the different classes of communication strategies for the amount of higher order information that is revealed to receivers. We show that the least informative communication strategy which induces a fixed distribution over posterior belief vectors lies in the relative interior of the set of all language independent communication strategies which induce that distribution.

**Title.** Beliefs, learning, and personality in the indefinitely repeated prisoner's dilemma

**Authors.** David Gill, Yaroslav Rosokha

**Session.** July 1, 14:00 - 15:30

**Abstract.** The indefinitely repeated prisoner's dilemma (IRPD) captures the trade-off between the short-term payoff from exploiting economic partners and the long-term gain from building successful relationships. We aim to understand how people form and use beliefs about others in the IRPD. To do so, we elicit beliefs about the supergame strategies chosen by others. We find that heterogeneity in beliefs and changes in beliefs with experience are central to understanding behavior and learning in the IRPD. Beliefs strongly predict cooperation, initial beliefs match behavior quite well, most subjects choose strategies that perform well given their beliefs, and beliefs respond to experience and become more accurate over time. Motivated by belief clustering, we use beliefs to estimate a level- $k$  model of boundedly rational thinking. Finally, we uncover a novel mechanism by which trusting subjects learn to cooperate through their interaction with experience, which helps to explain how trust underpins successful economic exchanges.

**Title.** Characterization of the minimum price Walrasian rule with reserve prices

**Authors.** Yuya Wakabayashi, Shigehiro Serizawa

**Session.** June 30, 9:00 - 10:30

**Abstract.** We consider an object allocation problem with payments. There are indivisible and heterogeneous objects. Each object is initially owned by a seller, and it is sold to an agent or kept by the seller. Each agent receives at most one object and pays money. If an agent receives the null object, it means that he receive no object. An agent's preference over bundles (the pairs of an object and payment) is classical if it satisfies the following properties: • money monotonicity: given an object, less payment makes an agent better off, • object monotonicity: given a payment, an agent prefers any object better than no object, • continuity: the upper and lower contour sets are both closed, • possibility of compensation: given a bundle, any change of object is compensated by a finite change of payment. The seller of each object has a

valuation. His preference is quasi-linear in the sense that his utility is the sum of valuation and payment to him if he keeps the object, and otherwise it is only payment to him. An (object) assignment is a function from the set of agents to the set of objects including the null object such that any two agent receive the same real object. An allocation is a pair of an assignment and agents' payments. The feasible set is the set of allocations. Given a price vector, each agent faces the budget sets, the set of bundles consisting of payments and their associated prices. Given a price vector, an agent demands an object if he prefers the pair of the object and its associated price in the budget set. A pair of object assignment and a price vector is a Walrasian equilibrium (with reserve prices) if i) each agent receive the objects he demands, ii) for each object, its price is not less than the valuation of its seller, and iii) the price of non-assigned object is the valuation of its seller. It is well-known that in this models, there is a minimum price Walrasian equilibrium whose prices are coordinate-wise smallest among the Walrasian equilibria. A set of objects is overdemanded if the number of agents who demand only objects in the set is larger than the number of objects. A set of objects is weakly underdemanded if the number of agents who demand some objects in the set is smaller than or equal to the number of objects. First, we show that "a pair of object assignment and a price vector is the minimum price Walrasian equilibria if and only if there are no overdemanded set and weak underdemanded set." We assume that sellers' valuations are common knowledge. A rule is a function from the class agents' preference profile to the feasible set. There are several desirable properties which a rule should satisfy. The first is "efficiency." A rule is efficient if there is no other allocation which all agents and each seller prefer to the original allocation given by the rule. The second is "strategy-proofness." A rule is strategy-proof if for each agent, revealing their true preference is optimal regardless of the others' preferences. The third is "individual rationality." A rule is individually rational if each agent prefers the allocation generated by the rule to no object and no payment, and each seller prefers the generated allocation to keeping object and no payment. The last is "no-subsidy for losers." A rule satisfies no-subsidy for losers if the payment of an agent who gets no object is positive or zero where negative payments means that he receive some money. The minimum price Walrasian rule is the rule which assigns a minimum price Walrasian equilibrium (with reserve prices) to each agents' preference profile. Next, we show that "a rule is a minimum price Walrasian rule with reserve prices if and only if it satisfies efficiency, strategy-proofness, two-sided individual rationality and no-subsidy for losers." Our result is an extension of the result of Morimoto and Serizawa (2015) since if a reserve price is equal to zero, then the minimum price Walrasian rule with reserve prices coincides with a minimum price Walrasian rule.

**Title.** Cognitive skills, strategic sophistication, and life outcomes

**Authors.** Victoria Prowse, David Gill, Eduardo Fe

**Session.** July 1, 14:00 - 15:30

**Abstract.** We investigate how childhood cognitive skills affect strategic sophistication and adult outcomes. In particular, we emphasize the importance of childhood theory-of-mind as a cognitive skill. We collected experimental data from more than seven hundred children in a variety of strategic interactions. First, we find that theory-of-mind ability and cognitive ability both predict level- $k$  behavior. Second, older children respond to information about the cognitive ability of their opponent, which provides support for the emergence of a sophisticated strategic theory-of-mind. Third, theory-of-mind and age strongly predict whether children respond to intentions in a gift-exchange game, while cognitive ability has no influence, suggesting that different measures of cognitive skill correspond to different cognitive processes in strategic situations that involve understanding intentions. Using the ALSPAC birth-cohort study, we find that childhood theory-of-mind and cognitive ability are both associated with enhanced adult social skills, higher educational participation, better educational attainment, and lower fertility in young adulthood. Finally, we provide evidence that school spending improves theory-of-mind in childhood.

**Title.** Competing Conventions with Costly Acquisition of Information

**Authors.** Roberto Rozzi

**Session.** June 30, 16:00 - 17:30

**Abstract.** We study the evolution of conventions in a "language" game – two groups of agents assign different positive payoffs for coordinating on different actions but zero to miscoordination – under the assumption that agents can pay a cost to learn the type (group) of their opponent. If they pay it, they can play separate actions with different types. We distinguish the analysis in two cases: in the first, the cost is equal to zero and, in the second, it is strictly positive. We look for long-run conventions using stochastic stability analysis. When the cost is zero or sufficiently low, agents always coordinate on their favorite action with their type, but their behavior in mixed interactions depends on their preferences. The favorite action by the type who is more rigid in preferences is the one played by the whole population in equilibrium. When the cost is high enough, two scenarios can happen. When one type is enough more rigid in preferences than the other, every agent plays the action preferred by that type with anyone. When they are both rigid in preferences, a heterogeneous strategy profile that causes miscoordination is the long-run equilibrium: in such a state, the two types play their favorite actions.

**Title.** Conditional rights and implementation

**Authors.** Foivos Savva

**Session.** June 30, 9:00 - 10:30

**Abstract.** We study the issue of decentralization from the implementation perspective. In most cases of institution design, a social planner is forced to operate in a decentralized manner, by designing distinct institutions that deal with different issues or sectors, over which agents may have complementarities in their preferences. By utilizing the notion of a rights structure, we consider a two-sector environment and examine the possibilities that arise in implementation when the social planner can condition the rights structure of one sector to the one of the other. We distinguish two cases, one when a sector constitutes an institutional constraint (constrained conditional implementation), and one where both sectors can be objects of design (conditional implementation). We characterize the social choice rules that are implementable in the first case, while in the second case we provide sufficient conditions for implementation. Our results outline the difficulties of implementation in decentralized environments. As applications of our characterization theorems, we include some possibility results. First we prove the implementability of a weaker version of the stable rule in a constrained matching environment with partners and projects and second, we prove the implementability of the weak Pareto rule in a multi-issue environment with lexicographic preferences.

**Title.** Consolidating Marginalism and Egalitarianism: A New Value for Transferable Utility Games

**Authors.** Surajit Borkotokey, Rajnish Kumar, Sudipta Sarangi, Dhruvajit Choudhury

**Session.** July 2, 9:00 - 10:30

**Abstract.** In cooperative games with transferable utilities, the Shapley value is an extreme case of marginalism while the Equal Division rule is an extreme case of egalitarianism. The Shapley value does not assign anything to the non-productive players and the Equal Division rule does not concern itself to the relative efficiency of the players in generating a resource. However, in real life situations neither of them is a good fit for the fair distribution of resources as the society is neither devoid of solidarity nor it can be indifferent to rewarding the relatively more productive players. Thus a trade-off between these two extreme cases has caught attention from many researchers. In this paper, we obtain a new value for cooperative games with transferable utilities that adopts egalitarianism in smaller coalitions on one hand and on the other hand takes care of the players' marginal productivity in sufficiently large coalitions. Our value is identical with the Shapley value on one extreme and the Equal Division rule on the other extreme. We provide four

characterizations of the value using variants of standard axioms in the literature. We also provide a mechanism that implements our value in sub-game perfect Nash equilibrium.

**Title.** Convexity in Games with Externalities

**Authors.** Mikel Alvarez-Mozos, Jose María Alonso-Meijide, María Gloria Fiestras-Janeiro, Andrés Jiménez-Losada

**Session.** July 2, 14:00 - 15:30

**Abstract.** We introduce new notions of superadditivity and convexity for games with coalitional externalities. We show parallel results to the classic ones for transferable utility games without externalities. In superadditive games the grand coalition is the most efficient organization of agents. The convexity of a game is equivalent to having non decreasing contributions to larger embedded coalitions. We also see that convex games can only have negative externalities.

**Title.** Cooperation, Dependencies, and Flexibility

**Authors.** Gero Henseler

**Session.** June 30, 16:00 - 17:30

**Abstract.** Heterogeneous individuals share interdependent fields of interests and may cooperate on each field gaining spillovers but bearing compromises. In equilibrium, cooperation is possible with interdependent, unilaterally dependent, and independent compromises. Under free exits, (Pareto efficient) equilibria exist always if and only if approvals of entries require linked cooperators' unanimous consent. Individuals are linked if their communities have some members in common.

**Title.** Core Compatible and Strongly Monotone Values on Supply Chain Games

**Authors.** Anna Ráhel Radványi, Miklós Pintér

**Session.** June 30, 9:00 - 10:30

**Abstract.** The supply chain games (GREEN games in Gopalakrishnan et al. (2020)) are considered. We characterize this class of TU-games, we show that the class of supply chain games is the convex cone generated by the dual of the unanimity games. Therefore, every supply chain game is totally alternating, hence it is concave. We also characterize the class of supply chain games in terms of unanimity games. Then we consider core compatible (CC) and strongly monotone (SM) values on the class of supply chain games. We show that the Shapley value is characterized by the properties of equal treatment of equals (ETP), CC and SM on the class of supply chain games. We illustrate the results and the notions by examples. Reference S. Gopalakrishnan, D. Granot, F. Granot, G. Susic, H. Cui (2020): Incentives and Emission Responsibility Allocation in Supply Chains, Management Science, 2020, <https://doi.org/10.1287/mnsc.2020.3724>

**Title.** Cost sharing methods for capacity restricted cooperative purchasing situations

**Authors.** Jop Schouten, Mirjam Groote Schaarsberg, Peter Borm

**Session.** June 30, 14:00 - 15:30

**Abstract.** This paper analyzes capacity restricted cooperative purchasing (CRCP) situations in which a group of cooperating purchasers face two suppliers with limited supply capacity. To minimize the total purchasing costs, we show that it is optimal for the group to order as much as possible at one supplier and the possible remainder at the other. To find suitable cost allocations of the total purchasing costs, a CRCP-situation is modeled as a cost sharing problem. We show that the corresponding cost function is piecewise concave and the intervals of concavity are determined by the restricted capacity of the suppliers. For cost sharing problems with concave cost functions, it is shown that the serial cost sharing

mechanism satisfies two desirable properties, unit cost monotonicity (UCM) and monotonic vulnerability for the absence of the smallest player (MOVASP). However, it is seen that these properties are lost in the setting of piecewise concave cost functions. We introduce a new context specific class of piecewise serial rules, in which the vector of order quantities is divided into separate vectors for the different intervals of concavity, using a bankruptcy rule and subsequently apply the serial rule to each interval. We show that the proportional rule is the only bankruptcy rule for which the corresponding piecewise serial rule satisfies UCM. Moreover, we show that the piecewise serial rule corresponding to the constrained equal losses rule satisfies MOVASP.

**Title.** Decentralization and mutual liability rules

**Authors.** Martijn Ketelaars, Peter Borm, Marieke Quant

**Session.** July 1, 9:00 - 10:30

**Abstract.** This paper builds on the recent work of Groote Schaarsberg et al. (Math Methods Oper Res 87(3):383–409, 2018) on mutual liability problems. In essence, a mutual liability problem comprises a financial network in which agents may have both monetary individual assets and mutual liabilities. Here, mutual liabilities reflect rightful monetary obligations from past bilateral transactions. To settle these liabilities by reallocating the individual assets, mutual liability rules are analyzed that are based on centralized bilateral transfer schemes which use a certain bankruptcy rule as its leading allocation mechanism. In this paper we derive a new characterization of mutual liability rules by taking a decentralized approach instead, which is based on a recursive individual settlement procedure. We show that for bankruptcy rules that satisfy composition, this decentralized procedure always leads to the same allocation as the one prescribed by the corresponding mutual liability rule based on centralized bilateral transfer schemes. Finally, we introduce a new reduction method for mutual liability problems and prove that any bankruptcy-rule-based mutual liability rule is invariant with respect to such a reduction

**Title.** Deceptive Features on Platforms

**Authors.** Robert Somogyi, Johannes Johnen

**Session.** July 1, 9:00 - 10:30

**Abstract.** Products sold on online platforms often include additional fees. Platforms can deliberately shroud these fees from consumers, e.g. by revealing them only late in the purchase process. For example, fees for shipping, services and handling, or upgrades like luggage or hotel services are often only revealed late in the purchase process. We study the incentives of a two-sided platform to disclose (a.k.a. unshroud) additional fees when some buyers naively ignore shrouded fees. We uncover a novel mechanism to explain shrouded product features: the platform shrouds or unshrouds additional fees to manipulate cross-group externalities between buyers and sellers. Exploring this mechanism, we highlight two results suggesting that the increasing relevance of online marketplaces might have led to more shrouding of additional fees. First, we ask when the platform shrouds fees of sellers on the marketplace. Driven by cross-group externalities to appear cheap and attract buyers, the platform has stronger incentives to shroud sellers' fees than sellers themselves. This holds even though the platform earns no commissions from sellers for shrouding their fees. Second, we investigate when the platform shrouds its own additional fees. We find platforms have stronger incentives to shroud their own fees exactly when they facilitate comparison and encourage competition between sellers. We highlight several policy implications: banning commissions or platforms' own brands will not induce a transparent marketplace. Policies that target seller- or platform fees differently affect transparency and total consumer surplus. We also connect our results to common practices like drip pricing, steering, and rebate design.

**Title.** Degree Centrality and Externalities in Networks

**Authors.** Agnieszka Rusinowska, René van den Brink

**Session.** July 1, 14:00 - 15:30

**Abstract.** In this paper, we aim at incorporating externalities into centrality measures. We characterize axiomatically a class of measures based on the degree measure in weighted networks and modified for an externality. We give a foundation of these measures as utility functions over network positions, expressing preferences over positions in networks, and bringing externalities of connections between other positions. Other nodes being more connected can have positive as well as negative externalities. Our class of measures contains two parameters, in particular, an externality parameter. Depending on these parameters, we can recover some specific measures, e.g., the degree measure if the externality parameter is equal to zero. By considering some additional axioms on the preferences, we can specify the range for the parameters in the utility functions. Negative (respectively, positive) values of the externality parameter express negative (respectively, positive) externalities. Negative externalities of other nodes being connected to each other always occur when the sum of the values assigned to all nodes is a constant. This is the case, for instance, for the average degree externality measure which assigns to every node in a network its degree minus the average degree over all nodes, and therefore leads to the sum of the values equal to zero.

**Title.** Demand commitment bargaining and bounded rationality: An experimental analysis

**Authors.** Michela Chessa, Nobuyuki Hanaki, Aymeric Lardon, Takashi Yamada

**Session.** July 2, 14:00 - 15:30

**Abstract.** In this paper we experimentally compare three implementations of Winter demand commitment bargaining mechanism: a one-period implementation, a two-period implementation with low and with high delay costs. Our results show that the three different implementations result in similar outcomes in all our domains of investigation, namely: coalition formation, alignment with the ex ante and the ex post theoretical prediction and axioms satisfaction. Our result suggests that a simpler implementation that is easier for the players to understand is sufficient in providing accurate results, because the cost of additional complexity introduced by a refinement of the mechanism offsets its benefit.

**Title.** Deviation from proportionality and Lorenz-dominance between the average of awards and the standard rules for claims problems

**Authors.** Iago Núñez Luigilde, Miguel Ángel Mirás Calvo, Carmen Quinteiro Sandomingo, Estela Sánchez Rodríguez

**Session.** June 30, 16:00 - 17:30

**Abstract.** The Lorenz-dominance criterion is commonly used to compare rules for claims problems. Thomson, W (2019) presents a comprehensive review of the literature on claims problems. The ranking of the standard rules has been established not only on the domain of claims problems but also on the lower-half and higher-half subdomains (Bosmans, K. and Lauwers L. (2011). In this work, we incorporate the average of awards rule (González Díaz, J. and Sánchez Rodríguez, E.(2007), Mirás Calvo, M.A. et al. (2020)), the mean value of the set of awards vectors for a claims problem, in the ranking by establishing some properties that are satisfied by this rule. The key requirements are progressivity and regressivity, properties studied in Ju, B. G. and Moreno Ternerero, J.D. (2008) in the context of taxation. We prove that the average of awards rule is regressive on the lower-half domain and progressive on the higher-half domain, which allows us to compare it with the adjusted proportional rule using the Lorenz-based characterization of this rule given in Mirás Calvo, M.A. et al. (2021). Finally, we define a coefficient, inspired by the Gini index, aimed at measuring, for any given claims problem, the discrepancy between the awards assigned by a rule and the proportional division. We show how this proportionality deviation index reflects the Lorenz-dominance relationship.

**Title.** Distributing the European Union Greenhouse Gas emission 2030

**Authors.** Foroogh Salekpay

**Session.** July 2, 14:00 - 15:30

**Abstract.** Due to the challenge of global warming, the European Union (EU) signs the Paris agreement (2015) to diminish the total Greenhouse Gas (GHG) emission. Nonetheless, the European Environmental Agency report (EEA, 2019) shows that EU cannot achieve its 2030 target since in the long-term the GHG emission of member states exceed the target emission budget. We propose to distribute the EU 2030 target emission budget among its member states to keep them in the path leading to this year. In doing so, we apply the claims problems approach (O'Neill, 1982) which is a method to divide a scarce resource among claimants with larger cumulative claims. We limit our study to the period of 2021 to 2030 to investigate the different ways we can allocate the total emission budget of these 10 years among member states and achieve the target of 40

**Title.** Effect of close elections on the likelihood of voting paradoxes: Further results in three-candidates elections

**Authors.** Abdelmonaim Tlidi, Mostapha Diss, Eric Kamwa

**Session.** June 30, 16:00 - 17:30

**Abstract.** Recently, the impact of election closeness on the likelihood of monotonicity paradox has been studied by some authors (Lepeley 2018, Miller 2017). It was shown that the frequency of such a paradox significantly increases as elections become more closely contested. This paper aims to analyze the impact of election closeness on other best-known paradoxes of voting. Based on the Impartial Anonymous Culture (IAC) assumption, our preliminary results show that closeness has also a significant effect on the likelihood of observing the studied voting paradoxes in the class of Scoring Rules and Scoring Elimination Rules.

**Title.** Effectiveness of protection measures in a clustered epidemic model

**Authors.** Vladislav Taynitskiy, Elena Gubar, Denis Fedyanin, Ilya Petrov

**Session.** June 30, 16:00 - 17:30

**Abstract.** Nowadays, epidemic modelling provides an appropriate tool for describing the propagation of biological viruses in human or animal populations, information in social networks and malicious software in computer or ad hoc networks. The current study represents a hierarchical epidemic model that describes the propagation of a pathogen in the clustered human population. Estimation of Novel coronavirus spreading worldwide leads to the idea of the hierarchical structure of the epidemic process. Thus, the propagation process is divided into several clusters. On each cluster, the pathogen propagation process is based on the Susceptible-Exposed-Infected-Recovered (SEIR) model. We formulate the modified model of transmission of the infected individuals between the clusters. The control of pathogen spreading can be seen as an optimal control problem where a tradeoff exists between the cost of active virus propagation and the design of the appropriate quarantine or pharmaceutical measures. Its network defines each cluster in the hierarchical system. We estimate the effectiveness of protection measures within clusters and between clusters of the population. Intralevel control is defined by increasing the proportion of the population in Quarantine and increasing the effectiveness of the treatment of infected agents. In contrast, inter-level control impacts the intensity of migration rate between clusters. Thus, we compare pharmaceutical interventions with several types of non-pharmaceutical ones. By series of numerical experiments, we demonstrate the network structure's influence on the interaction between clusters and inside clusters in a hierarchical epidemic model. The series of numerical experiments are corroborated the obtained results.

**Title.** Efficiency and strategy-proofness in package assignment problems with positive income effects

**Authors.** Hiroki Shinozaki, Tomoya Kazumura, Shigehiro Serizawa

**Session.** June 30, 9:00 - 10:30

**Abstract.** We consider the package assignment problem with money. Each agent can receive several objects, and has a preference on the set of pairs consisting of a package of objects and payments that exhibits positive income effects. First, we consider the case of multiple units of identical objects. In this environment, we show that if there are two units of the object, then the new rule that we call the generalized Vickrey rule with initial bundles satisfies both efficiency and strategy-proofness on the domain with nonincreasing marginal valuations and positive income effects. We further show that if there are three or more units of the object, then no rule satisfies both efficiency and strategy-proofness on the domain with nonincreasing marginal valuations and positive income effects whose degree is within a given positive number  $\epsilon$ . Our negative result can be applied to the gross substitutes domain with positive income effects. Second, we consider the case of multiple units of the distinct objects. Given a positive number  $\epsilon$ , a domain is  $\epsilon$ -rich if it includes preferences that exhibit constant marginal valuations and positive income effects whose degree is within  $\epsilon$ . We show that for each positive  $\epsilon$ , no rule on an  $\epsilon$ -rich domain satisfies efficiency and strategy-proofness. Our result in this environment can be applied to a number of important non-quasi-linear domains: the domain with nondecreasing marginal valuations with positive income effects, that with nonincreasing marginal valuations and positive income effects, the net substitutes domain with positive income effects, the net substitutes and complements domain with positive income effect, etc. All of these impossibility theorems are new.

**Title.** Efficient and fair solutions in cooperative games

**Authors.** Takumi Kongo

**Session.** character(0)

**Abstract.** We characterize a set of solutions for cooperative games with transferable utilities by one efficiency and two fairness axioms: (Pareto) efficiency and two weaker variations of the balanced contributions property. We weaken the balanced contributions property to apply it only to (i) pairs of symmetric players or (ii) games with three or more players as a result. Our result corresponds to a generalization of the characterization of the Shapley value (one-point solution) by efficiency and the balanced contributions property. We weaken the latter axiom of fairness and characterize the set of solutions including the Shapley value. Our characterized set of solutions is an affine combination of two one-point solutions. One is the Shapley value. The other is defined to satisfy the balanced contributions property for games with three or more players, based on the equal division value for games with two players.

**Title.** Efficient computation of power indices

**Authors.** Jochen Staudacher, László Á. Kóczy, Izabella Stach, Jan Filipp, Marcus Kramer, Till Noffke, Linus Olsson, Jonas Pichler, Tobias Singer

**Session.** July 2, 9:00 - 10:30

**Abstract.** Power indices are algorithms that can be used in order to analyse voting in committees or influence in networks. Currently, the applicability of these algorithms for analysing large problems is limited as available implementations are constrained due to storage requirements. In this presentation we will show how to overcome these limitations using the technique of dynamic programming (see e.g. [4] and [5]) providing truly efficient implementations for various different power indices for weighted voting games. We will be discussing algorithms and present new dynamic programming algorithms for computing lesser-used power indices for weighted voting games. We will present and discuss efficient C++ software for computing power indices via dynamic programming. In particular, we will discuss how to deal with the problem of handling very large integers in our software and present computation times for large examples.

**Title.** Efficient Effort Equilibrium in Cooperation with Pairwise Cost Reduction

**Authors.** Ana Meca, Jose A. García-Martínez, Antonio J. Mayor-Serra

**Session.** July 1, 14:00 - 15:30

**Abstract.** There is multiple situations in which bilateral interaction of agents results in considerable cost reductions. This pairwise cooperation often requires that the agents involved make a certain level of effort to achieve it. It is natural to think that the amount of cost that one agent could reduce to other agent could depend on the effort that this agent exerts. In the first stage, agents decide how much effort they are to exert, which have a direct impact on their pairwise cost reductions. This stage is modelled as a non-cooperative game, in which agents determine the level of pairwise effort to reduce the cost of their partners. In the second stage, agents participate in a bilateral interaction of independent partners. We study this bilateral cooperation as a cooperative game among agents, in which, as a result of cooperation, agents reduce their cost respectively, so that the total reduction of the cost of each agent in a coalition is the sum of the reductions generated by the rest of the members of that coalition. Based on this model, we explore the costs associated with setting up a pairwise effort network. We identify a family of cost allocations with weighted pairwise reduction, which are always feasible in the cooperative game and contains the Shapley value. We show that there always exist cost allocations with weighted pairwise reduction that generate an optimal level of efficient effort and provide a procedure to find the efficient effort equilibrium.

**Title.** Envy-induced collective strategy condensation

**Authors.** Claudius Gros, Carolin Roskothén

**Session.** June 30, 16:00 - 17:30

**Abstract.** People care how they are performing relatively to others. This trait, the desire to compare one's own success with that of others, is an expression of envy. We consider competitive societies of agents in which payoff functions contain envy as a psychological component in addition to standard monetary utilities. Agents with higher payoffs have incentives to consolidate their positions and hence also their respective strategies. Envy induces agents receiving low rewards on the other hand to search for alternatives, which generates mixed strategies. Increased value of envy raises the number of agents playing mixed strategies, which cover ever larger fractions of the available option space. A strategy condensation transition takes place when players run of option space. All mixed strategies collapse at this point into a single encompassing strategy for the lower class. Beyond this point the society is class stratified, with a finite income gap between the lower class (playing all the identical mixed strategy) and the upper class (playing distinct pure strategies).

**Title.** Epidemics with Behavior

**Authors.** Satoshi Fukuda, Nenad Kos, Christoph Wolf

**Session.** June 30, 14:00 - 15:30

**Abstract.** We study equilibrium distancing during epidemics. Distancing reduces the individual's probability of getting infected but comes at a cost. It creates a single-peaked epidemic, flattens the curve and decreases the size of the epidemic. We examine more closely the effects of distancing on the outset, the peak and the final size of the epidemic. First, we define a behavioral basic reproduction number and show that it is concave in the transmission rate. The infection, therefore, spreads only if the transmission rate is in the intermediate region. Second, the peak of the epidemic is non-monotonic in the transmission rate. A reduction in the transmission rate can lead to an increase of the peak. On the other hand, a decrease in the cost of distancing always flattens the curve. Third, both an increase in the infection rate as well as an increase in the cost of distancing increase the size of the epidemic. Our results have important implications on the modeling of interventions. Imposing restrictions on the infection rate has qualitatively different effects on the trajectory of the epidemics than imposing assumptions on the cost of distancing.

The interventions that affect interactions rather than the transmission rate should, therefore, be modeled as changes in the cost of distancing.

**Title.** Essential coalitions for non-balanced games

**Authors.** Zsófia Dornai, Miklós Pintér

**Session.** July 1, 9:00 - 10:30

**Abstract.** Huberman (1980) introduces the notion of essential coalitions. In balanced games essential coalitions have the property of being only needed in the computation of the nucleolus of the game. In our paper we provide two generalizations of Huberman's result. Both generalizations give classes of coalitions which are only needed for computing the prenucleolus of an arbitrary TU-game. We also demonstrate that both generalizations are real generalizations of the class of essential coalitions by Huberman (1980), and that the two introduced classes of coalitions are not related to each other.

**Title.** Evaluation of decision power in Multi-dimensional rules

**Authors.** Sebastien Courtin

**Session.** July 2, 9:00 - 10:30

**Abstract.** This work deals with the evaluation of decision power in Multi-dimensional rules. Courtin and Laruelle [2020] introduced a decision process that specifies the collective acceptance or rejection of a proposal with several dimensions. The decision process is modeled as follows: (i) There are several individuals. (ii) There are several dimensions. (iii) Each of the individuals expresses a binary choice ("Yes" or "No") on each dimension. (iv) A decision process maps each choice to a final binary decision ("Yes" or "No"). We extend and characterize five well-known power indices within this context: the Shapley-Shubik index (Shapley and Shubik [1954]), the Banzhaf (Banzhaf [1965]) index, the Public good index (Holler [1982]), the Null individual free index (Alonso-Meijide et al. [2011]) and the Shift index (Alonso-Meijide and Freixas [2010]).

**Title.** Every Country for Itself, and the Central Bank for Us All?

**Authors.** Reinhard Neck, Dmitri Blueschke

**Session.** June 30, 14:00 - 15:30

**Abstract.** In this paper we use a small stylized nonlinear three-country macroeconomic model of a monetary union to analyse the interactions between fiscal (governments) and monetary (common central bank) policy makers. The three fiscal players are divided into a financially stable core and a less stable periphery. The periphery itself consists of two players with different perceptions of the trade-off between fiscal stability and output growth. Using the OPTGAME algorithm we calculate solutions for two game strategies: one cooperative (Pareto optimal) and one noncooperative game type (the Nash game for the feedback information pattern). Introducing a negative demand shock we analyze the performance of different coalition options between the players. A higher level of cooperation leads in general to a better overall outcome of the game, however with highly varying burdens to be borne by the players.

**Title.** Every Normal-Form Game Has a Pareto-Optimal Nonmyopic Equilibrium

**Authors.** Steven Brams, Mehmet Ismail

**Session.** July 2, 9:00 - 10:30

**Abstract.** It is well-known that Nash equilibria may not be Pareto-optimal; worse, a unique Nash equilibrium may be Pareto-dominated, as in Prisoners' Dilemma. By contrast, we prove a previously conjectured result: Every finite normal-form game of complete information and common knowledge has at least one

Pareto-optimal nonmyopic equilibrium (NME) in pure strategies, which we define and illustrate. The outcome it gives, which depends on where play starts, may or may not coincide with that given by a Nash equilibrium. We use some simple examples to illustrate properties of NMEs—for instance, that NME outcomes are usually, though not always, maximin—and seem likely to foster cooperation in many games. Other approaches for analyzing farsighted strategic behavior in games are compared with the NME analysis.

**Title.** Fair and consistent prize allocation in sports competitions

**Authors.** Bas Dietzenbacher, Aleksei Kondratev

**Session.** June 30, 14:00 - 15:30

**Abstract.** Given the final ranking of a competition, how should the total prize endowment be allocated among the competitors? We study consistent prize allocation rules satisfying elementary solidarity and fairness principles. In particular, we axiomatically characterize two families of rules satisfying anonymity, order preservation, and endowment monotonicity, which all fall between the Equal Division rule and the Winner-Takes-All rule. Specific characterizations of rules and subfamilies are directly obtained.

**Title.** Fighting the Corona Pandemic: A Theoretical Assessment of the Non-Pharmaceutical Interventions in Germany

**Authors.** Frank Steffen

**Session.** June 30, 9:00 - 10:30

**Abstract.** The corona pandemic can be conceptualised as a public good dilemma where the absence of the SARS-CoV-2 virus constitutes a public good. In order to achieve this, members of the society must not only restrict their usual behaviour, but also adhere to behaviours that are appropriate to contain the virus. For the vast majority of the members of society, the latter contain behaviours that they would not voluntarily display in the absence of the virus. Accordingly, combating the virus requires deviating from pandemic free behaviour, which incurs costs for each individual. Notwithstanding some interim period, members of society cannot be excluded from the benefits once the virus is contained. At the individual level, therefore, it can be expected that some members of society will have no incentive to voluntarily restrict their pre-pandemic behaviour and to adhere to appropriate behaviour to contain the virus, i.e., they act like free riders. This situation is illustrated using a non-cooperative game theoretic approach. In the light of this problem and to avoid a delay in containing the virus that would impose a negative externality on society, the government may decide to restrict and mandate certain individual behaviours. In principle, individual compliance with these interventions can be achieved through appropriate penalties that would solve the dilemma. In this paper we examine the nature of the non-pharmaceutical interventions in Germany that, like interventions in other countries, have often been criticised for being inadequate and contradicting. Based on the insight that all interventions are inherently incomplete and combining a fuzzy set theoretic approach with possible world semantics, we resolve some of the critique, which has been raised in the public discussion in Germany. Finally, we outline an idea for a general non-pharmaceutical interventions scheme.

**Title.** Filter Bubbles and Online Price Dispersion

**Authors.** András Kálcz-Simon, Barna Bakó

**Session.** July 2, 9:00 - 10:30

**Abstract.** Empirical research on price dispersion in online commerce suggests that earlier hopes about the frictionless markets and the ensuing uniform (marginal cost) pricing were unfounded. Many studies have found that price dispersion has in fact increased in online markets. Our paper tries to explain this result

by borrowing a concept mainly used in social psychology and political science. Filter bubbles are isolated spaces including only like-minded people: naturally, this leads to distorted information. We suggest that this kind of distortion can explain not only the polarization of parties that is one of the main concerns of political scientists, but the same distortion can affect the functioning of the markets, leading to a higher dispersion of prices.

**Title.** Firm Reputations and Consumer Information Sharing

**Authors.** Lina Andersson

**Session.** character(0)

**Abstract.** I propose a simple model of firm reputations (when firm type cannot be directly observed by consumers) with the variation that the consumers decide whether or not to share information about the outcome of their interaction with the firm with the other consumers. In this model, a sequence of short-lived consumers interact over time with a single long-lived firm. In each period the firm chooses to exert high or low effort and the consumer chooses to buy a high- or low-priced product. The long-lived firm privately knows its type which is either normal or a simple commitment type committed to always exerting high effort. Consumers who have bought a good can pay to share their experience with subsequent consumers. They are motivated to do so because of i) reciprocal preferences that assign a weight to rewarding kindness with kindness and meanness with meanness, and ii) moral preferences that assign a weight to acting in accordance with Kant's moral imperative.

**Title.** Formation of coalitions in Regional Parliaments Bureau

**Authors.** Omar de la Cruz

**Session.** July 2, 14:00 - 15:30

**Abstract.** This paper analyzes the coalitions that exist in a parliamentary context for the formation of the representative body of the Table from a point of view of game theory (Nash equilibrium calculation), d'Hondt method and voting (power indices). The data of two parliaments are compared: the Andalusian and the Madrid. Difference between results are compared.

**Title.** Garbling an evaluation to retain an advantage

**Authors.** Jose A. García-Martínez, Ascensión Andina-Díaz

**Session.** June 30, 14:00 - 15:30

**Abstract.** We study the effect of introducing interpersonal comparisons on the decisions made by career concerned experts. We consider competition between two experts who may differ in their initial reputation. We obtain that whereas full transmission of the experts' private information is an equilibrium when experts are homogenous, this is not necessarily the case when they are heterogenous. In this case, we identify an incentive for the stronger expert to discard her private information, aiming at garbling the evaluation of the principal to retain her advantage. In equilibrium, this expert may even completely contradict her signal and the other expert's decision.

**Title.** Global Games on Social Networks

**Authors.** Przemysław Siemaszko

**Session.** July 2, 9:00 - 10:30

**Abstract.** In this paper we propose a model of a global game on a social network of information exchange. The aim is to examine how information structure and the network topology influence the decision of players who can choose to participate in a collective action. We show conditions for uniqueness in a static

network setting, provide comparative statics to analyse the effect of changes in parameters of the model. We find how trust in a player's prior compared to information received from others influences the equilibrium, and show mechanisms for players' willingness to share their personal views. Later on, the model is extended by introducing a network formation game and analyse its equilibria. Finally, we provide a simulation to illustrate the evolution of social networks under various edge formation approaches, and decisions taken by players.

**Title.** Hedonic games and social ranking solutions

**Authors.** Roberto Lucchetti, Stefano Moretti, Tommaso Rea

**Session.** July 2, 14:00 - 15:30

**Abstract.** A social ranking solution, or briefly a social ranking, over a set  $N$  is defined as a map assigning to each coalitional relation (i.e. a ranking over subsets of  $N$ ) another ranking over the single elements in  $N$ . This problem has been studied in the paper [3], where the authors axiomatically characterize a social ranking solution based on the idea that the most influential individuals are those appearing more frequently in the highest positions in the ranking of coalitions. Other social ranking solutions have been proposed and studied in papers [2, 6, 7]. In Hedonic games [5], players of a set  $N$  have preferences over coalitions they can form. The analysis of hedonic games mainly focuses on partitions of the set  $N$  into disjoint coalitions, which are in general referred to as coalition structures. A coalition structure may be stable according to various notions of stability (see, for instance, [1, 4]). In this paper we consider a particular class of hedonic games where the preferences of the agents over coalitions are induced by a social ranking. More precisely, agents compare coalition structures keeping into account both the ranking of coalitions to which they belong (according to the coalitional relation) and their position in the social ranking over those coalitions (here a social ranking over a coalition  $S$  is computed considering the restriction of the coalitional relation to coalition  $S$ ).  
References [1] Aziz, H., Brandt, F., Seedig, H.G. (2013) Computing desirable partitions in additively separable hedonic games. *Artificial Intelligence*, vol. 195, pp. 316-334. [2] Allouche, T., Escoffier, B., Moretti, S., Öztürk, M (2020). Social Ranking Manipulability for the CP-Majority, Banzhaf and Lexicographic Excellence Solutions. In *Twenty-Ninth International Joint Conference on Artificial Intelligence (IJCAI-PRICAI-20)* (pp. 17-23). [3] Bernardi, G., Lucchetti, R., Moretti, S. (2019) Ranking objects from a preference relation over their subsets. *Social Choice and Welfare*, 52(4), 589-606. [4] Çiftçi, B.B., Dimitrov, D.A. (2006) Stable Coalition Structures in Simple Games with Veto Control. *CentER Discussion Paper*, 2006. [5] Dreze, J.H., Greenberg, J. (1980) Hedonic coalitions: Optimality and stability. *Econometrica* (pre-1986), vol. 48, no. 4, p. 987, 1980. [6] Haret, A., Khani, H., Moretti, S., Öztürk, M. (2018) Ceteris paribus majority for social ranking. In *27th International Joint Conference on Artificial Intelligence (IJCAI-ECAI-18)* (pp. 303-309). [7] Khani, H., Moretti, S., Öztürk, M. (2019). An ordinal banzhaf index for social ranking. In *28th International Joint Conference on Artificial Intelligence (IJCAI 2019)* (pp. 378-384).

**Title.** Homophily and Polarization in Endogenous Networks

**Authors.** Patrick Allmis, Luca Paolo Merlino

**Session.** July 1, 14:00 - 15:30

**Abstract.** In many instances, economic agents consume a variety of public goods. To fix ideas, consider the following motivating examples. Individuals demand news on various topics and differ in how much they value news on different topics. Each individual thus demands a different news bundle. Agents can either search for news personally or consume news shared by others, whom they follow on Twitter. Another example is researchers who use various software tools to conduct their work. One can acquire knowledge on how to use software tools personally or consult Stack Exchange to free ride on the experiences of other users. Some disciplines employ certain tools more frequently, so the demands for information on how to use software tools differ by individual. In both examples, individual characteristics determine

how much agents value one public good relative to others and thus the public good bundle they want to consume. Moreover, public goods are local, i.e., accessing public goods requires a connection to the provider. This may represent following someone on Twitter or reading a thread on Stack Exchange. The value of connections depend on the bundle large contributors provide. Free riders can satisfy much of their demand by linking to a large contributor, whose taste is close to their own. Heterogeneity in tastes thus pushes towards homophily. On the other hand, players with strong taste for one good contribute a lot. Free riders access more public good, however, consume a different bundle compared to their autarky demand. Polarization arises. Establishing and maintaining connections, as well as personally providing public good, is costly. How costly connections are relative to contributions determines how homophilous and polarized a society is. The emerging social structure determines welfare in society. We propose a local public good game where heterogeneous players contribute to two public goods. Heterogeneity stems from players' relative tastes for public good. The choice of neighbors is endogenous. However, establishing connections is costly. Besides their own contributions, players access contributions of others, to whom they link. We characterize the Nash equilibrium of the game. Emerging equilibrium networks exhibit either of two structures. First, the equilibrium network is a bipartite graph, where all players who sponsor links receive no links themselves. Each free rider consumes more than her autarky demand of at least one good through spillovers. All others contribute and consume as in isolation. If three or more large contributors emerge, their neighborhoods of free riders do not overlap. We refer to a bipartite equilibrium graph as an independent equilibrium, since each large contributor collects all public good herself. Second, the equilibrium network exhibit a core-periphery structure, with exactly two players in the core and all others in the periphery. In any core-periphery graph, each core player contributes most to exactly one good; the good she values more. The equilibrium is collaborative if both core players free ride and partially collaborative otherwise. In collaboration, core players contribute their isolation demand to one good and consume the other through free riding. Periphery players contribute to at least one good only if they have a stronger taste for one public good than both core players do. Otherwise, they link to both core players and collect no public good themselves. In a partially collaborative equilibrium, one core player sponsors no links and contributes as in isolation, while the other only contributes to the good she values more. Large contributors in (partial) collaboration are more similar to each other compared to independence. If not, large contributors in independence would link to each other and the equilibrium would not be independent. In large societies, all equilibrium networks are characterized by a finite set of large contributors, while all others free ride. This is known as the "Law of the Few" and well documented in several empirical studies (Feick and Price 1987; Zhang, Ackerman and Adamic 2007; Conley and Udry 2010). In (partial) collaboration, exactly two players are in the core and the law of the few holds trivially. Since the type space is bounded, only a finite number of large contributors exist in an independent equilibrium. Otherwise, large contributors would demand similar bundles of public good and link to each other. We derive conditions under which the different equilibria emerge. The empty network is an equilibrium if, and only if, the linking cost exceeds the value of the most profitable connection in society. Otherwise, an independent equilibrium always exists. Collaborative structures emerge at a lower linking cost, since connections yield lower spillovers. However, arbitrarily low linking costs need not imply that a collaborative equilibrium exist. Players with strong taste for one good always collect some public good themselves. For low linking costs, core players find it profitable to free ride on players with a strong taste for one good. This crowds out their own contributions and collaboration breaks down. A similar argument applies to partial collaboration. Our main result uncovers how connection costs influence welfare and polarization and highlights the role of extremism in society. Extremism refers to the share of players with strong taste for one good and welfare is the sum of agents' utilities. Our notion of polarization relates agents' equilibrium consumption to their demand for public good in isolation. When agents consume public good at different ratios compared to isolation, we say consumption is biased towards one good. Polarization then captures the sum of all absolute consumption biases in society. We find a non-monotonic relationship between welfare and the linking cost if extremism in society is low. A similar result applies to polarization. Higher linking costs can

thus simultaneously yield higher welfare and less polarization. This result rests on the observation that a change in the linking cost alters the set of players, who can become large contributors in equilibrium. In particular, the number of large contributors in equilibrium is non-monotonic in the linking cost. If connections are costly, moderate types, i.e., types with no strong taste for either good, cannot receive links, since they never provide enough public good. The number of large contributors thus decreases as linking costs increase, which dampens welfare and polarization. For low linking costs, only players with strong taste for one good can become large contributors, since moderate types would link to each other. Therefore, two large contributors with overlapping neighborhoods of free riders characterize the equilibrium. Moderate large contributors may emerge for high enough, yet not too high, linking costs. In independence, the existence of moderate large contributors dampens polarization, since free riders can satisfy much of their autarky demand through spillovers from a single connection. Utilities of moderate types increase and welfare is higher if extremism in society is low. Moreover, in partial collaboration, core players are more moderate when linking is more costly. Hence, moderate free riders contribute less themselves. Higher linking costs therefore yield higher welfare and dampen polarization when there are many moderate types in society, i.e., when extremism is low.

**Title.** Incentives for Research Effort: An evolutionary model of publication markets with double blind and open review

**Authors.** Mantas Radzvilas, Francesco De Pretis, William Peden, Daniele Tortoli, Barbara Osimani

**Session.** July 1, 9:00 - 10:30

**Abstract.** Contemporary debates about scientific institutions and practice feature many proposed reforms, most of which require more effort on the part of scientists. But how do scientists' incentives for effort interact? How can scientific institutions encourage researcher effort? We explore these questions by a game-theoretic model of publication markets. We use a base game between authors and reviewers, before exploring some of its tendencies using analysis and simulations. We compare how the effort expenditures of these groups interact in our model, under a variety of settings, such as double blind versus open review systems. Our study provides the first formal economic modelling of peer review. We make a number of findings, such as that open review can increase the effort of researchers under a range of circumstances. This is by providing reviewers with reputation bonuses. However, the impact on authors' effort depends on the strength of several other influences.

**Title.** Inconsistent weighting in weighted voting games

**Authors.** Mostapha Diss, sylvain Béal, Marc Deschamps, Issouf Moyouwou

**Session.** June 30, 14:00 - 15:30

**Abstract.** In a weighted voting game, each voter has a given weight and a coalition of voters is successful if the sum of its weights exceeds a given quota. Such voting systems translate the idea that voters are not all equal by assigning them different weights. In such a situation, two voters are symmetric in a game if interchanging the two voters leaves the outcome of the game unchanged. Two voters with the same weight are naturally symmetric in every weighted voting game, but the converse statement is not necessarily true. We call this latter type of scenario inconsistent weighting. We investigate the conditions that give rise to such a phenomenon within the class of weighted voting games. We also study how the choice of the quota and the total weight can affect the probability of observing inconsistent weighting. Finally, we investigate various applications where inconsistent weighting is observed.

**Title.** Incumbent Competition and Pandering

**Authors.** Anne Marie Go

**Session.** June 30, 9:00 - 10:30

**Abstract.** Two politicians choose an action to maximize popularity with only partial information on the popular choice – the choice preferred by the public, and the socially optimal choice – the choice that maximizes public welfare. Although choosing the popular choice increases the popularity of politicians, pandering costs can be incurred when the socially optimal choice is revealed to be different from the popular choice. The paper looks at the types of policies passed for salient issues, issues for which following the popular choice provides higher payoffs, and non-salient issues, issues for which the popular choice does not always provide higher payoffs, given different levels of clarity on public opinion. We find that for salient issues, a divided public is better than a united but ill-informed one. For non-salient issues, policies are always passed when public opinion is clear, while politicians diverge strategically under low policy payoffs when public opinion is unclear. The model provides insights on when pandering can be observed and what policies are formed under a relative popularity framework.

**Title.** Influence in Weighted Committees

**Authors.** Alexander Mayer, Stefan Napel

**Session.** June 30, 14:00 - 15:30

**Abstract.** It is well-known that any reasonable voting rule is vulnerable to individual strategic manipulation when three or more alternatives are available. But voting rules differ substantially in their degrees of manipulability. A number of computational studies have compared aggregate manipulability measures for scenarios that involve symmetric voters. The present paper investigates how decision methods such as pairwise majority voting, plurality voting with or without a runoff, and Borda's rule differ in settings where voters wield asymmetric voting weights. Existing analysis of manipulability is thus extended to "weighted committee games" (Kurz et al. 2020). This also allows to compare voter specific manipulation possibilities and how these are linked to an underlying distribution of voting weights. The main finding of previous analysis that Borda's rule is especially manipulable turns out to be remarkably robust also for asymmetric voters.

**Title.** Innovation decisions for green products: the role of regulatory incentives and acquisitions in a consumer-firm game

**Authors.** Inês Carrilho Nunes, Margarida Catalão-Lopes

**Session.** June 30, 14:00 - 15:30

**Abstract.** Technological innovation arises as an essential element of green growth, especially since meeting long-term environmental targets requires substantial technology adoption. This paper applies game theory to analyze low-carbon innovation decisions by firms together with green consumption choices by consumers for which product "greenness" is a vertical attribute. We test the impacts that government intervention may have on innovation through consumer subsidization and discriminatory policies applied to firms. The effects of obtaining a desirable green innovation via acquisition, instead of R&D, are also examined. Consumer decisions and actions arise as crucial to incentivize green innovation and drive society towards a sustainable path. These questions have significant implications for policymakers and managers, since low-carbon sustainable development, and related challenges, occupy increasing amounts of managerial resources.

**Title.** Learning and Endogenous Technology Cycles in Games with Monitoring

**Authors.** Alae Baha

**Session.** July 1, 9:00 - 10:30

**Abstract.** This paper studies a dynamic monitoring environment in which the ability to detect fraud de-

depends on both the monitor's and the agent's investments. The monitor can acquire this ability through costly investments and loses it whenever the agent adopts novel fraud processes. As these investments are unobservable, the monitor updates her beliefs about the agent's fraud technology through fraud detection. Absent detection, the monitor becomes more pessimistic about his ability and invests in a novel detection technology. The agent reacts to this investment by adopting a novel fraud technology with a strictly positive probability which creates cyclical patterns in these environments. Both the length of these cycles and the amount of fraud during each cycle depend on the fines that fraudsters pay when fraud is detected. Raising fines intensifies the R&D race between the monitor and the agent, leading to higher frequency of investments which can limit the deterrence effect of such a policy. More specifically, when fraud decision is binary, it is shown that the optimal fines never exceed the benefits from fraud.

**Title.** Learning in Games Where Agents Sample

**Authors.** Eduardo Garcia Echeverri

**Session.** July 2, 9:00 - 10:30

**Abstract.** This paper proposes an equilibrium concept –the Sampling Bayesian Equilibrium– for games in which players observe the actions of only a small random sample of other players. I show the existence of these equilibrium points for i) a class of coordination of global games and for ii) general static games in normal form. For the first, I further show the existence of a unique interior Sampling Bayesian Equilibrium, easing comparative statics over the set of equilibria. Using asymptotic Bayesian analysis, in particular Bernstein- von Mises theorem, I show that most equilibrium points in the complete information games (where agents have perfect foresight over the actions of all other players) can be obtained as limits of pure-strategy Sampling Bayesian Equilibria of the perturbed games, as agents learn and sample sizes tend to infinity. These purification results are robust to a wide class of prior distributions over strategy profiles and are consistent with Nash's 'mass-action' interpretation of mixed strategies.

**Title.** Liberal parentalism

**Authors.** Aviad Heifetz, Enrico Minelli, Herakles Polemarchakis

**Session.** July 1, 9:00 - 10:30

**Abstract.** What normative constraints should bind parents (or policy makers) if they intervene in the choices of children (or constituencies) whose preferences evolve over time? For a sophisticated child who anticipates correctly his preference change, we prove that generically there exist parental interventions that are Pareto improving over the backward induction path that the child will follow on his own. If, in contrast, the child misperceives his future preferences, Pareto improving interventions might not exist, and even nudges might be painfully sobering. The parent may then choose to minimize the maximal disappointment along time that her benevolent intervention would cause.

**Title.** Local Public Goods with Weighted Link Formation

**Authors.** Markus Kinader, Luca Paolo Merlino

**Session.** July 2, 9:00 - 10:30

**Abstract.** We introduce weighted links in a local public good game in an endogenous network with heterogeneous players. We find that the equilibrium predictions are sharper than when links are not weighted. In particular, active players form a complete core-periphery graph, where they are either in the core of interconnected players, or connected to every player in the core. Furthermore, a player's type is tightly related to her provision and position in the network.

**Title.** Market choices driven by reference groups. Comparison of analytical and simulation results on random networks

**Authors.** Michał Ramsza

**Session.** July 2, 9:00 - 10:30

**Abstract.** A model of consumer choices driven by reference groups has been studied in a simplified setup in experimental and theoretical designs. An initial qualitative comparison with the model's behavior on Erdos-Renyi random network has been studied before. This paper reports the results of simulations on Erdos-Renyi, Barabasi-Albert, and Watts-Strogatz random networks. These results are used to estimate the model's detailed equilibria and those compared to analytical results based on a simplified model. The main result is that the model's behavior on random networks corroborates the theoretical models' findings.

**Title.** Market exit and minimax regret

**Authors.** Gisèle Umbhauer

**Session.** June 30, 14:00 - 15:30

**Abstract.** We study a war of attrition, an overcrowded duopoly market. The firms get a negative duopoly profit as long as they both stay in the market, but, as soon as one firm decides to exit the market, the other one gets a positive monopoly profit forever. Both firms are identical, information is complete, and the only strategic variable is the exit time. The only symmetric Nash equilibrium of this war of attrition is a full support mixed-strategy equilibrium where each firm gets a null expected payoff, i.e. the payoff obtained by immediately leaving the market. This result is not convincing, neither from an economic viewpoint, nor from a behavioral viewpoint. That is why we focus in this paper on the minimax regret approach, introduced in game theory by Hayashi (2008), Renou and Schlag (2010) and Halpern and Pass (2012). A player's regret when he plays a strategy  $s$  is the difference between the payoff he gets with  $s$  and the payoff he could have obtained by playing his best reply to the other players' strategies. The minimax regret criterion selects the strategy that minimizes the maximal regret it may lead to. This criterion is well adapted to contexts with a strong strategic uncertainty, like the studied game, where all strategies are rationalizable (in that they are best replies to at least one opponent's strategy). Moreover, in this "should I stay or should I go" problem, each firm may suffer from two types of regrets: it is worth staying in the market if the opponent exits the market fast (so a firm may regret leaving the market too early), but it is better to leave the market immediately if the opponent exits the market late (so a firm may regret exiting the market too late). The minimax regret approach adapts well to such contexts with multiple types of regrets, in that it balances the possible regrets. We study the model in discrete time and in continuous time and we compare the strategic content of the differential equations that underly the mixed Nash equilibrium and the mixed minimax regret behavior. We get two main results. The minimax regret behavior probability distribution is strikingly different from the mixed-strategy Nash equilibrium, regardless of the values of the parameters of the game. Moreover, the minimax regret criterion ensures a strictly positive expected profit to both firms, regardless of the values of the parameters, in contrast to the mixed Nash equilibrium, which always leads to a null expected payoff.

**Title.** Matching markets with (in)compatibilities

**Authors.** Sarah Kühn

**Session.** July 1, 14:00 - 15:30

**Abstract.** In classic matching models allocations on one-sided markets are based on agents' personal preferences over certain options. If an agent's preference list is or needs to be based on external (in)compatibilities due to common problems such as market size, external restrictions or clustered preference structures, preferences cannot be developed as usual. Therefore, we consider neighborhood help markets where services or goods are exchanged, and agents have limited information about other market participants. The

tasks agents perform are combined into clusters. Preferences are based on classifying each cluster as acceptable (compatible) or unacceptable (incompatible). Later, we relax this assumption and allow for variations of compatibility which result in cardinal preference schemes. The goal of this research is to model a one-to-one matching market where a centralized mechanism can be applied depending on given (in)compatibilities. Related problems are organ-exchange models as they exhibit similar properties due to their incompatibility structures. Our findings support the suitability of using (in)compatibilities to overcome certain types of imperfect information.

**Title.** Mergeable weighted majority games and Characterizations of power indices

**Authors.** Livino Manuel Armijos-Toro, Jose María Alonso-Meijide, Manuel A. Mosquera-

**Session.** July 2, 14:00 - 15:30

**Abstract.** The class of weighted majority games is a subclass of the simple games class in which each player has an associated weight and there is a quota. Then, a coalition is winning whenever the sum of weights of its members reach the quota. The Colomer-Martínez index is a power index defined exclusively for weighted majority games. In this paper, we propose a first characterization for the Colomer - Martínez index. For this aim, we need to define the merge of weighted majority games and to establish when they can be mergeable. Moreover, we provide a new index for weighted majority games combining the Colomer - Martínez and Holler indexes and we characterize it. Finally, we present an application to the National Assembly of Ecuador.

**Title.** Minimal winning coalitions and orders of criticality

**Authors.** Michele Aleandri, Marco Dall'Aglio, Vito Fragnelli, Stefano Moretti

**Session.** July 2, 14:00 - 15:30

**Abstract.** In this paper, we analyze the order of criticality in simple games, under the light of minimal winning coalitions. The order of criticality of a player in a simple game is based on the minimal number of other players that have to leave so that the player in question becomes pivotal. We show that this definition can be formulated referring to the cardinality of the minimal blocking coalitions or minimal hitting sets for the family of minimal winning coalitions; moreover, the blocking coalitions are related to the winning coalitions of the dual game. Finally, we propose to rank all the players lexicographically accounting the number of coalitions for which they are critical of each order, and we characterize this ranking using four independent axioms.

**Title.** Minimum cost spanning tree problems as value sharing problems

**Authors.** Christian Trudeau

**Session.** June 30, 16:00 - 17:30

**Abstract.** Minimum cost spanning tree (mcst) problems study situations in which agents must connect to a source to obtain a good, with the cost of building an edge being independent of the number of users. We reinterpret mcst problems as value sharing problems, and show that the folk and cycle-complete solutions, two of the most studied cost-sharing solutions for mcst problems, do not share values in a consistent way. More precisely, two mcst problems yielding the same value sharing problem might lead to value being shared in different ways. However, they satisfy a weaker version of the property that applies only to elementary problems, in which the cost on an edge can only be 0 or 1. The folk solution satisfies the version related to the public approach, while the cycle-complete solution satisfies the one related to the private approach, which differ depending if we allow a group to use the nodes of other agents or only their own nodes. We then build axiomatizations built on these properties. While the two solutions are usually seen as competitors in the private approach, the results point towards a different interpretation: the two

solutions are based on different interpretations of the most problem, but are otherwise conceptually very close.

**Title.** Minority Protection in Voting Mechanisms - Experimental Evidence

**Authors.** Alex Possajennikov, Dirk Engelmann, Hans-Peter Grüner, Timo Hoffmann

**Session.** July 2, 14:00 - 15:30

**Abstract.** Under simple majority voting an absolute majority of voters may choose policies that are harmful to minorities. It is the purpose of sub- and super-majority rules to protect legitimate minority interests. We study how voting rules are chosen under the veil of ignorance and whether there are systematic biases in these choices. In our experiment, individuals choose voting rules for given distributions of gains and losses that can arise from a policy, but before learning their own valuation of the policy. We find that subjects on average adjust the voting rule in line with the skewness of the distribution. As a result, a higher share of the achievable surplus can be extracted with the suggested rules than with exogenously given simple majority voting. While the rule choices are not significantly biased towards under- or overprotection of the minority, towards majority voting or towards status-quo preserving rules, they only imperfectly reflect the distributions of benefits and costs. In expectation this leads to only 63% of the surplus being extracted. The participants are heterogeneous with respect to how well their rule choices adapt to the distribution of valuations, with a large share of the surplus loss caused by a small group of participants.

**Title.** Monotonicity in sharing the revenues from broadcasting sports leagues

**Authors.** Gustavo Bergantiños, Juan D Moreno-Ternero

**Session.** June 30, 14:00 - 15:30

**Abstract.** We explore the implications of the principle of monotonicity in the problem of sharing the revenues from broadcasting sports leagues. We formalize different forms of this principle as several axioms for sharing rules. We show that, combined with two other basic axioms (equal treatment of equals and additivity), they provide axiomatic characterizations of focal rules for this problem, as well as families of rules compromising among them.

**Title.** Naivety about hidden information: An experimental investigation

**Authors.** Maria Montero, Jesal Sheth

**Session.** July 1, 14:00 - 15:30

**Abstract.** The unravelling prediction of disclosure theory relies on the idea that strategic forces lead firms (information senders) to voluntarily disclose information about the quality of their products provided the information disclosed is verifiable and the costs of disclosure are negligible. This theoretical prediction requires that consumers (information receivers) hold correct beliefs about non-disclosed information and, in equilibrium, treat all non-disclosed information with extreme scepticism. Previous research finds that receivers are insufficiently sceptical, or in other words are naive, about non-disclosed information, which leads to the failure of unravelling. This paper examines the extent to which naivety responds systematically to features of the decision environment, namely the availability of opportunities to communicate with others (Consultation treatment) and the context of the experimental setting (Context treatment, based on hygiene ratings). We find that complete unravelling fails to occur in all our treatments. Receiver's beliefs and guesses about non-disclosed information are similar across the Consultation and Context treatments relative to the Baseline implying that receivers are naive about non-disclosed information under naturalistic features that exist in field settings. We also find that senders are partly to blame for the lack of unravelling, as intermediate types would gain from disclosing more often given the observed receiver behaviour.

**Title.** Necessary versus equal players in axiomatic studies

**Authors.** Florian Navarro, Sylvain Béal

**Session.** July 2, 9:00 - 10:30

**Abstract.** This note introduces three variants of existing axioms in which equal players are replaced by necessary players. We highlight that necessary players can replace equal players in many well-known axiomatic characterizations, but not in all. In addition, we provide new characterizations of the Shapley value, the class of positively weighted Shapley values, the Solidarity value and the Equal Division value. This sheds a new light on the real role of equal treatment of equals in the axiomatic literature.

**Title.** Network Games on Probabilistic Graphs: Two Axiomatisations of the Myerson Value

**Authors.** Robert Gilles

**Session.** July 1, 14:00 - 15:30

**Abstract.** We consider the class of network games on the space of probabilistic graphs. A probabilistic graph is understood here as any probability distribution on the space consisting of all possible networks on any finite set of nodes or players. Within this context we appropriately extend the Jackson-Wolinsky definition of the generalised Myerson value to its expected value—the so-called extended MJW-value. We show two axiomatisations of this extended MJW value on this space of probabilistic graphs. The first axiomatisation is founded on appropriate extensions of the well-known component balancedness and equal bargaining properties. The second axiomatisation is founded on the extension of component balancedness as well as an extension of Slikker's balanced contributions property.

**Title.** Noisy Disclosure

**Authors.** Aidan Smith

**Session.** July 1, 9:00 - 10:30

**Abstract.** Even when experts are unable to lie, they may be misunderstood. We model a setting of verifiable disclosure in which a sender is restricted to reporting the state or sending no message, but communicates with a receiver who observes noisy realisations of messages, due to a language barrier. We show that full disclosure will only occur if the sender is sufficiently biased, and that the receiver-optimal disclosure rule does not feature full disclosure. We select equilibria which converge to full disclosure as noise vanishes, and show, taking noise as fixed, communication may be inefficient even with a perfectly aligned sender, as the presence of noise creates a commitment problem for the sender. We show that there are settings in which, ex-ante, a receiver prefers to face a biased rather than aligned sender.

**Title.** On majority voting rules with abstention

**Authors.** Josep Freixas, Dani Samaniego

**Session.** June 30, 14:00 - 15:30

**Abstract.** In this work we consider majority voting rules with abstention such that the collective decision is binary. This is a particular case of the voting context considered in the seminal article by K. May on decision functions, because the output set does not admit a tie. This framework typically arises in grading; in some sport competitions; in voting situations in which the status quo is put to the vote, etc. The purpose of this work is twofold. First, it gives an axiomatic characterization for the set of majority voting rules with abstention and for the simple majority rule, in particular. Second, it counts the number of inequivalent majority voting rules as a function of the number of voters.

**Title.** On multi-keyword sponsored search auctions: Equilibria, revenue and welfare

**Authors.** Ayano Nakagawa, Yukihiro Funaki

**Session.** June 30, 9:00 - 10:30

**Abstract.** Our primary goal is examining the effect of grouping multiple search terms on Nash equilibria in a multi-keyword auction. We show the sufficient conditions and necessary conditions of Nash equilibrium when search terms are formed into two keywords. Furthermore, we compare revenue of a search engine and social welfare of the equilibria in the presence of grouping with those in absence in order to clarify the effect of grouping. Our results reveal that weighted average value (WAV) of the advertisers play the key role in the multi-keyword auction with grouping. WAV is a weighted average of values for search terms by differences in CTR. As for revenue and social welfare, the search engine makes profit but social welfare decreases by grouping search terms in the equilibria.

**Title.** On properties of the average of awards rule with an application to the allocation of CO2 emissions

**Authors.** Miguel Ángel Mirás Calvo, Iago Núñez Luigilde, Carmen Quinteiro Sandomingo, Estela Sánchez Rodríguez

**Session.** June 30, 9:00 - 10:30

**Abstract.** The average of awards rule assigns to each claims problem the expectation of the uniform distribution defined over the set of awards vectors, or equivalently, the mean value of all the awards vectors bounded from below by the minimal rights and from above by the truncated claims. Therefore, the average of awards rule is the center of gravity of the core of the associated coalitional game (see [1, 5]). We show that this rule satisfies a good number of properties so as to be included in the inventory of solutions for this class of problems, among them, homogeneity, continuity, self-duality, claim monotonicity, and order preservation. [6] presents a comprehensive review of the literature on claims problems. We analyze in detail how the set of awards vectors changes when the endowment increases, and prove several additional properties that the average of awards rule satisfies: endowment monotonicity, population monotonicity, and other-regarding claim monotonicity ([2]). We also provide a method for computing the average of awards rule and analyze a new property called single-agent weighted consistency investigating the extension of the concede-and-divide rule using this property. Finally, we present an application to the allocation of CO2 emissions that illustrates the behavior of the average of awards rule and highlights some similarities and discrepancies with other rules ([3, 4]). REFERENCES: [1] GONZÁLEZ DÍAZ, J. AND SÁNCHEZ RODRÍGUEZ, E., A natural selection from the core of a TU game: the core-center. *International Journal of Game Theory* 36, 27–46, (2007). [2] MIRÁS CALVO, M.A., QUINTEIRO SANDOMINGO, C., AND SÁNCHEZ-RODRÍGUEZ, E., The core-center rule for the bankruptcy problem. Working paper 2020-02, ECOBAS. [3] MIRÁS CALVO, M.A., NÚÑEZ LUGILDE, I., QUINTEIRO SANDOMINGO, C., AND SÁNCHEZRODRÍGUEZ, E., An algorithm to compute the core-center rule of a claims problem with an application to the allocation of CO2 emissions. Working paper, (2020). [4] MIRÁS CALVO, M.A., NÚÑEZ LUGILDE, I., QUINTEIRO SANDOMINGO, C., AND SÁNCHEZRODRÍGUEZ, E., ClaimsProblems: An R package to analyze conflicting claims problems. Preprint, (2021) [5] O'NEILL, B., A problem of rights arbitration from the Talmud. *Mathematical Social Sciences* 2, 345–371, (1982). [6] THOMSON, W., How to divide when there isn't enough. From Aristotle, the Talmud, and Maimonides to the axiomatics of resource allocation. Cambridge University Press, (2019).

**Title.** On realizations with minimum sum of weighted majority games

**Authors.** Xavier Molinero, Maria Serna, Marc Taberner

**Session.** July 1, 14:00 - 15:30

**Abstract.** Game theory essentially considers two types of games: cooperative and non-cooperative games, depending on whether cooperation among players is allowed or not. We focus on weighted voting games (WVG), a subclass of cooperative games. In a WVG we can associate a weight (an integer number) to each player and fix an integer quota, in such a way that a coalition is winning when the sum of the weights of

the players in such coalition is at least the quota. A WVG admits many different representations, leading to the different definitions of minimal forms. We exhaustively study the weights and the quota for all WVG (up to isomorphism) represented by sequences of numbers in increasing order with minimum weight sum, up to 8 players. In particular, we study the distribution of the weights and the quota. This allows us to infer some general properties for representations with minimum sum. In particular, for any number of players, we are able to generate the minimum sum representation for some games. X. Molinero has been partially supported under grants PID2019-104987GB-I00 (JUVOCO) and M. Serna under grants TIN2017-86727-C2-1-R (GRAMM) and 2017-SGR-786 (ALBCOM).

**Title.** On the multidimension of simple games

**Authors.** Xavier Molinero, Fabián Riquelme, Salvador Roura, Maria Serna

**Session.** July 2, 9:00 - 10:30

**Abstract.** A simple game (SG) is a cooperative game in which the benefit that a coalition or set of players may have is always binary, i.e., a coalition may either win or lose. A weighted voting game (WVG) is a SG where each player can be assigned a voting weight, such that a coalition wins if the sum of weights in that coalition match or exceeds an adequate quota. It is known that each SG can be expressed as the intersection or the union of WVGs. The dimension (codimension) of a SG is the minimum number of WVGs such that their intersections (unions) generate the considered game. The (co)dimension is a relevant metric that allows in many cases representing SGs in a more efficient way. We are interested in the study of what we call the em multidimension of a SG, i.e., the minimum number of WVGs such that a combination of intersections or unions of those games gives the target game. We show, as expected, that for some SGs the multidimension can be less than the (co)dimension and thus the game can be represented in an even more compact way. Furthermore, we study what happens with the multidimension if we only consider WVGs without dummy players. X. Molinero has been partially supported under grants PID2019-104987GB-I00 (JUVOCO); F. Riquelme under grant Fundación Carolina - SEGIB 2020; M. Serna under grants TIN2017-86727-C2-1-R (GRAMM) and 2017-SGR-786 (ALBCOM).

**Title.** Optimal Management of Evolving Hierarchies

**Authors.** Juan D. Moreno-Ternero, Jens Leth Hougaard, Lars Peter Osterdal

**Session.** July 1, 9:00 - 10:30

**Abstract.** We study the optimal management of evolving hierarchies of revenue-generating agents. The initiator invests into expanding the hierarchy by adding another agent, who will bring revenues to the joint venture and who will invest herself into expanding the hierarchy further, and so on. The higher the investments (which are private information), the higher the probability of expanding the hierarchy. An allocation scheme specifies how revenues are distributed, as the hierarchy evolves. We obtain schemes that are socially optimal and initiator optimal respectively. Our results have potential applications for blockchain, cryptocurrencies, social mobilization and multi-level marketing.

**Title.** Parametric representations of ELS values for TU games

**Authors.** Marcin Malawski

**Session.** July 2, 9:00 - 10:30

**Abstract.** As shown by numerous authors, every linear, symmetric and efficient (ELS) value for n-person cooperative TU games can be represented in various ways by formulae involving sequences of n real coefficients; examples include the representations introduced by Weber, by Ruiz et al. and by Driessen and Radzik. Some of these families of coefficients admit attractive interpretations in the framework of "implementations" of the ELS values they represent. In this presentation, the relations between the parametriza-

tions will be shown, their possible interpretations discussed and the conditions on parameters necessary and / or sufficient for various properties of ELS values, in particular some monotonicity conditions, derived.

**Title.** Persuading Communicating Voters

**Authors.** Anastas Tenev, Toygar Kerman

**Session.** June 30, 16:00 - 17:30

**Abstract.** This paper studies a multiple-receiver Bayesian persuasion model, where a sender communicates with receivers who have homogeneous beliefs and aligned preferences. The sender wants to implement a proposal and commits to a communication strategy which sends private (possibly) correlated messages to the receivers, who are in an exogenous and commonly known network. Receivers can observe their neighbors' private messages and after updating their beliefs, vote sincerely on the proposal. We examine how networks of shared information affect the sender's gain from persuasion and find that in many cases it is not restricted by the additional information provided by the receivers' neighborhoods. Surprisingly, the sender's gain from persuasion is not monotonically decreasing with the density of the network.

**Title.** Positivity and convexity in cooperative games with partial information

**Authors.** Jan Bok, Martin Černý, David Hartman, Milan Hladík

**Session.** July 2, 14:00 - 15:30

**Abstract.** There are many approaches to modelling uncertainty in cooperative game theory. One of such models are partially defined cooperative games, a generalisation of classical cooperative games introduced by Wilson in 1993. Compared to standard cooperative games, values of the characteristic function for some of the coalitions can be missing and unknown. Therefore, we have just partial information. The talk will focus on our recent research involving two important properties of cooperative games in context of this model: convexity and positivity. In the first part, we focus on convexity and give a polynomially decidable condition for extendability and a full description of the set of symmetric convex extensions. The extreme games of this set, together with the lower game and the upper game, are also described. In the second part, we study the notion of positivity. We characterise the non-extendability to a positive game by existence of a certificate and provide a characterisation for the extreme games of the set of positive extensions. We use both characterisations to describe the set of positive extensions of several classes of incomplete games with special structures of their partial information. In the last part of the talk, we shall provide a context to the problem of completing partial functions. Finally, we will recall some basic definitions regarding cooperative games under interval uncertainty and describe a tight connection to partially defined games together with some open problems and future perspective.

**Title.** Power measures in communication networks

**Authors.** Encarnación Algaba, Rene van den Brink, Zuzana Sasovova

**Session.** July 1, 9:00 - 10:30

**Abstract.** We introduce a class of power measures for union stable network structures. We analyze their characteristics and formulate axioms that these measures have in common. We axiomatize these measures by a comparable set of axioms. Moreover, we show that the outcome according to these different measures can be considerably dissimilar. We illustrate this by providing an empirical example exploring the differences between the introduced measures. We show that these variations yield different rankings, demonstrating that the variation and normalization that is chosen is essential in evaluating positions in such networks.

**Title.** Pricing, Revenue sharing and Quality decisions in the Internet Value Chain

**Authors.** Sudha Madhavi Dastrala, Rajeev R. Tripathi

**Session.** June 30, 14:00 - 15:30

**Abstract.** With intense competition and with the rapidly changing consumption patterns, the telecom service providers (TSPs) are looking for other means to grow their revenues, while owning the mobile delivery channel and providing internet services. Clearly, digital advertising appears to be one of the potential areas of growth for the telecom companies. We consider a simplified trading path in the internet value chain, with the key players as the advertiser, the TSPs or the Internet service providers (ISPs) as ad-network provider and the content provider (CP) and focus on the pricing, quality and revenue sharing decisions between them. Through this path, advertisers can find an opportunity to measure their consumer engagement. CPs may find it attractive to increase their market share and the ISPs as the ad-network provider, have advantage of access and reach and therefore, facilitate the transactions between the advertisers and the CP. Through a sequential game along with two-sided market features, our paper attempts to address the question on how the ad-revenues and the subscription revenues are shared between CP and ISP and brings in insights on the players' quality, ad-revenue share, subscription fee and subscription revenue share decisions and their corresponding strategies in the digital advertising ecosystem, while considering the end-users' preferences. From our key results, we find that, in the case where only ad-revenue is shared, as quality level increases, the ad-revenue share also increases. Additionally, we identify the conditions under which CP behaves as a hybrid player or just as an advertising-based player and the conditions under which ISP behaves as an ad-network provider or just as an internet service provider. Lastly, we also analyze the case of a revenue sharing contract between the ISP and CP through Nash Bargaining solution (NBS) and derive the optimal revenue share that maximizes the surplus of ISP and CP. Our study would contribute towards pricing, quality and revenue sharing decisions in digital content supply chain with respect to ISPs and CPs.

**Title.** Priority-based Assignment with Reserves and Quotas

**Authors.** Aram Grigoryan, Atila Abdulkadiroglu

**Session.** July 1, 14:00 - 15:30

**Abstract.** We study priority-based assignment problems with distributional and diversity objectives. Our work provides an axiomatic characterization for a general class of choice rules based on type-specific reserves and quotas. The choice rules in the class differ by the order in which applicants are considered at units reserved for different types. We show that a particular reserves- and quotas-based choice rule, where all applicants are first considered at units reserved for their own types, uniquely minimizes priority violations in this class. We discuss the implications of our results for public school choice assignment with affirmative action policies.

**Title.** Privacy Accountability Measures via Shapley Value and Penalties: the case of IoT Firms.

**Authors.** Andrea di Liddo, Francesco Ciardiello

**Session.** June 30, 16:00 - 17:30

**Abstract.** Internet of things (IoT) business partnership are formed by technological partners and traditional manufacturers. IoT sensors and devices capture data from manufacturers' products. Data enforce product/service innovation thanks to data sharing among companies. However, data sharing among firms increases the risk of data breaches. The latter is due to two phenomena: information linkage and privacy interdependency. Data Protection Authorities (DPA) protect data users' rights and fine firms if there is an infringement of privacy laws. DPA sanction the responsible for the infringement of privacy laws. We present two different business scenarios: the first occurs when each firm is a data owner; the second occurs when only the manufacturer is the data owner. For both scenarios, we present measures of accountabil-

ity to privacy via Shapley value. These measures will be used to build penalties for firms. We present two fair penalty schemes that suggest the following: total amount of the fine; and how to share the fine among participants. Penalties critically vary at how innovation networks are structured in IoT industries. Our penalties provide incentives to data sharing since they redistribute firms' responsibility against data breaches. Our penalties may mitigate the risk on the manufacturer if is the unique responsible for data handling.

**Title.** Psychological Nash Equilibria under Ambiguity

**Authors.** Alba Roviello, Maria Romaniello, Giuseppe De Marco

**Session.** July 2, 9:00 - 10:30

**Abstract.** Psychological games have been introduced to understand how emotions, opinions and intentions of the decision makers can affect a game. In the pioneering paper by Geanakoplos et al. (1989), payoffs are assumed to be directly dependent not only on the strategies, but also on the beliefs of each player: players may have belief-dependent motivations or may believe that their opponents have belief-dependent motivations. Geanakoplos et al. (1989) present an equilibrium concept for this class of games based on the idea that the entire hierarchy of beliefs of each player must be correct in equilibrium. Moreover, they provide an existence result for this type of equilibria. There is another strand of literature that focuses on strategic ambiguity in classical games as it is well known that players may have ambiguous (or imprecise) beliefs about opponents' strategy choices. Many equilibrium concepts for games under strategic ambiguity have been introduced and used in applications (see for instance De Marco and Romaniello (2015), Dow and Werlang (1994), Eichberger and Kelsey (2000), Lehrer (2012), Riedel and Sass (2013)). In addition, limit results containing the assumptions which ensure the convergence of sequences of equilibria of ambiguous games to equilibria of the unperturbed ones can be found (see De Marco and Romaniello (2013) and references therein). In this paper, we consider the issue of strategic ambiguity in the framework of psychological games by taking into account ambiguous hierarchies of beliefs. In particular, we focus on the effects of ambiguity on the existence of psychological Nash equilibria. Firstly, we describe the model of psychological games under ambiguity and provide a suitable generalization of the psychological equilibrium concept in this framework. Numerical examples illustrating the differences between the ambiguous setting and the classical one are also shown. Then, we prove the existence of psychological Nash equilibria under ambiguity, focusing on maxmin preferences. Finally, we give a general limit theorem for sequences of equilibria of perturbed psychological games under ambiguity and we apply it to obtain a selection criterion for classical psychological equilibria, based on a property of stability with respect to ambiguous trembles of beliefs. References [1] De Marco, G. and Romaniello, M. (2013): A Limit Theorem for Equilibria under Ambiguous Belief Correspondences, *Mathematical Social Sciences*, 66, 431-438. [2] De Marco, G. and Romaniello, M. (2015): Variational preferences and equilibria in games under ambiguous belief correspondences, *International Journal of Approximate Reasoning*, 60, 8-22. [3] Dow, J. and Werlang, S.R.C. (1994): Nash Equilibrium under Uncertainty: Breaking Down Backward Induction, *Journal of Economic Theory*, 64, 305-324. [4] Eichberger, J. and Kelsey, D. (2000): Non-Additive Beliefs and Strategic Equilibria, *Games and Economic Behavior*, 30, 183-215. [5] Geanakoplos J., Pearce D. and Stacchetti, E. (1989): Psychological games and sequential rationality. *Games and Economic Behavior*, 1(1), 60-79. [6] Lehrer E. (2012): Partially Specified Probabilities: Decisions and Games, *American Economic Journal: Microeconomics*, 4, 70 -100. [7] Riedel, F. and Sass, L. (2013): Ellsberg Games. *Theory and Decision*, 76, 1-41.

**Title.** Ranking Game Theoretical Institutions

**Authors.** Balázs R. Sziklai

**Session.** July 1, 9:00 - 10:30

**Abstract.** We present a novel algorithm to rank smaller academic entities such as university departments or research groups within a research discipline. The Weighted Top Candidate (WTC) algorithm is a generalisation of an expert identification method. The axiomatic characterisation of WTC shows why it is especially suitable for scientometric purposes. The key axiom is stability – the selected institutions support each other’s membership. The WTC algorithm, upon receiving an institution citation matrix, produces a list of institutions that can be deemed experts of the field. With a parameter we can adjust how exclusive our list should be. By completely relaxing the parameter, we obtain the largest stable set – academic entities that can qualify as experts under the mildest conditions. With a strict setup, we obtain a short list of the absolute elite. We demonstrate the algorithm on a citation database compiled from game theoretic literature published between 2008–2017. By plotting the size of the stable sets with respect to exclusiveness, we can obtain an overview of the competitiveness of the field. The diagram hints at how difficult it is for an institution to improve its position.

**Title.** Regulation and Management Policy in Groudwater Exploitation

**Authors.** Marta Biancardi, Giovanni Villani, Gialuca Iannucci

**Session.** July 1, 9:00 - 10:30

**Abstract.** When a groundwater basin is exploited by a large number of farmers, acting independently, each farmer has little incentive to practice conservation that would primarily benefit other farmers. This can lead to excessive groundwater extraction. In countries where groundwater has long been considered as open access good, the establishment of rules for governing access to groundwater and its use is increasingly perceived as necessary. This calls for the design of innovative institutional frameworks, involving the redistribution of responsibilities between the Public Authority and users and increasing use of economic instruments providing incentives and theoretically leading to higher water use efficiency. The present paper constructs, with a differential game approach, a framework for describing the characteristics of economically efficient groundwater management plans, and examining how policies related to water protection can improve the efficiency of the status quo.

**Title.** Repeated Games with Switching Costs - Stationary vs History Independent Strategies

**Authors.** Yevgeny Tsodikovich, Xavier Venel, Anna Zseleva

**Session.** July 1, 14:00 - 15:30

**Abstract.** We study zero-sum repeated games where the minimizing player has to pay a certain cost each time he changes his action. Our contribution is twofold. First, we show that the value of the game exists in stationary strategies, which depend solely on the previous action of the player (and not the entire history), and we provide a full characterization of the value and the optimal strategies. The strategies exhibit a robustness property and typically do not change with a small perturbation of the switching costs. Second, we consider a case where the player is limited to playing completely history-independent strategies and provide a full characterization of the value and optimal strategies in this case. Naturally, this limitation worsens his situation. We deduce a bound on his loss in the general case as well as more precise bounds when more assumptions regarding the game or the switching costs are introduced.

**Title.** Reputation, Innovation, and Externalities in Venture Capital

**Authors.** Farzad Pourbabaee

**Session.** July 1, 14:00 - 15:30

**Abstract.** I introduce a dynamic model of random search where ex ante heterogeneous venture capitalists (investors) with unknown abilities match with a variety of startups (projects). There is incomplete yet symmetric information about investors’ types, whereas the projects’ types are publicly observable to

all investors. In the unique stationary equilibrium, the matching sets, value functions and steady state distributions are endogenously determined. Interpreting the market posterior belief about the venture capitalists' ability as their reputation, I study the outcomes of the economy when the success or failure of the projects create feedback effects: innovation spillovers and reputational externalities. When there are positive spillovers from successful early stage projects to late stage business opportunities, I show increased levels of search frictions could save the market from breakdown caused by the neglect of spillover effect. When the reputational externality is at play, namely when the deal flow of each investor is inversely impacted by the distribution of other investors' reputation, I show the proportion of the high ability inactive investors is inefficiently high, and the projects suffer from early termination.

**Title.** Rough Shapley values for games with a priori unions

**Authors.** Andrés Jiménez-Losada, Manuela Basallote, Carmen Hernández-Mancera

**Session.** June 30, 9:00 - 10:30

**Abstract.** In this paper we introduce a family of values that we can name Shapley values for cooperative games with a priori unions. In the construction of the family we see the a priori unions structure as an equivalence relation defining the coalitions as rough sets. We identify the family with a set of axioms and we test that the classic Shapley value and the Owen value are in the family.

**Title.** School Choice with Transferable Students' Characteristics

**Authors.** Carmelo Rodríguez-Alvarez, Antonio Romero-Medina

**Session.** July 1, 9:00 - 10:30

**Abstract.** We consider a school choice problem where school priorities depend on (transferable) students' characteristics. We define the Student Exchange with Transferable Characteristics (SETC) class of algorithms. Each SETC algorithm always selects a constrained efficient extended matching. That is, a matching and an allocation of students' characteristics such that i) the matching is stable according to the priorities generated by that allocation of characteristics and ii) is not Pareto dominated by another stable matching under any allocation of characteristics. Every constrained efficient extended matching that Pareto improves upon a stable extended matching is the outcome of an algorithm in the SETC class. When students' characteristics are fully transferable, a specific algorithm in the SETC family selects the matching obtained with the Efficiency Adjusted Deferred Acceptance Mechanism.

**Title.** Serial Vickrey mechanism

**Authors.** Yu Zhou, Shigehiro Serizawa

**Session.** July 1, 9:00 - 10:30

**Abstract.** We study an assignment market where multiple heterogeneous objects are sold to unit demand agents who have general preferences that accommodate imperfect transferability of utility and income effects. In such a model, there is a minimum price equilibrium (MPE). Nevertheless, none of the well-known mechanisms with finite-dimensional preference information revelation that find the MPEs in the quasi-linear environment can identify or even approximate the MPEs in our setting. We establish novel structural characterizations of MPEs and propose the "Serial Vickrey mechanism," to find an MPE in a finite number of steps. In the Serial Vickrey mechanism, objects are introduced one by one, and agents only report finite-dimensional prices infinitely many times. In particular, the Serial Vickrey mechanism has nice dynamic incentive properties.

**Title.** Sharing Profit by Ranking Partners

**Authors.** Jung You, Ruben Juarez, Chiu Yu Ko

**Session.** June 30, 16:00 - 17:30

**Abstract.** We study the problem of dividing a dollar when agents report rankings of the contributions of other people. We find optimal rules using the maximum absolute loss from the true profile for any number of agents. This can be implemented by a social planner under incomplete information. If budget-balance is required, optimal rules exist only for 3 and 4 agents. Budget balance rules that are nearly optimal are provided for 5 or more agents.

**Title.** Sharing the Surplus and Proportional Values

**Authors.** Yukihiro Funaki, Rene van den Brink, Zhengxing Zou

**Session.** June 30, 14:00 - 15:30

**Abstract.** We introduce a family of proportional surplus division values for TU-games. Each value first assigns to each player a compromise between his stand-alone worth and the average stand-alone worths over all players, and then allocates the remaining worth among the players in proportion to their stand-alone worths. This family contains the proportional division value and the new egalitarian proportional surplus division value as two special cases. We provide characterizations for this family of values, as well as for each single value in this family.

**Title.** Simultaneous conflicting claims problems

**Authors.** Josep Maria Izquierdo, Carlos Rafels, Pero Timoner

**Session.** June 30, 9:00 - 10:30

**Abstract.** A given set of agents is involved in different but simultaneous conflicting claims problems. In each of these problems an amount of a homogeneous resource is in disputed and no agent can receive more than an objective claim. Contrary to solve them separately one by one, the purpose of the paper is to give a global solution based on egalitarian properties. To this aim we propose two equity properties: (a) constrained aggregate egalitarianism (CAE) and (b) pairwise balancedness across problems (PBP). For the two-person problem the min-variance rule is the unique allocation rule that satisfies CAE and PBP. For the n-person case, we show the min-variance rule satisfies CAE, PBP and a property of consistency.

**Title.** Single Unit Double Auctions

**Authors.** Matthijs Ruygrok

**Session.** July 2, 14:00 - 15:30

**Abstract.** Consider an auction where many sellers possess one unit of a good, and many buyers want to purchase one unit. The auction is held sequentially, one unit at a time. All participants have a private valuation of the good, but the distribution of the valuations is common knowledge. Each buyer submits a bid and each seller an ask. A specified mechanism then decides which agents trade, and at what price. The problem for a participant is the determination of her optimal bid or ask, given her valuation. Two mechanisms are compared. The first is the "Complete k-double auction", where a seller and a buyer are picked at random. If the bid of the buyer is larger than the ask of the seller, there will be a transaction, with a price that is a weighted average of the bid and the ask. If the bid is smaller than the ask, the procedure is repeated until there is a transaction. The analysis of the game is very similar to that of the classic bilateral trade game with one seller and one buyer, whose valuations are drawn from a known distribution. The first order conditions for an equilibrium lead to a dynamical system with a 3-dimensional phase space. The equilibria of the game form a 2-parameter family of curves in this phase space. The other mechanism is the "Open Outcry". Sellers and buyers are selected randomly to, sequentially, announce their ask or bid. The mechanism keeps track of the highest bid and the lowest ask. Once an ask comes in that is lower than

the highest bid (or bid that is higher than the lowest ask), a transaction occurs at the price of the standing highest bid (or lowest ask). This mechanism has a number of remarkable properties. The expressions for the payoff functions are unexpectedly simple. The phase space is not a slice of 3-dimensional space, but rather a curved 2-dimensional surface. As a result, instead of an infinite set of equilibria, the game has an unique equilibrium! A bonus is that for uniform distributions of the valuations, this equilibrium solution can be calculated explicitly.

**Title.** Solidarity measures in binary decision-making process

**Authors.** Izabella Stach, Cesarino Bertini, Jacek Mercik

**Session.** July 2, 9:00 - 10:30

**Abstract.** This research regards some measures for dividing a (public) good, amount or a budget among members with different quotas of participation in a binary decision-making process. A main characteristic of such measures is that it should have elements of solidarity with those who have a weak quota of participation in the process. The measure seems appropriate for deals that require solidarity, which contrasts with the classical power indices.

**Title.** SOLO FTRL algorithm for production management with transfer prices

**Authors.** Dmitry Rokhlin, Ougolnitsky Mechanics and Guennady

**Session.** July 2, 9:00 - 10:30

**Abstract.** We consider a firm producing and selling  $d$  commodities, and consisting from  $n$  production and  $m$  sales divisions. The firm manager tries to stimulate the best division performance by sequentially selecting internal incentive commodity prices (transfer prices). In the static problem under general strong convexity and compactness assumptions we show that the SOLO FTRL algorithm of Orabona and P'al (2018) gives the estimates of order  $T^{-1/4}$  in the number  $T$  of iterations for optimality and feasibility residuals. This algorithm uses only the information on division reactions to current prices. It does not depend on any parameters and requires no information on the production and cost functions. In the dynamic problem we assume that these functions depend on an i.i.d. sequence of random variables. It is shown that the same algorithm over a hypercube ensures no-regret learning with respect to the best possible plan sequence, and the average regret is stochastically bounded by a quantity of order  $T^{-1/4}$ . In this case the algorithm requires the knowledge of upper bounds for optimal transfer prices.

**Title.** Spoiler Effects in Multiparty Systems: A Mathematical Model

**Authors.** Daria Boratyn, Dariusz Stolicki, Wojciech S lomczyński

**Session.** June 30, 9:00 - 10:30

**Abstract.** We propose a generalized definition of a spoiler in multi-winner, multi-party elections by defining spoilers as those players whose impact on election results is disproportionately high given their level of support. The paper's main feature is a formal method of measuring a party's electoral impact, consisting of (1) a method for estimating a probability distribution on the space of interparty vote swings on the basis of spatial preference model; (2) a method for estimating the effect of vote swings on seat allocations; and (3) a metric on the space of election results that accounts for the importance of the majority threshold by comparing voting power rather than seat shares. We then analyze certain properties of the proposed definition.

**Title.** Stable agreements through liability rules: a multi-choice game approach to the social cost problem

**Authors.** Kevin Techer

**Session.** June 30, 14:00 - 15:30

**Abstract.** We consider a class of social cost problems in which one polluter interacts with an arbitrary number of potential victims. Agents are supposed to cooperate and negotiate an optimal pollution level together with monetary transfers. We examine multi-choice cooperative games associated with a social cost problem and an assignment (or mapping) of rights. We introduce a class of mappings of rights that takes into account the pollution intensity and we consider three properties on mappings of rights: core compatibility, Kaldor-Hicks core compatibility and no veto power for a victim. We show that there exist only two families of mappings of rights that satisfy core compatibility, while no mapping of rights satisfies Kaldor-Hicks core compatibility and no veto power for a victim.

**Title.** Stable cooperation in differential games on networks

**Authors.** Anna Tur, Leon Petrosyan

**Session.** July 2, 9:00 - 10:30

**Abstract.** A class of differential games on networks is considered. It is assumed that interaction on the network is possible between neighboring players and between players connected by paths. Various types of payoffs of players are proposed to guarantee the existence of strong time-consistent cooperative optimality principles. The construction of cooperative optimality principles using a special type of characteristic function that takes into account the network structure of the game is investigated. The core, the Shapley value, and the strong time-consistent subcore are used as cooperative optimality principles. The formula for explicit calculation of the Shapley value is derived. An algorithm for the construction of imputations from the strong time-consistent subcore is given. The results are illustrated by the example of one differential marketing game.

**Title.** Stable Partitions for Proportional Generalized Claims Problem

**Authors.** Oihane Gallo, Bettina Klaus

**Session.** June 30, 16:00 - 17:30

**Abstract.** We consider a set of agents, e.g., a group of researchers, who have claims on an endowment, e.g., a research budget from a national science foundation. The research budget is not large enough to cover all claims. Agents can form coalitions and coalitional funding is proportional to the sum of the claims of its members, except for singleton coalitions which do not receive any funding. We analyze the structure of stable partitions when coalition members use well-behaved rules to allocate coalitional endowments, e.g., the well-known constrained equal awards rule (CEA) or the constrained equal losses rule (CEL). For continuous, (strictly) resource monotonic, and consistent rules, stable partitions with (mostly) pairwise coalitions emerge. For CEA and CEL we provide algorithms to construct such a stable pairwise partition. While for CEL the resulting stable pairwise partition is assortative and sequentially matches lowest claims pairs, for CEA the resulting stable pairwise partition is obtained sequentially by matching in each step either a highest claims pair or a highest-lowest claims pair.

**Title.** Stable Sets Protected from Abstention in Multidimensional Spatial Games

**Authors.** Francesco Ciardiello

**Session.** July 2, 9:00 - 10:30

**Abstract.** The spatial theory of voting is premised on the idea that alternatives are placed on ideological continuous spaces endowed with a metric. Alternatives may have a vector-type structure, i.e., each alternative is the aggregation of multiple policy dimensions. Agents have preferences on each dimension of alternatives and, then, have preference on the whole set of alternatives. Agents vote at each alternative in order to accept a new alternative or reject it or they abstain. Our approach to abstention is similar to

the one proposed in the literature of the theory of power indices. Von Neumann and Morgenstern stable sets provide a prediction under sophisticated voting in social environments. Multiplicity of Von Neumann and Morgenstern stable sets is an obstacle, but also an incentive, to study their properties against the phenomenon of abstention of one single voter. If an abstention occurs at a stable alternative, such alternative ought to be protected by the consequence of potential abstentions. We identify a refinement of Von Neumann and Morgenstern stable sets, the so-called Protected Stable Sets (PSS), against a specific phenomenon of abstention in multidimensional spatial games under majority rules. Otherwise, stable sets are UnProtected (UPSS). PSS have one alternative which remains protected if one voter decides abstention. In particular, we define refinements of PSS: Fully-Protected stable sets (FPSS), Quasi-Protected stable sets (QPSS) and Hyper-Protected Stable Sets (HPSS). FPSS and HPSS are stable sets which satisfy a different protection from the potential abstention of one single voter. Each alternative in a FPSS is protected by the abstention of one single voter at least. However, such a protection is not guaranteed for the potential abstention of any voter. There is at least one alternative in a HPSS such that this alternative is protected by the potential abstention of any voter. The ideal protected scenario would be that any stable set is fully- and hyper-protected. We show how this occurs in a lucky case: the number of voters is odd and the core is nonempty. We face the simplest case of three voters but with an empty core. Interestingly, we find the following results: (1) if a stable set is finite then it is FPSS; (2) if a stable set is infinite, then it is QPSS. We have found a theoretical evidence on how the emptiness of the core tend to weaken security against one single voter's abstention. We wonder whether protection decreases for more general cases: an arbitrary odd number of voters and, as usual, an empty core. Firstly, we state a result on the existence of a class of finite stable sets. We show how this class of stable sets is composed by PSS. Alongside the above analysis, the case of an even number of voters is left out. We fill the gap. We conclude that stable sets are UPSS or PSS if the number of voters is even. Protection from abstention is guaranteed more with an odd number of voters than with an even number of voters. Our analysis, finally, embraces situations in which the core is empty; the number of voters and the dimension of the space of alternatives are arbitrary. The whole set of results are obtained under specific conditions on preferences. Preferences are represented by utility functions that are strictly concave and, then single-peaked, and continuously differentiable.

**Title.** Stackelberg Competition in Dynamic Advertising With an Application to Cryptocurrency Market

**Authors.** Rajani Singh

**Session.** July 1, 9:00 - 10:30

**Abstract.** In this paper, we study a dynamic game model of brand advertising in continuous time with the finite time horizon. The total payoff or profit of players or firms is discounted over time and the rate at which the firms attract the customers from its rival, called attraction rate, is taken from the economic theory of contest. As a novelty of our game model, the attraction rate of a firm depends on both: player's or firm's advertising effort and the advertising effort of players or firm's rivalry. We solve the game for Stackelberg equilibrium (with the leader and follower differing by information and/or the sequence of choosing strategies) as well as for Nash equilibrium. Further, we graphically compare the results obtained for the Stackelberg and the Nash equilibrium. Surprisingly, we have obtained that if the revenue per unit of market share is equal for Nash and Stackelberg equilibrium then the results for Nash player 1 overlaps with the leader and the results for Nash player 2 overlaps with follower. Finally, we present the application of our dynamic game model in the cryptocurrency market where two firms compete with each other for the cryptocurrency market share.

**Title.** Strategic Investments in Distributed Computing: A Stochastic Game Perspective

**Authors.** Swapnil Dhamal, Walid Ben-Ameur, Tijani Chahed, Eitan Altman, Albert Sunny, Sudheer Poojary

**Session.** June 30, 16:00 - 17:30

**Abstract.** We study a stochastic game with a dynamic set of players, for modeling and analyzing their computational investment strategies in distributed computing. Players obtain a certain reward for solving the problem or for providing their computational resources, while incurring a certain cost based on the invested time and computational power. We first study a scenario where the reward is offered for solving the problem, such as in blockchain mining. We show that, in Markov perfect equilibrium, players with cost parameters exceeding a certain threshold, do not invest; while those with cost parameters less than this threshold, invest maximal power. Here, players need not know the system state. Also, if players have equal maximal power available to them, the expected utility of an investing player computed in a state is inversely proportional to the number of investing players in that state. We then consider a second scenario where the reward is offered for contributing to the computational power of a common central entity, such as in volunteer computing. Here, in Markov perfect equilibrium, only players with cost parameters in a relatively low range which collectively satisfy a certain constraint in a given state, invest. For the case where players are homogeneous, their investment in a state is proportional to the 'reward to cost' ratio and approximately inversely proportional to the number of players in that state. With simulations in both scenarios, we study the effects of players' arrival and departure rates on the trade-off between their obtained reward and incurred cost, hence on their utilities. An increase in players' arrival rates results in an insignificant change in their utilities in the first scenario, however, lowers their utilities in the second scenario. An increase in players' departure rates lowers their utilities in both scenarios. We conclude by showing for both scenarios that, if players invest as per the Markov perfect equilibrium, the total invested power in any given state is a monotone increasing function of the offered reward. The increase is a step function in the first scenario, while a piecewise-linear ramp function in the second scenario.

**Title.** Strategic Settings with Social and Psychological Elements

**Authors.** Joel Watson, Gregory Raiffa

**Session.** June 30, 16:00 - 17:30

**Abstract.** We examine a class of strategic settings that we call "mind games," in which the players' strategies include both physical actions and "mental actions." These are conventional noncooperative games, where payoffs are a function of strategy profiles, but in some cases the payoffs are nonlinear in probabilities. We explore the connection between mind games and so-called "psychological games" in which payoffs depend directly on both the players' strategies and their beliefs, in particular higher-order beliefs. We prove that all psychological games can be expressed as mind games for the analysis of rational behavior, addressing an outstanding question in the literature about whether preferences over higher-order beliefs can be captured using a more conventional modeling approach. The analysis generalizes Kolpin (1992) by allowing for best-response and rationalizability-based theories of behavior as well as equilibrium theories. Developing this platform allows us to address a number of issues in the existing literature on psychological games. Some applications may be conveniently reformulated as mind games, either by direct translation or with simpler models that still capture the key strategic elements. We show that, when classifying applications, it is helpful to distinguish between preferences that are nonlinear in probabilities and preferences that depend on higher-order beliefs. Some common applications in the psychological-game literature are in the former category but not the latter. Another benefit of the mind-game modeling framework is that it encompasses both psychological games and what we call "sociological games," in which utilities depend on endogenous individual or interpersonal markers such as status and identity. This facilitates the development of novel applications such as to the concept of legitimacy, and suggests that a variety of applications may be usefully characterized as exhibiting endogenously coordinated preferences. It also offers an interpretation of psychological games in which it is common knowledge that players want to hold accurate beliefs.

**Title.** Strategy-proof mechanism design with non-quasi-linear preferences: Ex-post revenue maximization for an arbitrary number of objects

**Authors.** Ryosuke Sakai, Shigehiro Serizawa

**Session.** July 2, 14:00 - 15:30

**Abstract.** We consider the multi-object allocation problem with monetary transfers where each agent obtains at most one object (unit-demand). We focus on allocation mechanisms satisfying individual rationality, non-wastefulness, equal treatment of equals, and strategy-proofness. Extending the result of Kazumura et al. (2020B), we show that for an arbitrary number of agents and objects, the minimum price Walrasian is the unique ex-post revenue maximizing mechanism among the mechanisms satisfying no subsidy in addition to the four properties, and that no subsidy in this result can be replaced by no bankruptcy on the positive income effect domain.

**Title.** Sustainable cooperation in extensive games based on the subgame-perfect core concept

**Authors.** Denis V. Kuzyutin, Nadezhda V. Smirnova

**Session.** July 1, 14:00 - 15:30

**Abstract.** We consider the dynamic aspects of long-term cooperation in an n-person extensive-form game. To ensure a sustainability of a cooperative agreement in a dynamic game with transferable utility the players may design an appropriate payment schedule (or payoff distribution procedure – see, for instance, [1, 2]) which satisfies at least the following properties. First, a fragment of the cooperative trajectory (or path) for the original game  $\Gamma^{x_0}$  should “remain optimal” at each subgame  $\Gamma^{x_t}$  as the game unfolds along a cooperative path (the time consistency property). Secondly, a cooperative payoff-to-go at the subgame  $\Gamma^{x_t}$  is no less than the non-cooperative payoff-to-go for all coalitions, including individual players (see, [1, 2, 5, 6]). Finally, the payoff distribution procedure which the players use to redistribute optimal cooperative payoffs meets the (strict) balance condition [1, 3 - 5], i.e. at each node in the cooperative path the players may redistribute exactly the sum of the players’ payoffs at this node. Different mechanisms to ensure sustainable long-term cooperation for extensive-form games with transferable utility (in particular, for multicriteria games) were provided in [3 - 5]. Recently, a new solution concept for cooperative games in extensive form (for the special case when the payoffs are only defined in terminal nodes), called the subgame-perfect core (SP Core), was introduced in [6]. We consider the ways how to extend the concept of the SP Core to extensive-form games with the payoffs defined in all the nodes, to multicriteria extensive-form games and the games with chance moves. It turns out, that a special payoff distribution procedure should be designed to implement SP Core in more broad classes of extensive games. We focus on the properties of this payment schedule which ensure a sustainability of a long-term cooperative agreement for some classes of extensive-form games. References [1] L. Petrosyan, D. Kuzyutin, Games in extensive form: optimality and stability, Saint Petersburg University Press, 2000. (in Russian). [2] A. Haurie, J.B. Krawczyk, G. Zaccour, Games and Dynamic Games, Scientific World: Singapore, 2012. [3] D. Kuzyutin, E. Gromova, Ya. Pankratova, Sustainable cooperation in multicriteria multistage games, Operations Research Letters, Vol. 46, issue 6, (2018), pp. 557-562. [4] D. Kuzyutin, N. Smirnova, E. Gromova, Long-term implementation of the cooperative solution in multistage multicriteria game, Operations Research Perspectives, 6, (2019), 100107. [5] D. Kuzyutin, N. Smirnova, Subgame Consistent cooperative behavior in an extensive form game with chance moves, Mathematics, 8 (2020), 1061. [6] P. Chander, M. Wooders, Subgame-perfect cooperation in an extensive game, Journal of Economic Theory, 187 (2020), 105017.

**Title.** The Attack-and-Defense Conflict with the Gun-and-Butter Dilemma

**Authors.** Subhasish Chowdhury, Iryna Topolyan

**Session.** June 30, 16:00 - 17:30

**Abstract.** We analyze a general equilibrium model of attack and defense. One attacker and one defender allocate their fixed endowments either to produce gun or to produce butter, and the amount of guns produced determines the winner in the conflict. If the attacker wins, then s/he appropriates all the butter produced in the economy; otherwise, each consume only their own butter. We characterize the unique interior and unique corner equilibrium for this game. Defenders may spend more on conflict than the attacker even without loss aversion, attackers may expend all their resources only in conflict, and the interior and corner equilibria cannot coexist. We show that these results are very different from that of the traditional models that incorporate either only the attack and defense problem, or only the gun and butter problem.

**Title.** The complexity of problems for simple games under succinct representations

**Authors.** Maria Serna

**Session.** July 2, 9:00 - 10:30

**Abstract.** Simple games model situations in which the outcome of the game is either yes or no. A simple game is defined by those coalitions of players that can force a yes decision, the so called winning coalitions. As the family of winning coalitions is assumed to be monotonic simple games can be described in a succinct way by monotone boolean functions. Recently, in the context of social networks, a succinct representation of simple games based on graphs, the so called influence games, have been introduced. We show that transforming a representation by monotone circuits into one by influence games, in both directions, can be performed in polynomial time. We show a similar result for monotone formula with respect to a particular subclass of influence games. This allows us to translate several complexity results for problems on simple games under one representation to the others. Thus settling the computational complexity of several problems on simple games when they are described by a monotone circuit or a monotone boolean formula. Acknowledgements M. Serna has been partially supported under grants TIN2017-86727-C2-1-R (GRAMM) and 2017-SGR-786 (ALBCOM).

**Title.** The core and balancedness of TU games with infinite many players

**Authors.** Miklós Pintér, David Bartl

**Session.** July 2, 14:00 - 15:30

**Abstract.** Transferable utility cooperative games with infinitely many players are considered. We generalize the notions of core and balancedness, and present a generalized Bondareva-Shapley Theorem for games without and with restricted cooperation. Our generalized Bondareva-Shapley Theorem extends previous results by Bondareva (1963), Shapley (1967), Schmeidler (1967), Faigle (1989), and Kannai (1969, 1992) among others.

**Title.** The Role of Information Design in Facilitating Trust and Trustworthiness

**Authors.** Michiko Ogaku, Saori Chiba

**Session.** July 2, 14:00 - 15:30

**Abstract.** This paper studies the role of mediators who assist in initiating a new trade between independent parties. The success of the initiation of a trade largely depends on the extent to which the parties can trust and conversely be trustworthy for each other. We address the following questions: (1) do the mediators facilitate the initiation; (2) does such an intermediation system affect the intergenerational transmission of preferences to trust and to be trustworthy for others; and (3) what is the mediators' effect on cultural transmission of preferences to trust and/or be trustworthy? We first confirm that the mediators indeed facilitate the initiation of a trade by providing the optimal rules to recommend actions to the concerned parties. Second, we show that the mediators might prevent (respectively, facilitate) intergenerational transmission of

preferences to trust (respectively, be trustworthy for) others. Lastly, we show that the mediators' effect on cultural transmission of the preferences could result in a further decrease (respectively, a further increase) in the fraction of those who trust (respectively, are trustworthy for) others.

**Title.** Three-person Unstructured Bargaining Experiment: Effect of Communication

**Authors.** Taro Shinoda, Yukihiko Funaki

**Session.** July 2, 14:00 - 15:30

**Abstract.** 1. Introduction In the real world, doing a task by cooperating with others is usually more efficient than doing it alone, but cooperation needs to be agreed upon. For example, a business partnership among some firms reaches an agreement only when each of them believes that it brings more profits. This kind of issue is analyzed by cooperative game theory. In cooperative game theory, the most important issues are who to cooperate with and how to distribute the profits earned by the cooperation. These are called the coalition formation problem and the payoff distribution problem. However, it is assumed that individuals will form the grand coalition, i.e., there will be full cooperation among all individuals under the condition of superadditivity. Then, the main issue becomes the payoff distribution problem. Cooperative game theory is formalized by a set of all coalitions and the worth of these coalitions, which describes how much they obtain from the coalition. In the case of firms, worth represents the surplus of cooperation among several firms. Superadditivity means that the worth of the union of two disjoint coalitions is not less than the sum of the worth of the two coalitions. In other words, merging two disjoint coalitions is more profitable than leaving them separate. However, is this assumption truly reasonable? Let us take a simple example. In this paper, we focus on the three-person cooperative games and name the three players A, B and C hereafter. There are seven possible coalitions: ABC, AB, AC, BC, A, B, C. Every coalition has its value. For example,  $v(ABC)=120$ . Likewise, let us suppose that  $v(AB)=90, v(AC)=70, v(BC)=50, v(A)=v(B)=v(C)=0$ . This game is superadditive. Also let us suppose that the three players are talking about coalition formation and payoff distribution and player C offers the grand coalition and an allocation (40,40,40). Do A and B agree with the offer? The answer should be NO, because both A and B can be better off by forming coalition AB and sharing 90 equally. Again, suppose that C makes another offer, the grand coalition and (65,30,25). Then A and B might agree because no pair can be better off by deviation from the grand coalition. Such notion can be expressed by the core. The core is a set of allocation against which no smaller coalition can be better off. Even if a game is superadditive, the core does not always exist. For example, take  $v(ABC)=120, v(AB)=100, v(AC)=90, v(BC)=70, v(A)=v(B)=v(C)=0$ . This game is superadditive but the core does not exist. When the core does not exist, we can find no allocation on the grand coalition that is not deviated. Therefore, we can expect the grand coalition will be formed in the former example (the core exists) and will not be formed in the latter example (the core does not exist). This is the main motivation of this paper. 2. Experimental Design We ran a laboratory experiment to check the difference of coalition formation between the games with an empty core and the games with the nonempty core. The experiment was run by zTree (Fischbacher (2007)). One of the characteristics of our experiment is that it is unstructured: the experimental subjects can make offers at any moment of bargaining. We invited 30 undergraduate students at Waseda University in each session and they are randomly divided into 10 groups of three. They make offers of coalition formation and payoff distribution. For example, player A can offer one of the grand coalition ABC, coalitions AB or AC and an allocation which splits the value of the coalition. The offer reaches an agreement when all members involved in the coalition accept. The grand coalition is formed when A, B and C agree. On the other hand, coalition AB is formed when A and B agree. There is five minute of time limit and if the subjects use it up without reaching an agreement, they all are regarded to form single person coalitions. We employed stranger matching, so the members of the groups are reshuffled when the round ends. There are many two-person unstructured bargaining experiments (see Anbarci and Feltovich (2018), Navarro and Veszteg (2020), and Feltovich and Swierzbinski (2011)) and three-person structured (noncooperative game like) bargaining experiments (also see Rapoport and

Kahan (1976), Bolton and Brosig-Koch (2012) and Nash et al. (2012)), but there is hardly three-person unstructured bargaining experiment. The subjects played 10 games and each game was played once. All games are superadditive, and half of them has an empty core and the other half has the nonempty core. We compare these two to answer our motivation. If our expectation is correct, the grand coalition will be more likely to be formed when the core exists than it does not exist. Although our main concern is the validity of the core, we are also interested in the effect of communication. We put the chat window on the computer screen of the bargaining stage and the subjects can freely send their message there. In this experiment, there are many possibilities of coalition formation and payoff distribution, so communication among the subjects can be helpful to make bargaining smooth. Also, we can expect that the grand coalition is more likely to be formed when they communicate with each other. In order to check effectiveness of communication, we employed two treatments: the chat window is available in one treatment and unavailable in the other.

3. Basic Results As an experimental result, we have found the following things. First, as our pre-experimental expectation, the grand coalition is more likely to be formed when the core exists than it does not exist. Instead of the grand coalition, coalition AB, that gives the largest payoff of the two-person coalitions, was most frequently formed when the core does not exist. Second, the stronger the player is, the more he or she can get. We measure the players' strength by quota defined by Shapley (1953). Its value positively correlated with the subjects' experimental earnings. Third, the availability of the chat window also positively correlated with formation of the grand coalition. The grand coalition was more likely to be formed when the chat window is available with statistically significant level. However, actually the chat window was hardly used because the subjects were too busy with making and reacting to offers at the bargaining stage. Hence, we decided to run additional treatments where we encourage them to use the chat window in the first minute of the bargaining stage.

4. Additional Linguistic Analysis In the additional treatments, the subjects used the chat window frequently. This made it possible for us to do a linguistic analysis. We read their messages and put some labels on them. There are two types of the label: coalition label and allocation label. For example, if a message says "let us form the grand coalition and share its value equally," then the coalition label is "ABC" and allocation label is "A=B=C". We have counted the labels to find the following results. First, as the actual outcome, the grand coalition was more frequently mentioned than coalition AB when the core exists, but coalition AB was more frequently mentioned when the core does not exist. Second, regarding the allocation labels, the equal split between A and B was more frequently mentioned than asymmetric allocations (A's payoff  $\geq$  B's payoff). On the other hand, between A and C, the asymmetric allocations were more frequently mentioned. Finally, the weaker the player is, the more frequently he or she proposes coalition and allocation on the chat window.

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**Title.** To what extent does the model of processing sincere incomplete rankings affect the likelihood of the truncation paradox?

**Authors.** Eric Kamwa

**Session.** June 30, 9:00 - 10:30

**Abstract.** For a given voting rule, if voters can favor a preferred outcome by providing only a part of their sincere rankings on the competing candidates, rather than listing their entire preference rankings on all the competing candidates, this rule is said to be vulnerable to the truncation paradox. In this paper, we show that the way of dealing with the truncated ballot can really impact the occurrence of the paradox: this paradox never occurs with any one-shot scoring rules when truncated ballot is treated according to the optimistic model. The optimistic model is, along with the pessimistic model and the averaged model, the three most common ways of dealing with truncated preferences. The few papers assessing the likelihood of the occurrence of this paradox implicitly assume the pessimistic model. In order to have a fairly complete picture of the impact of the truncated preference model on the occurrence of the truncation paradox, we assess the likelihood of the truncation paradox under the two other models for three-candidate elections and large electorates. We focus on whole families of one-shot scoring rules, iterative scoring rules both with one-by-one eliminations and with elimination by the average. This assessment confirms that the choice of model may really matter: under the optimistic model, all the one-shot scoring rules are immune to the truncation paradox, whereas it is more likely to occur under the pessimistic model than under the averaged model; for each of the scoring runoff rules, we find that the likelihood of the truncation paradox is higher under the pessimistic model, and lower under the optimistic model. Our analysis is performed under the Impartial Anonymous Culture assumption.

**Title.** Two characterizations of the Banzhaf bisemivalue

**Authors.** Margarita Domènech Blàzquez, José Miguel Giménez Pradales, María Albina Puente del Campo

**Session.** July 1, 14:00 - 15:30

**Abstract.** We focus on bicooperative games, a variation of the classic cooperative games and, in particular, on the Banzhaf bisemivalue defined on these games. Recently the same authors introduced bisemivalues on bicooperative games in a similar way to the cooperative case, and generalized the Banzhaf power index for ternary bicooperative games, defined and axiomatized by Bilbao et al. in 2010, by introducing the Banzhaf bisemivalue on bicooperative games. It is a particular case of a subfamily of bisemivalues, called  $(p,q)$ -bisemivalues. The Banzhaf bisemivalue of a player is the average of the contributions of this player to all pair of coalitions either he/she joins or he/she leaves. In this work, we consider three special classes of players: weak null, necessary defender and necessary detractor players. By introducing new properties related to this kind of players, we provide two axiomatic characterizations of the Banzhaf bisemivalue giving, in both cases, a set of independent properties that univocally determine it.

**Title.** Unaware consumers and disclosure of deficiencies

**Authors.** Dominik Bruckner, Stefanie Schmitt

**Session.** June 30, 16:00 - 17:30

**Abstract.** We analyze a model where consumers have imperfect information about deficiencies of goods. We distinguish two types of imperfect information: First, some consumers are unaware that deficiencies, which reduce the quality of a good, can exist. Second, only some consumers are able to infer the true level of deficiency once they are aware of the existence of deficiencies. We show that a monopolist's disclosure decision depends on the composition of the consumer side of the market. In addition, we find that the larger the fraction of aware consumers, the more the monopolist invests to reduce deficiencies and the higher the probability that the monopolist discloses her deficiency. Thus increasing the fraction of aware consumers is beneficial to consumers, but harmful for the monopolist and overall welfare. In contrast,

the effect of competition on investments in reducing deficiencies is not clear-cut. Whether an increase in competition increases investments and the probability to disclose depends on the initial composition of the consumers. Furthermore, our model gives rise to a different motivation for introducing a voluntary label instead of a mandatory label. The mere existence of a label increases awareness among consumers and thus affects prices and welfare without costs for the policy maker to monitor the appropriate use of the label. In addition, we show that a minimum standard might be less effective than a voluntary label.

**Title.** Uniqueness of Clearing Payment Matrices and Continuity of Bankruptcy Rules in Financial Networks

**Authors.** Péter Csóka, P. Jean-Jacques Herings

**Session.** June 30, 16:00 - 17:30

**Abstract.** We consider bankruptcy rules in financial networks, where agents are linked to each other with financial contracts. The way the proportional division rule for claims problems is extended to financial networks can be used to extend any division rule. The resulting bankruptcy rules consist of computing each agent's asset value and then making payments in accordance with the given division rule. Since payments made depend on payments received, we are looking for equilibria (fixed points) with coherent accounting, called clearing payment matrices. Although clearing payment matrices in financial networks are unique under mild conditions when proportional division rules are used, this is not the case in general. In particular, when using priority rules or constrained equal awards rules, multiple clearing payment matrices may arise with different set of defaulting agents and, as a consequence, additional systemic risk. We provide sufficient monotonicity conditions for the uniqueness of clearing payment matrices. We also show that if a bankruptcy rule leads to a unique clearing payment matrix, then it is continuous.

**Title.** Valuation monotonicity and manipulability of stable rules in a multiple-partners job market

**Authors.** Gerard Domenech, Marina Núñez

**Session.** July 1, 9:00 - 10:30

**Abstract.** We consider a job market where multiple partnership is allowed (see Sotomayor (1992)), that is, each firm may hire several workers and also each worker may be matched to several firms, up to a given quota. We show that the firms-optimal stable rule, that given a valuation profile selects an optimal matching and salaries according the firm-optimal stable payoffs, is neither valuation monotonic nor pairwise monotonic, in contrast to the simple assignment game. Instead, if a firm decreases all its valuations in a constant amount up to a given threshold, then this firm decreases its payoffs by the same amount in the firm-optimal stable rule. This firm-covariance characterizes the firms-optimal stable rule among all stable rules. Moreover, although the firms-optimal stable rule is not strategy-proof, it cannot be manipulated by a constant over-report of a firm's valuations. Parallel results are obtained for the worker-optimal stable rule.

**Title.** Valuation monotonicity, fairness and stability in assignment problems

**Authors.** Marina Núñez, Rene van den Brink, Francisco Robles

**Session.** July 1, 9:00 - 10:30

**Abstract.** In two-sided assignment markets with transferable utility, we first introduce two weak monotonicity properties that are compatible with stability. We show that for a fixed population, the sellers-optimal (respectively the buyers-optimal) stable rules are the only stable rules that satisfy object-valuation antimonotonicity (respectively buyer-valuation monotonicity). Essential in these properties is that, after a change in valuations, monotonicity is required only for buyers that stay matched with the same seller. Using Owen's derived consistency, the two optimal rules are characterized among all allocation rules for two-sided assignment markets with a variable population, without explicitly requiring stability. Whereas these two monotonicity properties suggest an asymmetric treatment of the two sides of the market, valua-

tion fairness axioms require a more balanced effect on the payoffs of buyers and sellers when the valuation of buyers for the objects owned by the sellers change. For assignment markets with a variable population, we introduce grand valuation fairness requiring that, if all valuations decrease in the same amount, as long as all optimal matchings still remain optimal, this leads to equal changes in the payoff of all agents. We show that the fair division rules are the only rules that satisfy this grand valuation fairness and a weak derived consistency property.

**Title.** Value-Free Reductions

**Authors.** David Perez-Castrillo, Chaoran Sun

**Session.** July 2, 9:00 - 10:30

**Abstract.** We introduce the value-free (v-f) reductions, which are operators that map a coalitional game played by a set of players to another "similar" game played by a subset of those players. We propose properties that v-f reductions may satisfy, we provide a theory of duality for them, and we characterize several v-f reductions (among which the value-free version of the reduced games proposed by Hart and Mas-Colell, 1989, and Oishi et al., 2016). Unlike reduced games, which were introduced to characterize values in terms of consistency properties, v-f reductions are not defined in reference to values. However, a "path-independent" v-f reduction induces a value. We characterize v-f reductions that induce the Shapley value, the stand-alone value, and the Banzhaf value. Moreover, we can connect our approach to the literature on consistency because any value induced by a path-independent v-f reduction is consistent with that reduction.

**Title.** Vote Delegation and Misbehavior

**Authors.** Manvir Schneider, Akaki Mamageishvili, Hans Gersbach

**Session.** June 30, 14:00 - 15:30

**Abstract.** We study vote delegation with "well-behaving" and "misbehaving" agents and compare it with conventional voting. Typical examples are validation or governance tasks on blockchains. There is a majority of well-behaving agents, but since voting is costly, they may want to abstain or delegate their vote to other agents. Misbehaving agents always vote. We compare conventional voting allowing for abstention with vote delegation. Preferences of voters are private information and a positive outcome is achieved if well-behaving voters win. We provide three insights: First, if the number of misbehaving voters, denoted by  $X$ , is high, both voting methods fail to deliver a positive outcome. Second, if  $X$  is moderate, conventional voting delivers a positive outcome, while vote delegation fails with probability one. Third, if  $X$  is low, delegation delivers a positive outcome with a higher probability than conventional voting. Finally, our results allow us assessing the performance of vote delegation which is known as "liquid democracy".

**Title.** Weak assortative multisided matching games

**Authors.** Javier Martínez de Albéniz, CARLOS RAFELS, Neus Ybern

**Session.** July 2, 14:00 - 15:30

**Abstract.** This paper analyzes an open question posed by Sherstyuk (1999) about how to relax the monotonicity condition on the array of a multisided matching game with complementarities. We close the open question in the positive: it is enough to request monotonicity on the entries in the central strip of the multisided array to guarantee Sherstyuk's results. In this way we introduce weak assortative multisided matching games. We also provide, for the first time in the multisided case, new formulas to obtain the maximum and minimum core payoff for any player, directly from the model's data.

**Title.** Weighted Shapley Value for Ambulance Repositioning

**Authors.** Rudramoorthi Thangaraj, Amit R K

**Session.** June 30, 9:00 - 10:30

**Abstract.** In emergency medical services (EMS) management, the ambulance service providers face a major challenge in locating and relocating the ambulances in real-time to reduce the response time in addressing the emergency requests. Based on the data collected from an ambulance service provider in Chennai, the average response time is 16 minutes, which is higher than the benchmark standard of 8 minutes. Among the several strategies, the repositioning of ambulances (Alanis et al.,2013) is considered most familiar among the EMS service providers to improve operational efficiency. Determining the importance of each base station in the EMS network is necessary to develop a dynamic repositioning policy for ambulances. In this study, we focus on analyzing the interaction among the base stations to provide services. Also, while deploying the ambulances in the base stations the EMS provider considers the coverage in that area and its support to neighboring base stations. The cooperative game theory was used to study these interactions in the EMS network (Fragnelli et al.,2017). Following a similar approach, we consider base locations as the players, and the characteristic function is defined based on the number of demands covered within a threshold time. Each base station may not be symmetrical in providing the coverage due to uncertainty in the travel time. Hence, the characteristic function is modified by considering the uncertainty in the travel time. The worth of each player in the coalitions is determined using the weighted Shapley value (Kalai and Samet,1987). The proposed method is used to develop the compliance table and the relocation policy for the EMS service provider operating in Chennai. The results showed that the relocation plan based on the Shapley value compliance improved the coverage as compared with criticality-based compliance. Further, this study can be extended by considering the randomness in demand.

**Title.** Weighted values via face games

**Authors.** Estela Sánchez Rodríguez, Miguel Ángel Mirás Calvo, Iago Núñez Luigilde, Carmen Quintero Sandomingo

**Session.** July 1, 9:00 - 10:30

**Abstract.** Face games were introduced initially for the class of convex games ([2]) and generalized to the class of balanced games ([4]). Each face of the core contains the best stable allocations for a coalition provided that the members of the complement coalition get their minimum worth inside the core. In [1], a hierarchical value is defined by applying the face games repeatedly to an ordered partition of the players. In this paper we introduce nonsymmetric weight systems, similarly to the model of [3], and define new weighted values via face games. The system of weights can be extended not only to single-player coalitions but also to arbitrary coalitions. The (symmetric) Shapley value ([5]) can be obtained as a particular case. Properties of these values are studied to compare them with the classical weighted Shapley values ([3]) and with the weighted-egalitarian Shapley values ([6]). REFERENCES: [1] FIESTRAS-JANEIRO, M.G., SÁNCHEZ RODRÍGUEZ, E., AND SCHUSTER, M., A precedence constraint value revisited. TOP 24, 156–179, (2015). [2] GONZÁLEZ-DÍAZ J. AND SÁNCHEZ-RODRÍGUEZ E., Cores of convex and strictly convex games. Games and Economic Behavior 62, 100–105, (2008). [3] KALAI, E. AND SAMET, D., On weighted Shapley values. International Journal of Game Theory 16(3), 205–222, (1987). [4] MIRÁS CALVO, M.A., QUINTEIRO SANDOMINGO, C., AND SÁNCHEZ-RODRÍGUEZ, E., The boundary of the core of a balanced game: face games. International Journal of Game Theory 49, 579–599, (2020). [5] SHAPLEY, L.S., A Value for n-Person Games In: Kuhn H.W., Tucker A.W. (eds). Contribution to the Theory of Games II, vol 28 of Annals of Mathematics Studies, Princeton University Press, 307–317, (1953). [6] TAKA AKI, A. AND SATOSHI, N., The weighted-egalitarian Shapley values Social Choice and Welfare 52, 197–213, (2019).

**Title.** Horizontal differentiation in a Hotelling Network with uncertainty on costs

**Authors.** Joao Paulo Almeida

**Session.** July 1, 14:00 - 15:30

**Abstract.** We develop a theoretical framework to study the location-price competition under uncertainty of firms' production costs. Firms compete in a two-stage Hotelling-type network game, with linear transportation costs. We show the existence of a Bayesian-Nash equilibrium price if, and only if, some explicit conditions on the expected production costs and on the network structure hold. Furthermore, we prove that the local optimal location of the firms are at the nodes of the network.

**Title.** Evolutionary information search dynamics against fake news

**Authors.** Alberto Pinto, José Martins

**Session.** June 30, 16:00 - 17:30

**Abstract.** Inspired in Daley-Kendall and Goffman-Newill models, we propose an Ignorant-Believer-Unbeliever rumor (or fake-news) spreading model with the following characteristics: (i) a network contact between the individuals that determine the spread of the rumors; (ii) a value (benefits versus costs) for the individuals who search for truthful information (learning); (iii) an impact measure that assess the risk of believing on the rumor; (iv) an individual search strategy (or learning strategy) based on the probability that an individual searches for truthful information; (v) a population search strategy based on the proportion of individuals of the population who decide to search for truthful information; (vi) a payoff for the individuals that depends on the parameters of the model and the strategies of the individuals. Furthermore, we introduce the evolutionary information search dynamics (or learning dynamics) and study the dynamics of the population search strategies. For each value of searching for information, we compute the evolutionary stable information search strategies (occurring in non-cooperative environments) that are the attractors of the information search dynamics; and the optimal information search strategy (occurring in, eventually forced, cooperative environments) that maximizes the expected information payoff of the population. For rumors that are advantageous or harmful to the population (positive or negative impact), we show the existence of distinct scenarios that depend on the value of searching for truthful information. We fully discuss which evolutionary stable information search strategies and which optimal information search strategies eradicate (or not) the rumor and the corresponding expected payoffs.

**Title.** Vaccination cycles for the reinfection SIRI model

**Authors.** Alberto Pinto, José Martins

**Session.** July 2, 9:00 - 10:30

**Abstract.** For diseases in which vaccination is not compulsory, individuals take into account different aspects when deciding between to vaccinate or not. The decision depends on the morbidity risks from vaccination and from infection, but also depends on the probability of being infected, that varies with the course of the disease and the decisions of other individuals. Using some basic game theoretical concepts, we study the evolution of the individual vaccination strategies depending upon the morbidity risks and upon the parameters of the basic reinfection SIRI model. In [1], it was introduced the evolutionary vaccination dynamics for a homogeneous vaccination strategy of the population. Here, we introduce the dynamical evolution of the morbidity risks and we observe the emerging of periodic vaccination strategies.

**Title.** Properties of anti-manipulation method

**Authors.** Honorata Sosnowska

**Session.** June 30, 16:00 - 17:30

**Abstract.** There is considered situation in classical music competitions where jurors vote who will be a

winner. Such situation is also in some other competitions, for example sport competitions and experts' assignments. There are suspicions there jurors manipulate, form clique in classical music competitions. These suspicions were motivation to form a voting method which may diminish manipulation. It follows Gibbard (1973) and Satherwaitte (1975) theorem that it impossible to get full anti-manipulation but it is possible to create methods where it would be less comfortable to manipulate. Kontek and Sosnowska (2020) propose such method, called the anti-manipulation method. The method is constructed as follows. First, all jurors order contestants (alternatives) from the best to the worst without ties. For every contestant the mean of scores is computed. Then for every juror the distance of his vector of scores and the vector of means is computed. Jurors with the highest distance from the vector of means are removed. The Borda Count for remaining jurors is computed. It is assumed that a juror does not want to be removed and he does not use extreme scores for manipulation only. A distance maybe chosen in many ways. In what follows the Manhattan distance is used. The results depend on a choice of a distance. Removing jurors also maybe defined in many ways. In what follows the whole part of 20% of jurors is removed. Again, the results depend on a choice of a way of removing jurors. In this paper the properties of anti-manipulation method are presented. First, the method is not equivalent to any scoring function. It yields from the fact that scoring functions fulfill the consistency condition (Young 1975) and the anti-manipulation method does not (Ramsza, Sosnowska 2019). The consistency condition is also the basis of reasoning that the method is not equivalent to any of the following methods : Copeland, instant- runoff, Kemeny-Young, majority judgment (Balinski – Laraki), minimax, ranked pairs, Schulze. The counter-examples for the consistency condition for these methods does not work for the anti-manipulation method (Ramsza, Sosnowska 2019). Other properties follow properties considered in Nurmi (2004) and Nurmi and Felsenthal (2018). The Condorcet winner maybe not the anti-manipulation method winner. The Condorcet looser maybe the anti-manipulation method winner. The anti-manipulation method is invulnerable to reversal bias paradox. That means that the alternative cannot be a winner according some order and its reversal order. The anti-manipulation method is vulnerable to the non show paradox. It means that a group of voters can have a better result when they do not vote than when they vote. A method fulfills the subset choice condition if a winner chosen from a subset of a set of alternatives  $S$  is also chosen from the set  $S$ . If the method does not choose the Condorcet winner as a winner, the method does not fulfill the subset choice condition. So, the anti-manipulation method does not fulfill the subset choice condition. A method is homogeneous if the choice is invariant under multiplication of voters. The anti-manipulation method id homogeneous only for special multiplications. A method is monotonic if a winner remains a winner when a voter or a group of voters assign him higher in their preferences. The anti-manipulation method is monotonic in case of 2 alternatives. There is an open problem for other cases

**Title.** Multi-issue bankruptcy problems with crossed claim

**Authors.** Rick Acosta, Encarnación Algaba, Joaquín Sánchez-Soriano

**Session.** June 30, 14:00 - 15:30

**Abstract.** In this paper, we introduce a novel model of multi-issue bankruptcy problem inspired from a real problem of abatement of emissions of different families of pollutants in which pollutants can belong to more than one family. In our model, therefore, several perfectly divisible goods (estates) have to be allocated among certain set of agents (claimants) that have exactly one claim which is used in all estates simultaneously. In other words, unlike of the multi-issue bankruptcy problems already existent in the literature, this model study situations with multi- dimensional states, one for each issue and where each agent claims the same to the different issues in which participates. In this context, we present an allocation rule that generalizes the well-known constrained equal awards rule (CEA) from a procedure derived from analyzing the CEA rule for classical bankruptcy problems as the solution to a sucession of linear programming problems. Next, we carry out an study of its main properties, and we characterize it using the well-known property of consistency.

**Title.** Criticality orders in flow situations

**Authors.** Teresa Estañ, Vito Fragnelli

**Session.** July 1, 14:00 - 15:30

**Abstract.** In this work we define several simple games related to the network flow problems. In particular, we are focused on the Path problem, that is the problem of sending a flow from the source to the sink, independent of the flow value or other concepts, e.g. the minimum path. We are interested in analyzing the relevance of the players (arcs) of the game. To do that, we study the path problem from the point of view of criticality orders. To give a solution to this situation, we present two different approaches: Quantitative (by computing two power index) and qualitative (by ranking the players).

**Title.** Social solidarity with dummies in the museum pass problem

**Authors.** Ricardo Martínez, Joaquín Sánchez-Soriano

**Session.** June 30, 9:00 - 10:30

**Abstract.** We study the problem of sharing the revenue obtained by selling museum passes from the axiomatic perspective. In this setting, we propose replacing the usual dummy axiom with a milder requirement: social solidarity with dummies. This new axiom formalizes the philosophical idea that even null agents/museums may have the right to receive a minimum allocation in a sharing situation. By replacing dummy with social solidarity with dummies, we characterize several families of rules, which are convex combinations of the uniform and Shapley approaches. Our findings generalize several existing results in the literature. Also, we consider a domain of problems that is richer than the domain proposed by Ginsburgh and Zang (2003) in their seminal paper on the museum pass problem.