



GAMES

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5th World Congress of the Game Theory Society



EC16

17th ACM Conference on
Economics and Computation

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BOOK OF ABSTRACTS

Maastricht, July 19 2016

Dear participants of GAMES 2016 and EC'16,

This document contains the abstracts of all talks and poster presentations, insofar as these were available. The first part presents all the abstracts for GAMES, session by session and in chronological order, while the second part, starting at page 237, does so for EC'16. For searching specific talks or posters, please use the standard pdf search options like CTRL-F.

We are grateful to the programme committees of the two conferences for bringing together an excellent group of scientists and we thank Katharina Schüller for preparing this document.

Kind regards,

Local Organizers GAMES 2016 and EC'16

GAMES 2016

Abstracts

Robust Mechanism Design of Exchange

Tomasz Szadzik and Pavel Andreyanov

Session: Sun9-A

We provide a robust (or detail-free) strategic foundation for the Walrasian Equilibrium: a mechanism for an exchange economy with asymmetric information and interdependent values that is ex-post individually rational, incentive compatible, generates budget surplus and is ex-post nearly Pareto Efficient, when there are many agents. The level of inefficiency is proportional to the impact a single agent has on the Walrasian price. Conversely, we show that mechanisms generating smaller efficiency losses must violate some of the constraints, and so our efficiency bound is tight. The tight robust asymptotic efficiency is achieved by σ -Walrasian Equilibrium mechanisms, in which the allocation is as if each agent traded knowing all the information distributed in the economy, faced with the price that increases in the quantity traded with slope σ .

Position auctions with endogenous supply

Sergei Izmalkov, Dilyara Khakimova and Gleb Romanyuk

Session: Sun9-A

We consider a multi-object private values setting with quantity externalities: a value to a bidder from an object may depend on the total number of objects sold. For example, the likelihood a customer will respond to an advertisement is higher the fewer other advertisements are shown; a spectrum license is more valuable the fewer licenses are being allocated. We raise and solve the problem of finding revenue maximizing and efficiently allocating auctions in such a setting. We show that both optimal and efficient auctions have the property that the quantity of objects sold depends non-trivially on the whole profile of players' valuations. That is, the quantity to sell is determined endogenously, within the auction. We demonstrate that auctions currently used for allocating advertising positions are suboptimal and offer simple designs that can implement (or approximate) optimal and efficient auctions under quantity externalities.

Simple Pricing Schemes for Consumers with Evolving Values

Shuchi Chawla, Nikhil R. Devanur, Anna Karlin and Balasubramanian Sivan

Session: Sun9-A

We consider a pricing problem where a buyer is interested in purchasing/using a good, such as an app or music, repeatedly over time. The consumer's value for the good evolves with each use. Optimizing seller's revenue in such dynamic settings is a complex problem and requires assumptions about buyer's behavior before learning his future value(s), and in particular, how he reacts to risk. We ask whether it is possible to achieve meaningful revenue guarantees in such a setting in a detail-free manner. We explore the performance of a class of simple-to-use pricing mechanisms where the buyer reacts to prices myopically

and the seller needs to optimize for revenue over a space of only two parameters. We show that when the buyer's value evolves as a martingale, a pricing mechanism of this form is approximately optimal regardless of the buyer's risk profile or fine details of the value evolution process.

Jump bidding in FCC spectrum auctions

Younghwan In

Session: Sun9-B

We investigate the bids submitted in spectrum auctions conducted by the Federal Communications Commission (FCC) during 1994-2008, most of which were simultaneous ascending auctions. Jump bidding was prevalent in these auctions. We test whether complementarity and substitutability among the auctioned licenses, the degree of competition, and the imposed rules affect bidders' jump-bidding behavior. We also test whether jump bidders were successful in deterring competitors and paying less when they win.

Optimal Structure and Dissolution of Partnerships

Simon Loertscher and Cedric Wasser

Session: Sun9-B

We study a partnership model with non-identical type distributions and interdependent values. For any convex combination of revenue and social surplus in the objective function, we derive the optimal dissolution mechanism for arbitrary initial ownership. This mechanism involves ironing around worst-off types, which are endogenously determined and typically interior. Given the optimal mechanism, we then determine the optimal initial ownership structures. Equal ownership is always optimal with identical distributions but not with non-identical distributions. When distributions are ranked by stochastic dominance, stronger agents receive higher initial ownership shares when the weight on revenue is small but not necessarily when it is large.

Patent Licensing, Entry and the Incentive to Innovate

Yair Tauman and Chang Zhao

Session: Sun9-B

We analyze the economic impact of process innovations when the innovator sells licenses to both potential entrants and incumbent firms. Licenses are sold by auction aiming to maximize the revenue of the innovator. The post innovation market structure, the diffusion of the innovation and the incentive to innovate are compared with the case where licenses are sold only to incumbent firms and not to entrants. It is shown, quite surprisingly, that opening the market to entrant licensees, the incentive to innovate is maximized in a monopoly market rather than oligopoly or competitive markets and this is true for drastic as well as non-drastic innovation.

Credence goods markets with heterogeneous experts

Nicolas Fugger, Florian Gössl and Joachim Heinzl

Session: Sun9-C

We analyze a credence goods market with regulated prices and heterogeneous experts. Experts are assumed to differ in the cost of treating a minor problem. We investigate the effect of this heterogeneity on the market level of fraud and overall welfare. We show that a cost reduction does not always increase welfare. We also analyze the incentives to invest in a cost reduction and find that a cost reduction increases welfare if sufficiently many experts are affected by it.

Market Institutions, Efficiency and Prices

Nejat Anbarci and Nick Feltovich

Session: Sun9-C

We theoretically and experimentally examine three common market institutions. In posting, sellers post fixed prices that are seen by buyers who then choose which seller to visit. Under haggling, prices are not posted, but emerge via negotiation or bidding depending on how many potential trading partners a seller has. Under flexible pricing, prices are posted but can be negotiated upwards or downwards like under haggling. We find that efficiency is highest under posting, though differences become smaller with time and experience. Transaction prices and thus sellers surplus are highest under haggling and lowest under posting, while buyers surplus has the reverse ordering. When there is local excess demand, sellers appropriate a majority of the surplus, but substantially less than the predicted amount. When there is no local excess demand, bargaining tends to favour the seller relative to the predictions of standard bargaining theory.

Tempting and Testing Through Costly Monitoring

Dhruva Bhaskar

Session: Sun9-D

A principal can hire an agent of hidden ability, but strictly prefers his outside option to hiring a low type. The agent's output when working is not observable so they cannot contract on performance. Every period that the agent is hired, a simultaneous move game is played. The principal sets the agent a test which is costless for the high type to pass and costly for the low type to pass, and the principal can monitor the result of the test at a cost. Without commitment, the principal's payoff in equilibrium is the same as never monitoring, independent of the cost of monitoring. With commitment, the principal's optimal contract involves monitoring even after learning that the agent is the high type.

Robust Sequential Search

Karl Schlag and Andriy Zapechelnyuk

Session: Sun9-D

We consider the problem of sequential search with free recall and discounting. Performance of a search rule for a given prior is measured as the fraction of the maximal payoff under this prior. A search rule is robust if it has a high performance under every prior. Bayesian search rules are not robust as, while being optimal under one prior, they can perform very poorly under a different prior. We present a search rule that performs well after any search history under any prior with a given support. In each round the rule stops searching with a probability that is linear in the best previous offer.

Frictions Lead to Sorting: a Partnership Model with On-the-Match Search

Ignacio Monzon and Cristian Bartolucci

Session: Sun9-D

We present a partnership model where heterogeneous agents bargain over the gains from trade and search on the match. Frictions allow agents to extract higher rents from more productive partners, generating an endogenous preference for high types. More productive agents upgrade their partners faster, therefore the equilibrium match distribution features positive assortative matching. Frictions are commonly understood to hamper sorting. Instead, we show how frictions generate positive sorting even with a submodular production function. Our results challenge the interpretation of positive assortative matching as evidence of complementarity.

Private Value Bargaining with Naive Players: Theory and Experiment

Alex Possajennikov and Rene Saran

Session: Sun9-E

This paper analyzes double-auction two-player bargaining with private values. We consider a setting with discrete two-value overlapping distributions of traders' valuations. We characterize all pure-strategy equilibria in the presence of traders that behave naively, i.e. set bid or ask equal to their valuation or cost. We show theoretically that equilibrium efficiency can be lower with more such traders. In the experiment, we vary the proportion of naive traders by introducing the possibility of being matched with a computer who behaves in the naive manner. Despite the theoretical possibility, efficiency is not lower with more naive traders in the experiment. Subjects behave strategically, setting bids lower than their values and asks higher than their costs, but they do not realize that the presence of more naive players allows for more strategic behavior. We also find evidence that framing the double auction as a direct mechanism lead to more naive behavior.

Bargaining with a Residual Claimant: An Experimental Study

Matthew Embrey, Kyle Hyndman and Arno Riedl

Session: Sun9-E

Most negotiations involve risks that are only revealed ex-post. Often these risks are not incurred equally by the parties involved. We experimentally investigate bargaining situations where one player is exposed to ex-post risk, whereas the other is not. We find that residual claimants extract a risk premium, which increases in risk exposure. This premium is sometimes high enough to make it advantageous to bargain over a risky rather than a risk-less pie. Standard theory captures some of our observations but important issues remain. First, comparatively less risk averse residual claimants benefit the most. Second, when given the chance, residual claimants tend to choose a riskier distribution of surpluses only when there is the possibility of an equal-split ex-post. Third, bargaining frictions increase as risk increases. Our results indicate that bargaining models require separation between the determinants of bargaining power and fair compensation for risk exposure.

An Experimental Study of Proposal Power in Legislative Bargaining

Suntak Kim and Enseen Tang

Session: Sun9-E

In this paper we experimentally investigate factors that affect the proposal power in Baron-Ferejohn legislative bargaining experiments. As is shown in the previous literature about experimental bargaining, we find that proposal power is smaller than what the equilibrium model predicts. However, the proposal power of legislators decreases in the extent to which people value the future payoffs (discount factor), increases in the number of bargaining group size (competition effect), and appears greater under simple majority than unanimity rule. Our study thus confirms the comparative static predictions of rational-choice model of multilateral bargaining and suggests simple but important controls for proposer behavior.

Multi-period Matching with Commitment

Mu Zhang

Session: Sun9-F

Many multi-period matching markets exhibit some level of commitment. That is, agents' ability to terminate an existing relationship is somehow restricted by cost of divorce, binding contracts or social norms. Based on real-world examples, this paper models matching markets with commitment of different restrictive power, defines notions of stability and corresponding stable mechanisms, as well as specifying conditions for efficiency, strategy-proofness and other properties. Specifically, the market with full commitment (no divorce) resembles the static matching market the most, but there is no stable matching mecha-

nism based on spot markets without assuming no preference cycle. By comparison, the market with one-sided commitment requires more assumptions about preferences, such as Sequential Improvement Complementarity (SIC, Kadam and Kotowski, 2015a), to produce satisfactory outcomes. We also show how to incorporate external entries and exits of agents, which are incompatible with SIC, into the model with one-sided commitment.

Matching Strategies of Heterogeneous Agents in a University Clearinghouse

Britta Hoyer and Nadja Maraun

Session: Sun9-F

In actual school choice applications the theoretical underpinnings of the Boston Mechanism (BM) (complete information and rationality of the agents) are often not given. We analyze the actual behavior of agents in such a matching mechanism, using data from the matching mechanism currently used in a clearinghouse at Paderborn University, where a variant of BM is used and supplement this data with data generated in a survey among students who participated in the clearinghouse. We find that under the current mechanism over 70% of students act strategically. Controlling for students' limited information, we find that they do act rationally in their decision to act strategically. However, we do not find evidence that they follow any of the strategies advised in the literature. While students thus seem to react to the incentives to act strategically under BM, they do not seem to be able to use this to their own advantage.

Matching Problems with Priorities and Preferences: Compulsory Social Service Allocation in Colombia

Paula Jaramillo, Cagatay Kayi and Santiago Velez

Session: Sun9-F

We study manytoone matching problems where doctors have strict preferences over hospitals, hospitals have strict preferences over sets of doctors, and the law assigns priorities to hospitals over sets of doctors. We are interested in mechanisms that are efficient, stable, strategy-proof, minimize unfilled positions, and respect priorities. We show that the mechanisms used in Colombia do not satisfy any of these properties. We modify three mechanisms: the deferred acceptance, the immediate acceptance, and the top trading cycle. None of these mechanisms is efficient and stable, but all minimize unfilled positions. The deferred acceptance and the top trading cycle are strategy-proof. The deferred acceptance is the only one that respects priorities. We introduce a weakening of stability and efficiency, constrained stability and constrained efficiency respectively. We show that the deferred acceptance is the only constrained stable, but the top trading cycles and the immediate acceptance are the only constrained efficient.

Strategy-Proofness and Efficiency for Tiered Objects Preferences

Yu Zhou and Shigehiro Serizawa

Session: Sun9-G

We consider the allocation problem of assigning heterogeneous objects to agents and determining their payments. Each agent receives at most one object. Agents have non quasi-linear preferences over pairs consisting of an object and a payment. Under non quasi-linear setting, we focus on the situations where if objects are equally priced, (i) agents have the common ranking over objects or (ii) objects are partitioned into several tiers, and agents have the common ranking over object tiers. The minimum price Walrasian rule is a rule that assigns a minimum price Walrasian equilibrium to each preference profile. We establish that on both common object ranking domain and common tiered object domain, an allocation rule satisfies efficiency, strategy-proofness, individual rationality and no subsidy if and only if it is the minimum price Walrasian rule. Similar characterizations hold for subdomains including preferences only exhibiting positive income effects, or only exhibiting negative income effects.

Partial Strategyproofness: An Axiomatic Approach to Relaxing Strategyproofness for Assignment Mechanisms

Timo Mennle and Sven Seuken

Session: Sun9-G

We introduce partial strategyproofness, a relaxed notion of strategyproofness, to study the incentive properties of non-strategyproof assignment mechanisms. Under partially strategyproof mechanisms, truthful reporting is a dominant strategy for agents whose values for any two objects are sufficiently different. A single numerical parameter, the degree of strategyproofness, controls the extent to which agents values must differ. We provide a new axiomatic decomposition of strategyproofness, and we show that partial strategyproofness arises by dropping the least important of the axioms and that the underlying domain restriction is maximal. Then we show that partial strategyproofness can alternatively be defined in terms of partial dominance, that it is intermediate between strategyproofness and many relaxed incentive concepts, and that it unifies two prior local sufficiency results. It enables the comparison of important non-strategyproof mechanisms such as Probabilistic Serial, two variants of the Boston mechanism, the HBS Draft mechanism, and new hybrid mechanisms.

Strategy-Proofness and Essentially Single-Valued Cores Revisited

Lars Ehlers

Session: Sun9-G

We consider general allocation problems with indivisibilities where agents' preferences possibly exhibit externalities. In such contexts many different core notions were pro-

posed. One is the gamma-core whereby blocking is only allowed via allocations where the non-blocking agents receive their endowment. We show that if there exists an allocation rule satisfying individual rationality, efficiency, and strategy-proofness, then for any problem for which the gamma-core is non-empty, the allocation rule must choose a gamma-core allocation and all agents are indifferent between all allocations in the gamma-core. We apply our result to housing markets, coalition formation and networks.

Interior-Point Methods for Dynamic Markov Games

Pieter Collins and Frank Thuijsman

Session: Sun9-H

In this talk, we will describe the use of interior-point methods to find Nash equilibria for discrete-time Markov games with discounting. The approach uses the formulation for the Nash equilibrium conditions for a stationary strategy as a nonlinear complementarity problem, with dual variables representing expected payoffs. We formulate the equations of the central path for a primal-dual interior-point method, and show that these can be efficiently solved using Newton's method, with the dual variable updates determining the updates of the primal variables. We illustrate our approach with an example of a simple two-player game, and consider the limiting solutions without discounting.

Dynamic Games with Almost Perfect Information

Wei He and Yeneng Sun

Session: Sun9-H

This paper aims to solve two fundamental problems on finite or infinite horizon dynamic games with complete information. Under some mild conditions, we prove (1) the existence of subgame-perfect equilibria in general dynamic games with simultaneous moves (i.e. almost perfect information), and (2) the existence of pure-strategy subgame-perfect equilibria in perfect-information dynamic games with uncertainty. Our results go beyond previous works on continuous dynamic games in the sense that public randomization and the continuity requirement on the state variables are not needed. As an illustrative application, a dynamic stochastic oligopoly market with intertemporally dependent payoffs is considered.

Type-Symmetric Randomized Equilibrium

Xiang Sun, Yeneng Sun and Haomiao Yu

Session: Sun9-J

We introduce the notion of type-symmetric randomized equilibrium (TSRE) by requiring those agents with the same type of characteristics to choose the same randomized choice. Such a notion provides a generic micro-foundation for the macro notion of equilibrium distribution, as used in the literature on games and economies with many agents.

In particular, we show that if the space of agents is modeled by the classical Lebesgue unit interval, any Nash (resp. Walrasian) equilibrium distribution in a large game (resp. economy) is uniquely determined by one TSRE. Furthermore, we provide examples to demonstrate that this uniqueness characterization does not necessarily hold when a non-Lebesgue agent space is used.

A Notion of Statistical Equilibrium for Games with Many Players

Peter Hammond

Session: Sun9-J

The economists ideal of a perfectly competitive market involves many participants. Such a market is often described using a game with many players. Similar games arise when economists discuss public finance, mechanism design, insurance, and macromodels of national or international economies. Formally, the player set in a large game has usually been represented by the uniform probability distribution over the Lebesgue unit interval of the real line. Yet this poses significant measurability issues, especially when considering a probability distribution over profiles of all players strategies. This has recently led some mathematical economists to explore greatly enriched player spaces. Here I propose a more workable statistical approach that distinguishes between the unit interval of potential players and the countably infinite set of actual players drawn randomly from this interval. Then a suitable Bayesian Nash statistical equilibrium in pure strategies exists for a broad class of large games.

Nearly-Pure Equilibria of Large Games

Guilherme Carmona

Session: Sun9-J

We consider Nash equilibria of large semi-anonymous finite-player games which are nearly pure, in the sense that a large fraction of players play a pure strategy. We show that (a) nearly-pure Nash equilibria may fail to exist no matter how large the number of players is, (b) regular equilibria of non-atomic games may fail to yield a nearly-pure Nash equilibrium in all sufficiently large finite-player games that are sufficiently close to the non-atomic game and (c) the same holds for strict equilibria of non-atomic games with infinite action spaces. Despite these difficulties, we show that for generic distributions of players' characteristics (i.e. action sets and payoff functions), nearly-pure Nash equilibria exist in all sufficiently large finite-player games with a distribution of characteristics sufficiently close to the given one. This result is then applied to the setting of Mas-Colell (1983).

Strategic teaching and learning in games

Burkhard Schipper

Session: Sun9-K

We show that there is no uncoupled learning heuristic leading to Nash equilibrium in all finite games that a player has an incentive to adopt, that would be “evolutionary stable” or that could “learn itself”. Rather, a player can strategically teach such a learning opponent in order to secure at least the Stackelberg leader payoff. This holds even when we restrict to the class of generic games, two-player games, potential games, games with strategic complements or 2x2 games, in which learning is known to be “nice”. It also applies to uncoupled learning heuristics leading to correlated equilibria, rationalizability, iterated admissibility, or minimal curb sets.

An Experiment on Behavior, Learning, and Forgetfulness in Inductive Game Theory

Ai Takeuchi, Yukihiro Funaki, Mamoru Kaneko and Jeffrey Kline

Session: Sun9-K

We conduct an experimental study on behavior and cognition in various 22 games with/without role-switching from the perspective of inductive game theory (IGT). Here, subjects have no prior knowledge about payoffs and can only learn them by playing the game. Without role-switching, subjects can, and many do, successfully learn their own payoffs. To learn the payoffs of the other, role-switching is required. While this gives more information about the whole structure, subjects do not learn all payoffs successfully. We find that role-switching has both behavioral and cognitive effects. On the behavioral side, without role-switching, many subject pairs converged to a Nash equilibrium. With role-switching, subject pairs converged to either Nash or ICE (intrapersonal coordination equilibrium) maximizing the average payoffs, as predicted by IGT. On the cognitive side, correct recall of payoffs is positively correlated with the number of experiences but is negatively correlated with convergence to some action pair.

Queueing to learn

Chiara Margaria

Session: Sun9-K

I study a model of strategic experimentation with direct payoff externalities. A continuum of forward-looking players compete for a scarce resource; each player's valuation is uncertain, and evolves independently from other players. The strategic interaction arises from congestion, as players engage in costly queueing in their exploration phases. I solve for the unique stationary equilibrium under different service disciplines, and address the problem of designing the optimal service discipline. Congestion always generates over-experimentation with respect to the efficient solution. Next, I study the problem of the

monopolist who chooses the throughput rate in order to maximize profit. The optimal level of congestion trades off the size of the customer base and the speed of service. I show that profit-maximization leads to excessively slow service, providing an explanation for long lines in economic applications.

Contests Evolving

Caleb Koch and Heinrich Nar

Session: Sun9-L

We consider repeated strategic interactions where individuals take two kinds of actions. In the moment, they repeatedly make competitive investments to appropriate recurring rivalrous resources. Over time, they invest into lobbying activities to change the competitiveness of the environment. Environments vary with respect to (i) the competitiveness of the environment (endogenously) and (ii) the degrees of foresight and asymmetry in contest efficacy amongst competitors (exogenously). The main contribution of our study is to show how the long-run stable levels of the former (i) dynamically depend on the latter (ii). Our model predicts correspondences between these factors, and quantifies the resulting social loss due to rent-seeking for each case.

The Reverse War of Attrition

Christian Seel

Session: Sun9-L

This paper analyzes a contest in which rivals cannot observe each other's effort decisions. The designer maximizes discounted aggregate effort by choosing a starting time and a deadline of the contest. At the deadline, the contestant who exerted most effort wins a prize, which consists of the endowment of the designer plus collected interest. I determine the Nash equilibria of the contest for all possible choices of starting time and deadline. The combination which maximizes discounted aggregate effort is characterized in closed form. I consider several extensions such as different types of asymmetries, a different contest success function and a different goal function of the designer.

Repeated Contests with Private Information

Greg Kubitz

Session: Sun9-L

In repeated contests with private information, weak contestants prefer to appear strong while strong contestants prefer to appear weak. In contrast to a single contest, this leads to an equilibrium where effort is not strictly monotonic in ability and allows for a less able contestant to win against a contestant of higher ability. While the aggregate payoffs of contestants are higher per contest than in the single contest benchmark, aggregate output per contest is lower. Depending on the economic setting, the presence of private

information can lead to productive or allocational inefficiencies.

Maximal Cooperation in Repeated Games on Social Networks

Catherine Moon and Vincent Conitzer

Session: Sun9-N

Standard results on and algorithms for repeated games assume that defections are instantly observable. In reality, it may take time for the knowledge that a defection has occurred to propagate through social networks. How does this affect the structure of equilibria and algorithms for computing them? In games with cooperation and defection, we prove that there exists a unique maximal set of forever-cooperating agents in equilibrium and give an efficient algorithm for computing it. Through simulations with random graphs, we observe a phase transition between cooperation everywhere and defection everywhere, based on the value of cooperation and the discount factor. We give an analytical expression for where the phase transition occurs and prove its accuracy (in the limit). Finally, we provide a condition for when the equilibrium found is credible, in that agents will in fact punish deviating agents. This condition always holds in our simulations, for sufficiently large graphs.

Unique Stability Point in Social Storage

Pramod Mane, Kapil Ahuja and Nagarajan Krishnamurthy

Session: Sun9-N

We analyze Social Storage systems based on strategic network formation games. Given the disk-failure-rate and the cost to add and maintain links, we define utilities of players in two frameworks, one where costs to add and maintain links are considered in the utility and another where budget constraints are considered. We, then, adapt the pairwise stability concept for Social Storage where both addition and deletion of links require mutual consent. We prove that, for symmetric storage networks with N players, there exists a unique stability point n . That is, all players try to achieve degree n . In particular, if N or n is/ are even, and if $N \geq n$, then n -regular networks on N vertices are the only stable Social Storage networks, unique up to isomorphism. We provide conditions for a Social Storage network to be stable, in general, and also discuss the number of non-isomorphic stable networks.

Paradoxical examples of games on social networks

Mikhail Raskin and Nikita Nikitenkov

Session: Sun9-N

Paradox of choice occurs when permitting new strategies to some players yields lower pay-offs for all players in the new equilibrium via a sequence of individually rational actions. We consider social network games. In these games the payoff of each player increases

when other players choose the same strategy. The definition of games on social networks was introduced by K. Apt and S. Simon. In an article written jointly with E. Markakis, they considered four types of paradox of choice in such games and gave examples of three of them. The existence of paradoxical networks of the fourth type was proven only in a weakened form. The existence of so-called vulnerable networks in the strong sense remained an open question. In the present paper we solve this open question by introducing a construction, called a cascade, and use it to provide uniform examples for all four definitions of paradoxical networks.

Fads and changing tastes

Nick Janetos

Session: Sun9-P

I analyze a model of fads. A fad is when a choice with no intrinsic value becomes popular, then unpopular. For example, in the 1960s, tailfins on cars were popular, in the 1970s, they were not. In the model, fads are driven through the channel of imperfect information. Some players have better information about the past actions of other players and are interested in communicating this through their own action choices. I show that in equilibrium, better informed players initially pool on a single action choice. Over time, the rest of the players learn which action the better-informed players are pooling on, and start to mimic them. Once a tipping point is reached, the better-informed players switch to a different action, and the process repeats.

Rational Allocation of Attention in Decision-Making

Stefanie Schmitt

Session: Sun9-P

This paper proposes a model of rational attention allocation. An agent chooses between attention strategies to maximize her expected utility in a choice between two options. The optimal choice is given stochastically and the processing of information is costly. An attention strategy specifies which and in which order pieces of information are processed. Results demonstrate the superiority of three attention strategies: inattention, direct selection of decisive information, and a more complex conditional selection. This provides a rational foundation for bottom-up and top-down control of attention, reported in the psychological literature. Further, attention is context dependent and low processing costs do not guarantee processing. Strategic considerations of the supply side reveal an incentive to produce the opposite quality of what agents expect and opportunities to exploit agents.

From Rationality to Irrationality : Dynamic Interacting Structures

Aleen Lotz, Pierre Gosselin and Marc Wambst

Session: Sun9-P

This article develops a general method to solve dynamic models of interactions between multiple strategic agents. It describes a general model of several interacting agents, their domination relations and a graph encoding their information pattern. It provides a general resolution algorithm and discusses the dynamics around the equilibrium. Our model explains apparent irrational or biased individual behaviors as the result of the actions of several goal-specific rational agents. In a three-agent model describing the conscious, the unconscious, and the body, we show that, when the unconscious strategically dominates, the equilibrium is unconscious-optimal, but body and conscious-suboptimal. Our results allow for a precise account of agents' time rate preference. Myopic behavior among agents leads to oscillatory dynamics. This describes cyclical and apparently inconsistent or irrational behaviors in the dual agent.

Unawareness of Decision Criteria in Multicriteria Games

Yasuo Sasaki

Session: Sun9-Q

The present paper incorporates unawareness of decision criteria into multicriteria games. This is also an extension of single-criterion games with unawareness to the multicriteria case, though I focus only on unawareness of criteria. Generalized Pareto equilibria are defined as the equilibrium concept of the extended framework. The equilibria coincide with generalized Nash equilibria of weighted games with unawareness and their existence is proved. I also discuss how unawareness of criteria may change the set of equilibria with some illustrative examples.

Choice Regularities Relative identification of choice theories

Kemal Yildiz

Session: Sun9-Q

For a given choice function, a first order regularity is an if...then requirement of the form: if some alternative a_1 is chosen from some choice set S_1 , then some alternative a_2 should be chosen from some choice set S_2 . This definition is extended to k th-order regularity by having k -many choice requirements in the precedent part of the statement. A choice theory is k th-order regular if one can find a collection of k th-order regularities that identifies this theory. I use the order of regularity to discipline the complexity of a choice axiom. I characterize the neutral choice theories that nest rational choice and are 1-regular. As my main result, I consider a family of boundedly rational choice theories, and characterize all the second order regularities that might be satisfied by any of these theories. I observe that second-order regular, second order regularities are sufficient to

observationally disentangle each theory.

Typology of beliefs and rationalizability with many players

Michael Greinecker

Session: Sun9-Q

This paper extends the Harsanyi types model of beliefs to games in which there can be both negligible and nonnegligible players. A universal type space exists in which every other type space can be uniquely embedded. The abstract types model is then used to explicitly characterize rationalizability, suitably formulated, as behavior compatible with common knowledge of rationality.

Characterization sets for the nucleolus in balanced games

Tamas Solymosi and Balázs Sziklai

Session: Sun9-R

We provide a new modus operandi for the computation of the nucleolus in cooperative games with transferable utility. Using the concept of dual game we extend the theory of characterization sets. Dually essential and if the game is monotonic dually saturated coalitions determine both the core and the nucleolus whenever the core is non-empty. We show how these two sets are related to the existing characterization sets. In particular we prove that if the grand coalition is vital then the intersection of essential and dually essential coalitions forms a characterization set itself.

Insights into the nucleolus of the assignment game

Javier Martinez-De-Albeniz, Carlos Rafels and Neus Ybern

Session: Sun9-R

The assignment game (Shapley and Shubik, 1972) is a model for a two-sided market where there is an exchange of indivisible goods for money and buyers or sellers demand or supply exactly one unit of the good. The potential profit obtained by a buyer and a seller if they trade can be represented in a matrix, the assignment matrix. We show that the family of assignment matrices which give rise to the same nucleolus form a compact join-semilattice with one maximal element, which is always a valuation (see p.43, Topkis (1998)). We give an explicit form of this valuation matrix. The above family is in general not a convex set, but path-connected, and we construct minimal elements of this family. We analyze the conditions to ensure that a given vector is the nucleolus of some assignment game. We study a specific rule to compute the nucleolus in some cases.

A monotony-based simplified method for computing interval least square prenucleolus of interval cooperative games

Yin-Fang Ye, Deng-Feng Li and Xun-Feng Hu

Session: Sun9-R

Least square prenucleolus is one of the important solutions of cooperative games. The main purpose of this paper is to extend it to interval cooperative games. In this method, through adding some weaker coalition monotony-like conditions, it is proven that the least square prenucleolus of cooperative games is a monotonic and non-decreasing function of coalitions values. Hence, we can respectively obtain the lower and upper bounds of the interval least square prenucleolus, which form the interval least square prenucleolus of interval cooperative games. Hereby, we develop the concept of interval least square prenucleolus of interval cooperative games and its simplified method. The method proposed in this paper does not use the Moores interval subtraction and hereby can effectively overcome the issues resulted from the Moores interval subtraction. Moreover, real numerical examples are used to demonstrate the feasibility and applicability of the method proposed in this paper.

Reconciling Rationality and Stochasticity: Rich Behavioral Models in Two-Player Games

Mickael Randour

Session: Sun9-S

Two traditional paradigms describe the behavior of agents in multi-agent complex systems: full rationality (systems seen as multi-player games) and full stochasticity (systems seen as large stochastic processes). From the standpoint of a particular agent having to choose a strategy, the choice of the paradigm is crucial: the most adequate strategy depends on the assumptions made on the other agents. In this paper, we focus on two-player games and their application to the automated synthesis of reliable controllers for reactive systems. In this setting, the system to control is a player, and its environment is its opponent, usually assumed to be fully antagonistic or fully stochastic. We illustrate several recent developments aiming to breach this narrow taxonomy by providing formal concepts and mathematical frameworks to reason about richer behavioral models. We illustrate those novel models on a classical challenge of the everyday life: planning a journey in an uncertain environment.

Completely Mixed Strategies for Generalized Bimatrix and Switching Controller Stochastic Game using Vertical Linear Complementarity Problem

Dipti Dubey and S. K. Neogy

Session: Sun9-S

In this paper, we revisit a result by Jurg et al. (1990) where the necessary and sufficient

condition for a bimatrix game to be weakly completely mixed is given. We present an alternate proof of this result using linear complementarity approach. We extend this result to a generalization of bimatrix game introduced by Gowda and Sznajder (1996) via a generalization of linear complementarity problem introduced by Cottle and Dantzig (1970). We further study completely mixed switching controller stochastic game (in which transition structure is a natural generalization of the single-controller games) and extend the results obtained by Filar (1985) for completely mixed single controller stochastic game to completely mixed switching controller stochastic game.

Linear Complementarity and the class of Structured Stochastic Games

S. K. Neogy and Dipti Dubey

Session: Sun9-S

A major area of research in the field of stochastic games is to identify those classes of zero-sum stochastic games for which there is a possibility of obtaining a finite step algorithm to compute a solution. These classes are referred in the literature as structured stochastic games. For a class of structured stochastic games, it is known that optimal stationary strategies exist and that the value vector and optimal stationary strategies satisfy the ordered field property. In this paper, we discuss the problem of computing the value vector and stationary strategies for the class of stochastic game with special structure as a linear complementarity problem (vertical linear complementarity problem) and obtain sufficient conditions for solvability using Lemke's algorithm or Cottle-Dantzig's algorithm (a generalization of Lemke's algorithm). We also discuss some open problems that arises in complementarity formulation associated with structured stochastic game.

Optimal Contracts for team experimentation

Aodi Tang

Session: Sun9-T

This paper considers the contracting issue of an innovation project between a principal and a team of agents where experimentation is required to explore the state of world. How many agents to hire is primary concern of the principal as the project is initiated. The decision could be made as if the principal takes entire expected payoff of the project into consideration. The model shows that the principal tends to hire less agents in correspondence to his downward-adjusted belief. And the principal's time preference alters his hiring choice. Patient principal would hiring less agents initially and experiments longer compared to impatient ones. To deal with the prevalent free-rider problem, the principal could charge each agent a certain price upfront given that a huge bonus would be provided as long as any one of them makes a success. Under this contract, the principal would benefit from extracting the entire surplus.

How to share it out: The value of information in teams

Alex Gershkov, Jianpei Li and Paul Schweinzer

Session: Sun9-T

We study the role of information exchange, leadership, and coordination in team or partnership structures. For this purpose, we view individuals jointly engaging in productive processes—a 'team'—as endowed with individual and privately held information on the joint production process. Once each team member decided on whether or not to share their private information truthfully, they individually choose which effort to exert in the joint production process. This effort, however, is not contractible; only the realized output (or profit) of the team can be observed. Our central question is whether or not incentives can be provided to a team in this environment such that team members communicate their private information and exert efficient productive efforts on the basis of this communication. Our main result shows that there exists a simple ranking-based contract which implements both desiderata in a wide set of situations.

Trick or Treat: Putting Peer Prediction to the Test

Xi Alice Gao, Andrew Mao, Yiling Chen and Ryan Adams

Session: Sun9-U

Collecting truthful subjective information from multiple individuals is an important problem in many social and online systems. While peer prediction mechanisms promise to elicit truthful information by rewarding participants with carefully constructed payments, they also admit uninformative equilibria where coordinating participants provide no useful information. To understand how participants behave towards such mechanisms in practice, we conduct the first controlled online experiment of a peer prediction mechanism, engaging the participants in a multiplayer, real-time and repeated game. Using a hidden Markov model to capture players strategies from their actions, our results show that participants successfully coordinate on uninformative equilibria and the truthful equilibrium is not focal, even when some uninformative equilibria do not exist or are undesirable. In contrast, most players are consistently truthful in the absence of peer prediction, suggesting that these mechanisms may be harmful when truthful reporting has similar cost to strategic behavior.

Informational Substitutes for Prediction and Play

Yiling Chen and Bo Waggoner

Session: Sun9-U

We propose definitions of substitutes and complements for pieces of information (signals) in the context of a decision problem. Informational substitutes capture diminishing marginal value of information, while complements capture increasing marginal value, with respect to a particular decision or prediction problem. The main application is to infor-

mation aggregation in prediction markets, which are toy models for financial markets. We show a broad characterization: Substitutes characterize existence of good market equilibria where information is immediately aggregated, while complements capture existence of bad or trivial equilibria where the efficient market hypothesis fails. This broadly generalizes previous results. We additionally examine the algorithmic problem of information acquisition under constraints, showing efficient algorithms when signals are substitutes, but computational hardness in general. The total set of results and characterizations give some evidence that, in parallel with substitutable goods, informational substitutes play a natural role in some fundamental contexts.

Optimal Selling Mechanisms for On-line Services I: Price Discrimination and the Risk of Interruption

Georgios Petropoulos

Session: Sun11-A

We study the economic rationale of the use of auctions and posted price selling mechanisms for the simultaneous allocation of on-line services having the infrastructure as a service public cloud computing market as a motivating example. By offering both selling mechanisms, the monopolist of a homogeneous good can discriminate among buyers of different private valuations. Auctioning the services can be designed so as to incorporate the risk for the winners of losing access to their service while it is still in operation. The posted price can by construction eliminate that risk. Buyers of high valuations prefer to pay a risk premium and get the service through the posted price mechanism while buyers of low valuations unable to meet the price level of the risk premium enter the auction. This is the optimal selling mechanism when the cost of interruption in the auction is high affects primarily the high valuation buyers.

Multi-dimensional Virtual Values and Second-degree Price Discrimination

Nima Haghpanah and Jason Hartline

Session: Sun11-A

We consider a multi-dimensional screening problem of selling a product with multiple quality levels. We show that only offering the highest quality is the revenue optimal mechanism if high valued customers are relatively less sensitive to quality. Our main methodological contribution is a framework to design multi-dimensional virtual values. A challenge of designing virtual values for multi-dimensional agents is that a mechanism that pointwise optimizes virtual values resulting from a general application of integration by parts on arbitrary paths is not incentive compatible. We resolve this issue by imposing additional restrictions on the problem so that the virtual value for the high quality product is uniquely defined, which pins down the paths and, consequently, the virtual values for other products. As a second application we use our method to derive conditions of

optimality for selling only the grand bundle of items to an agent with additive preferences.

Promises and Social Distance in Buyer-Determined Procurement Auctions

Jeannette Brosig-Koch and Timo Heinrich

Session: Sun11-B

This study explores the effects of communication and its interaction with reputation information. Our focus is on buyer-determined procurement auctions with moral hazard in which buyers can select a bidder based on prices and all other information available. The results of our laboratory experiment demonstrate that in contrast to reputation information communication only slightly increases market efficiency. If reputation information is available, communication has no additional efficiency effect. Buyers' choice of a bidder is influenced by both, reputation information and the content of communication. Specifically, buyers prefer bidders with a good reputation and bidders who promise them a specific profit. If this kind of promise is infeasible as it is often the case in real auctions, buyers prefer bidders whose arguments reduce social distance. Unspecific promises have no significant effect. In the field we find a choice pattern that is consistent with our lab data.

Competition in Procurement Auctions with Corruption

Daniel Z. Li and Minbo Xu

Session: Sun11-B

We study the effects of corruption on equilibrium competition and social welfare in a public procurement auction. A bureaucrat runs the auction on behalf of a government. He invites firms into the auction at positive costs, and may request a bribe from the winning firm afterward. We first show that, under standard assumptions, in the absence of corruption, the bureaucrat invites more firms than social optimum number that maximizes social welfare. Secondly, the effects of corruption on competition and social welfare vary across different forms of bribery. In the case of fixed bribe, corruption has no effect on equilibrium competition, yet does induce social welfare loss due to the distortion cost of increased public spending. In the case of proportional bribe, the corrupt bureaucrat will invite less firms into the auction, which may result in Pareto-improving allocation in equilibrium.

Stable Licensing Schemes in Technology Transfer

Shin Kishimoto

Session: Sun11-C

We consider stable licensing schemes that are combinations of lump-sum fee and per-unit royalty realized as bargaining outcomes in transferring a new technology of a technology holder to oligopolistic firms through licensing. Our solution concept is the rejection-proof

core for each group of licensees, which is defined as a set of licensing schemes from which no coalition has an incentive to deviate credibly. We show that, for the group of licensees that maximizes the sum of the technology holder's profit and licensees' total surplus, the rejection-proof core is always non-empty. Further, the non-empty rejection-proof cores suggest that it should be optimal for the technology holder to license the new technology to such a group from the viewpoint of his profit maximization.

R&D Investments under Endogenous Cluster Formation

Herbert Dawid and Tim Hellmann

Session: Sun11-C

We study investments in R&D and the formation of R&D clusters of firms who are competitors in the market. In a three stage game, firms first decide on investments in R&D, then form research clusters and finally compete in quantities. We show that for any distribution of R&D investments, the second stage cluster formation modeled by the unanimity game (Bloch, 1996) has an equilibrium which is generically unique up to a permutation of firms who chose the same investment. Restricting to two investment strategies in the first stage, we provide a complete characterization of the equilibria of the three stage game. We show that for some range of investment costs equilibria with no-investment co-exist with equilibria where a large fraction or even all firms invest in R&D. Furthermore, in the high-investment equilibrium firms over-invest compared to a scenario with fixed clusters and to the welfare optimum.

On Multitasking and Job Design in Relational Contracts

Akifumi Ishihara

Session: Sun11-D

We investigate the optimal job design in a repeated principal-agent relationship with multiple tasks where the performance measurement is distorted, aggregated, and non-verifiable. We compare task bundling where all the tasks are assigned to a single agent with task separation where the tasks are split and assigned to two agents. Compared to task bundling, task separation mitigates misallocation of efforts among the tasks but requires more commitment due to dispersion of informal bonuses to multiple agents. As a result, task separation is better than task bundling if and only if the discount factor of the parties is high. We also consider an extended model in which the principal combines explicit incentive pays based on a verifiable, distorted, and aggregated signal. In such cases, task separation is optimal if the discount factor is sufficiently high or sufficiently low.

On the optimal use of correlated information in contractual design under limited liability

Daniel Danaou and Annalisa Vinella

Session: Sun11-D

In a principal-agent relationship in which the agent's type is correlated with an ex post signal, the principal may attain first best if she offers a lottery such that each type is rewarded for one signal realization and punished equally for all the others (Riordan and Sappington, 1988). When the agent is protected by limited liability, this kind of lottery is most likely to satisfy local incentive constraints (Gary-Bobo and Spiegel, 2006). We show that a different lottery, including three levels of profit (rather than two), is most likely to attain global incentive-compatibility if local incentive constraints are strictly satisfied. We identify conditions under which first best is implemented and pin down the optimal distortions when those conditions are violated. When the first-best allocation is locally but not globally incentive-compatible, output distortions are induced but no information rent is conceded.

Optimal Crowdfunding Design

Matthew Ellman and Sjaak Hurkens

Session: Sun11-D

We characterize optimal reward-based crowdfunding where production is contingent on an aggregate funding threshold. Crowdfunding adapts project implementation to demand (market-testing) and its multiple prices enhance rent-extraction via pivotality, even for large crowds, indeed arbitrarily large if tastes are correlated. Adaptation raises welfare. Rent-extraction can enhance adaptation, but sometimes distorts production and lowers welfare. Threshold commitment, central to All-Or-Nothing platforms, raises profits but can lower consumer welfare. When new buyers arrive ex-post, crowdfunding's market-test complements traditional finance and optimizes subsequent pricing. We prove that crowdfunding is a general optimal mechanism in our baseline.

Costless Delay in Negotiation

Jean-Jacques Herings and Harold Houba

Session: Sun11-E

We study strategic negotiation models featuring costless delay, general recognition procedures, endogenous voting orders, and finite sets of alternatives. Two examples show: 1. non-existence of stationary subgame-perfect equilibrium (SSPE). 2. the recursive equations and optimality conditions are necessary for SSPE but insufficient because these equations can be singular. Strategy profiles excluding perpetual disagreement guarantee non-singularity. The necessary and sufficient conditions for existence of stationary best responses additionally require either an equalizing condition or a minimality condition.

Quasi SSPE only satisfy the recursive equations and optimality conditions. These always exist and are SSPE if either all equalizing conditions or all minimality conditions hold

Transparency and Delay in Bargaining

Deepal Basak

Session: Sun11-E

This paper studies the Rubinstein bargaining game, in which both agents have reservation values. Agents are uncertain whether their opponents have high or low reservation values. Each agent tries to convince the other that he has a high reservation value, resulting in a unique war of attrition, as in the reputation literature. I analyze the information sensitivity of delay when agents publicly observe some noisy signal about their opponents reservation values. A bargaining environment is said to be more transparent if the available information is more precise. I show that information disclosure increases delay, in the sense of first-order stochastic dominance, if transparency is not sufficiently high. This paper also analyze the scope of intermediation in bargaining from an information designs perspective.

Delay in Bargaining with Outside Options

Dongkyu Chang

Session: Sun11-E

A seller negotiates price with a buyer who has an outside option that arrives at a random time during the negotiation. Both the buyers valuation of the good and the value of the outside option are unknown to the seller. We show that the interplay between information asymmetry and outside options is a source of delay in bargaining. In the seller-optimal bargaining mechanism, the seller and the buyer delay in reaching an agreement with positive probability; neither offers and counter-offers being exchanged nor the outside option being exercised while the parties wait. A delay occurs even in the limit as the arrival rate of the outside option grows to infinity. If the seller cannot commit to the seller-optimal bargaining mechanism, the same outcome is approximately achieved in a perfect Bayesian equilibrium of the bargaining game in which the seller makes all offers.

Assortative matching with inequality in voluntary contribution games

Stefano Duca, Dirk Helbing and Heinrich H. Nax

Session: Sun11-F

Voluntary contribution games are a classic social dilemma where the individually dominant strategies result in a poor performance of the population. The negative zero-contribution predictions from social dilemma situations give way to more positive (near-)efficient ones when assortativity, instead of random mixing, governs the matching process in the population. Under assortative matching, agents contribute more than what would

otherwise be strategically rational in order to be matched with others doing likewise. An open question has been the robustness of such predictions in terms of provisioning of the public good when heterogeneity in budgets amongst individuals is allowed. Here, we show analytically that the consequences of permitting heterogeneity depend crucially on the exact nature of the underlying public-good provision efficacy, but generally are rather devastating. Using computational methods, we quantify the loss resulting from heterogeneity vis-a-vis the homogeneous case as a function of the public-good provision efficacy and the population inequality.

Promoting Diversity of Talents: A Market Design Approach

Chia-Ling Hsu

Session: Sun11-F

I propose the endogenous-priority student placement problem to study a centralized matching problem between students and schools, where the priorities of students are endogenous in terms of their efforts. With the motivation that in a desirable effort allocation students should allocate more efforts on the subjects that they are more talented at, I propose several notions of promoting diversity of talents including promoting versatility of talents, promoting unique talents, promoting n-selective talents and their variations. These notions differ in terms of degree of specialization. I also design matching systems that satisfy these notion. For the matching programs that I survey, most of them satisfy one of the notions that I propose. Finally, I study the matching programs in Taiwan in 2014 that match students to high schools and find that the features of the programs could encourage students to accumulate their human capital in a lexicographic manner.

Equilibrium and Matching under Price Controls

P. Jean-Jacques Herings

Session: Sun11-F

The paper considers a one-to-one matching with contracts model in the presence of price controls. This set-up contains two important streams in the matching literature, those with and those without monetary transfers, as special cases and allows for intermediate cases with restrictions on the monetary transfers that are feasible. An adjustment process that ends with a stable outcome is presented, thereby proving the existence of stable outcomes. The process contains the deferred acceptance algorithm of Gale and Shapley (1962) and the approximate auction mechanism of Demange, Gale, and Sotomayor (1986) as special cases. The paper presents a notion of competitive equilibrium for this class of models, called Drze equilibrium, thereby extending the concept as developed by Drze (1975) for economies with divisible commodities subject to price controls. It is shown that Drze equilibrium allocations are equivalent to allocations induced by stable outcomes.

From behind the veil: Evaluating allocation rules by ex-ante properties

Patrick Harless

Session: Sun11-G

We study rules for allocating objects. Departing from standard analysis, we evaluate rules according to their performance at an ex-ante stage, before individuals learn their preferences. Introducing an appropriate notion of ex-ante efficiency, we search for rules that are both efficient and provide incentive for individuals to truthfully report their eventual preferences. Our main results characterize the priority (“serial dictatorship”) rules by ex-ante efficiency and either strategy-proofness or Bayesian incentive compatibility on natural preference domains. When behind the veil, agents and objects are indistinguishable. In this setting, all rules in a large family achieve the same utilitarian welfare, and the family admits Lorenz maximal and minimal elements. Allowing the size of the economy to grow, we find that average welfare under each rule approaches that of a utilitarian rule. Comparing further, we introduce solidarity properties and consider an interim participation constraint. These considerations distinguish methods of randomizing over families.

On the Tradeoff between Efficiency and Strategyproofness

Haris Aziz, Florian Brandl, Felix Brandt and Markus Brill

Session: Sun11-G

We study social decision schemes (SDSs), i.e., functions that map individual preferences over alternatives to a lottery over the alternatives. Depending on how preferences over alternatives are extended to preferences over lotteries, there are varying degrees of efficiency and strategyproofness. In this paper, we consider four such preference extensions: stochastic dominance (SD), a strengthening of SD based on pairwise comparisons (PC), a weakening of SD called bilinear dominance (BD), and an even weaker extension based on Savage’s sure-thing principle (ST). While random serial dictatorships are PC-strategyproof, they only satisfy ex-post efficiency. On the other hand, we show that strict maximal lotteries—a little known class of SDSs due to Fishburn—satisfy PC-efficiency and ST-strategyproofness. The incompatibility of SD-efficiency and SD-strategyproofness was recently shown using computer-aided solving techniques. We provide a manual proof of the the same statement using the PC extension. Finally, we show that no SDS satisfies ex-post efficiency and SD-group-strategyproofness.

Strategy-proofness in private good economies with linear economies

William Thomson and Jo Cho

Session: Sun11-G

For private good economies with arbitrarily many agents whose preferences are linear, we show that no rule satisfies the following properties: efficiency, equal treatment of equals in welfare terms and strategy-proofness, the requirement that for each preference profile, in

the direct revelation game associated with a rule, no agent even gain by misrepresenting his preferences.

Strongly Time-Consistent Solutions in N-person Differential and Dynamic Games.

Leon Petrosyan

Session: Sun11-H

Cooperative differential and dynamic TU games with prescribed duration are considered. Different approaches to the definition of characteristic function are proposed. One of basic problems in considered class of games is time-inconsistency of solution concepts taken from classical cooperative game theory. This problem is partly solved by introduction of IDP (imputation distribution procedure) but in the case when solution does not consist of unique imputation a more stringent condition of strongly time-consistency (STC) for sustainable cooperation is necessary. Unfortunately the class of games in which this stringent condition holds is very limited. To overcome this difficulty different approaches are proposed. Among them integral transformation of characteristic function and two refinements of STC (with weaker conditions). The sufficient conditions for the existence of strongly time-consistent (in weak sense) core and other solutions are derived. The proposed approach can be easily extended to discrete-time cooperative dynamic games.

On Tauberian Theorems for Dynamic Games

Dmitry Khlopin

Session: Sun11-H

The report is concerned with two-person dynamic zero-sum games in continuous setting. We investigate the limit of value functions of finite horizon games with long run average cost as the time horizon tends to infinity and the limit of value functions of λ -discounted games as the discount tends to zero. Under quite weak assumptions on the game, we prove the Uniform Tauberian Theorem: existence of a uniform limit for one of the value functions implies the uniform convergence of the other one to the same limit. We also prove the analogs of the One-sided Tauberian Theorem, i.e., the inequalities on asymptotics for the lower and upper games. Also, a variant of the theorem for discrete-time games is treated separately. Special attention is devoted to the case of differential games.

A characterization of subgameperfect equilibrium plays in Borel games of perfect information

Janos Flesch and Arkadi Predtetchinski

Session: Sun11-H

We obtain a characterization of subgameperfect equilibrium plays in a class of perfect information games under the assumption that each players payoff function is Borel mea-

surable and has a finite range. The set of subgameperfect equilibrium plays is obtained through a process of iterative elimination of plays. Extensions to games with bounded Borel measurable payoff functions are discussed. As an application of our results, we show that if every players payoff function is bounded and upper semicontinuous, then, for every positive epsilon, the game admits a subgameperfect epsilonequilibrium. As we do not assume that the number of players is finite, this result generalizes the corresponding result of Purves and Sudderth [2011].

Purification without Common Knowledge of Priors

Ibrahim Inal

Session: Sun11-J

We show generically that the Purification Theorem of Harsanyi (1973) does not hold for 2×2 games without the assumption of common knowledge of priors. We obtain that the limit of the Mirage Equilibrium - the corresponding generalization of Bayesian Equilibrium - of the perturbed game does not coincide with the mixed strategy equilibrium of the unperturbed game, rather it yields a pure strategy.

Information Correlation in a Strategic-Complements Game and the Extension of Purification Theorem

Rongyu Wang

Session: Sun11-J

In this paper, we study a 2 by 2 strategic-complements Bayesian entry game with correlated private information. The distribution of private information is modelled by a bivariate normal distribution. We examine the comparative statics of the model, indicating how the number of equilibrium varies with the correlation coefficient and variances of the prior distribution. We show that Harsanyi's (1973) purification theorem can be extended to games with dependent perturbation errors that follow a normal distribution if the correlation coefficient is positive for the strategic complements games or negative for the strategic substitutes games.

Collusion Constrained Equilibrium

Rohan Dutta, David Levine and Salvatore Modica

Session: Sun11-J

We study collusion within groups in non-cooperative games. The primitives are the preferences of the players, their assignment to non-overlapping groups and the goals of the groups. Our notion of collusion is that a group coordinates the play of its members among different incentive compatible plans to best achieve its goals. Such equilibria need not exist. We introduce the notion of collusion constrained equilibrium, which allows randomizations by groups between alternatives to which they are not indifferent. Collusion

constrained equilibria always exist and are a subset of the correlated equilibria of the underlying game. We examine three perturbations of the underlying game. In each case we show that equilibria in which groups choose the best alternative exist and that limits of these equilibria lead to collusion constrained equilibria. Finally we show that for a broader class of perturbations every collusion constrained equilibrium arises as such a limit.

Constrained No Regret Learning

Ye Du and Ehud Lehrer

Session: Sun11-K

In this paper, we investigate the dynamic decision making problem when there are a set of linear constraints on the empirical frequency of actions actually played. To cope with this, we introduce the constrained no-regret learning model. In this model, the set of alternative strategies, with which a dynamic decision mechanism is compared, is the set of stationary mixed actions that satisfy the set of linear constraints. We show that there is indeed a constrained no-regret dynamics.

Games of Incomplete Information Played by Statisticians

Annie Liang

Session: Sun11-K

The common prior assumption is a convenient restriction on beliefs, but conflicts with evidence that agents publicly disagree in many economic environments. This paper proposes a foundation for heterogeneous beliefs in games, in which disagreement arises from different interpretations of common information. I model players as statisticians who learn about their payoffs from data. Players know that they may use different learning rules, but have common certainty in the predictions of a class of rules. Using this framework, I study the robustness of solutions to a relaxation of the common prior assumption. The main results characterize which rationalizable actions and which Nash equilibria persist when agents observe finite quantities of data. I additionally provide a lower bound on the quantity of data needed to learn these solutions. This approach suggests a new criterion for equilibrium selection based in the statistical complexity of payoffs.

Contemplation vs. intuition. A reinforcement learning perspective.

In-Koo Cho and Anna Rubinchik

Session: Sun11-K

In a search for a positive model of decision-making with observable primitives, we rely on the burgeoning literature in cognitive neuroscience to construct a three-element machine (agent). Its control unit initiates either impulsive or cognitive element to solve a problem in a stationary Markov environment, the chosen element depends on the nature of the

problem, memory of past successes and inhibition. Our predictions are based on a stationary asymptotic distribution of the memory, which can generate different “characters”, e.g., an uptight dimwit, who could succeed more often with less inhibition, as well as a relaxed wise-guy, who could gain more with a stronger inhibition of impulsive (intuitive) responses. As one would expect, stronger inhibition and lower cognitive costs increase the frequency of decisions made by the cognitive element. More surprisingly, increasing the “carrot” and reducing the “stick” enhances contemplative decisions for an alert agent, who identifies novel problems frequently enough.

A Beauty Contest with Flexible Information Acquisition

Alexandros Rigos

Session: Sun11-L

This paper studies beauty-contests with rationally inattentive players. Players are driven by a coordination motive and a fundamental motive. Each player can flexibly acquire information on the fundamental by choosing the probability distribution of her signal while paying a cost linear in the reduction of entropy. A necessary condition is derived for well-behaved equilibria without requiring the fundamental to be normally distributed. Aggregately affine equilibria (AAE) where the average action is an affine function of the fundamental are found to exist only if the fundamental is normally distributed. For a large region of the parameter space, there exists a unique equilibrium within the classes of AAE and equilibria without information acquisition. Interestingly, when the coordination motive is high and for relatively low information costs, there is a multiplicity of equilibria within the classes considered, suggesting that flexible information acquisition technology can be a source of multiple equilibria.

Behavioural Variation in Tullock Contests

Aidas Masiliunas, Friederike Mengel and J. Philipp Reiss

Session: Sun11-L

We conduct an experiment to uncover the reasons behind the typically large behavioural variation and low explanatory power of Nash equilibrium observed in Tullock contests. In our standard contest treatment, only 7% of choices are consistent with Nash equilibrium which is in line with the literature and roughly what random (uniform) choice would predict (6.25%). We consider a large class of social, risk and some other ‘non-standard’ preferences and show that heterogeneity in preferences cannot explain these results. We then systematically vary the complexity of both components of Nash behaviour: (i) the difficulty to form correct beliefs and (ii) the difficulty to formulate best responses. Our results show that bounded rationality rather than heterogeneity in preferences is the reason behind the huge behavioural variation typically observed in Tullock contests.

Asymmetric endogenous prize contests

Damian Damianov, Shane Sanders and Anil Yildizparlak

Session: Sun11-L

We consider contests in which two opponents with different initial strengths have the option to make spot allocations to enhance their performance. We allow the prize to depend on total performance in the contest and consider the respective cases in which efforts are productive and destructive of prize value. When the contest success function takes a logit form, and marginal cost is increasing in effort, we show that a Nash equilibrium exists and is unique both in productive and destructive endogenous prize contests. In a productive contest, the underdog behaves more aggressively and wins the prize more often in comparison to a fixed value contest. These results have implications for the understanding of a variety of phenomena in which the value of the prize is endogenous, including (asymmetric) armed conflict, litigation, sports contests, R&D races, and labor tournaments.

Incentives and the Structure of Communication

Thomas Rivera

Session: Sun11-M

This paper analyzes the incentives that arise within an organization when communication is restricted to a particular network structure (e.g., a hierarchy). We show that restricting communication between the principal and agents may create incentives for the agents to misbehave when transmitting information and tasks throughout the organization. To remedy this issue, we provide necessary and sufficient conditions on the topology of the network of communication such that restricting communication to a particular network does not restrict the set of outcomes that the principal could otherwise achieve. We show that for any underlying incentives and any outcome available when communication is unrestricted, there exists a communication scheme restricted to a particular network that implements this outcome (i.e., does not induce agents to misbehave in the communication phase) if and only if that network satisfies our conditions.

Categorization and Coordination

Vessela Daskalova and Nicolaas J. Vriend

Session: Sun11-M

This paper considers individuals who make predictions in new situations using categories. We present a framework to examine when decision makers may be better off using fewer rather than more categories even without exogenous costs or restrictions concerning the number of categories available. We study three aspects of this problem: An individual whose goal is to predict the unobserved value of a new object correctly, individuals who want to coordinate their predictions with each other, and individuals who are interested

in both. We analyze the effect of the coordination motive on individual categorization and we show that the attempt to coordinate with others can be a rationale to categorize coarsely.

Wage Dynamics and Peer Referrals

Vincent Boucher and Marion Gouss

Session: Sun11-N

We present a flexible model of wage dynamics where information about job openings is transmitted through social networks. The model is based on Calvo-Armengol & Jackson (2004, 2007) and extends their results outside the stationary distribution, and under observed and unobserved heterogeneity. We present an empirical application using the British Household Panel Survey by exploiting direct information about individuals social networks. We find that the distribution of job offers is positively affected by the employment status of an individuals friends, and that this relationship is stronger for women.

From Rational Secret Sharing to Social and Socio-Rational Secret Sharing

Mehrdad Nojournian and Douglas Stinson

Session: Sun11-N

Rational secret sharing was proposed in STOC'04. The authors show that, in a setting with rational parties, secret sharing is only possible if the actual secret recovery round remains unknown to the players. We change the direction by bridging cryptography, game theory, and reputation systems, and propose a social model for repeated rational secret sharing. We provide a new scheme, named socio-rational secret sharing, in which players are invited to each game based on their reputations, i.e., they run secret sharing protocols while sustaining a public trust network. As a result, new notions such as a rational foresighted player, social game, and social Nash equilibrium are introduced. To motivate our approach, consider a repeated game such as sealed-bid auctions. If we assume each party has a reputation value, we can penalize (reward) the players who are selfish (unselfish) from game to game. This social reinforcement stimulates players to be cooperative.

Illusion of Control and Related Perception Biases

Jakub Steiner and Olivier Gossner

Session: Sun11-P

We study perception biases arising under second-best perception strategies. An agent's type is either high or low, and accurate perception of one's type is costly. A perception strategy specifies the probabilities of the two types of perception errors. After the true and perceived types are realized, the agent faces a random decision problem. Payoffs depends on types as well as choices and thus misperceptions distort choice. We say that the high type has more control over her payoffs than the low type if the payoff difference

across actions is likely to be large for the high type and small for the low type. As elimination of perception errors is costly, the optimal strategy exhibits an illusion of control—the probability that the agent perceives her type as high exceeds the true probability of the high type. We show in examples that the effect generates overconfidence about talent or knowledge, and optimism.

Who is a Bayesian?

Roe Teper and Ehud Lehrer

Session: Sun11-P

We take a decision theoretic approach to predictive inference. We construct a simple dynamic setup in the presence of inherent uncertainty. At any given time period the decision maker updates her posterior regarding the uncertainty related to the subsequent period. The posteriors reflect the decision makers preferences, period by period. We study the evolution of the agents posteriors and provide axioms under which the decision maker exhibits learning in a Bayesian fashion. We show how behavioral implications of different Bayesian models differ from one another, and specifically from those dictated by exchangeability.

Zero-sum games with charges

János Flesch, Dries Vermeulen and Anna Zseleva

Session: Sun11-P

We consider two-player zero-sum games with infinite action spaces and bounded payoff functions. The players' strategies are finitely additive probability measures, called charges. Since a strategy profile does not always induce a unique expected payoff, we distinguish two extreme attitudes of players. A player is viewed as pessimistic if he always evaluates the range of possible expected payoffs by the worst one, and a player is viewed as optimistic if he always evaluates it by the best one. This approach results in a definition of a pessimistic and an optimistic value for each player. We provide an extensive analysis of the relation between these values, and connect them to the classical values, and to other known techniques to define expected payoffs, based on computation of double integrals. In addition, we also examine existence of optimal strategies with respect to these values.

The Universal Type Space with Unawareness for Conditional Probability Systems

Pierfrancesco Guarino

Session: Sun11-Q

The construction of the universal type space for conditional probability systems of Battigalli and Siniscalchi [Hierarchies of Conditional Beliefs and Interactive Epistemology

in Dynamic Games, J. Econ. Theory, 88 (1999) 188230] is a fundamental ingredient for the epistemic analysis of dynamic games. In this paper we extend the construction to address simple unawareness, showing that the universal type space for the standard case is a special instance of the universal type space constructed here, where the perception of the domain of uncertainty that players have does not change.

Universal Interactive Preferences

Jayant Ganguli, Aviad Heifetz and Byung Soo Lee

Session: Sun11-Q

We prove that a universal preference type space exists under more general conditions than those postulated by Epstein and Wang (1996). To wit, it suffices that preferences can be encoded monotonically in rich enough ways by collections of continuous, monotone real-valued functionals over acts, which determine even in discontinuous fashion the preferences over limit acts. The proof relies on a generalization of the method developed by Heifetz and Samet (1998a).

On Generalized Stable Sets

Weibin Han and Adrain van Deemen

Session: Sun11-R

We revisit the solution of generalized stable sets for abstract decision problems. This solution was introduced by van Deemen (1991) as a variant of stable sets formulated in Von Neumann and Morgenstern (1944). Here, we propose an alternative characterization for generalized stable sets which may reveal the stability of generalized stable sets from a new perspective. Moreover, we compare the sensitivities of generalized stable sets and of stable sets to changes in the dominance relation. Finally, the collection of generalized stable sets may be very large in cyclic domains so that this solution may lose its power to discriminate among alternatives. As such, we refine this solution to select more discriminatory generalized stable sets.

An Infinitely Farsighted Stable Set

Parkash Chander

Session: Sun11-R

We show that Harsanyi's critique of vNM stable sets is not really valid and a subset of vNM stable sets are actually farsighted. To show this, we motivate and introduce an alternative concept of a stable set, to be called an infinitely farsighted stable set. The concept of an infinitely farsighted stable set is based on a new and more general notion of a credible deviation. According to this notion, a coalition may not only deviate from a deviant coalition, but may also merge with some residual players. Thus, objections are not necessarily nested in the sense of coming from subsets of progressively smaller coalitions.

After establishing the general properties of infinitely farsighted stable sets, we prove their existence and comprehensively characterize them for general three-player superadditive characteristic function games and also prove their existence for simple majority rule and convex games with any number of players.

Single-payoff farsighted stable sets in strategic games with dominant punishment strategies

Toshiyuki Hirai

Session: Sun11-R

We investigate the farsighted stable set in a class of strategic games with dominant punishment strategies. In this class of games, each player has a strategy that uniformly minimizes the other players' payoffs for any given strategies of other players. We particularly investigate a special class of the farsighted stable sets each of which consists of strategy profiles yielding an identical payoff vector. We call such farsighted stable sets as the single-payoff farsighted stable sets. We completely characterize the single-payoff farsighted stable sets in the strategic games with dominant punishment strategies by the notion of the inclusive set. We also show that the set of payoff vectors yielded by the single-payoff farsighted stable sets is closely related to the strict alpha-core in strategic games. Further, we apply the results to the binary choice strategic game and strategic games for many-to-many matching markets with substitutability.

The roles of transparency in regime change: Striking when the iron's gone cold

Frederik Toscani and Daniel Quigley

Session: Sun11-S

How does freedom of information about an institutions resilience affect its stability? We study the ex ante impact of an informative public signal on regime change in a global game, accounting for uncertainty over what will be communicated. We show that a fundamental tension exists in the way public information impacts coordination. When the probability of regime change is already high, public information systematically incentivizes larger attacks. But under these conditions public information targets attacks wastefully, causing agents to strike when the regime is so weak it would have fallen anyway and retreat when the regime is vulnerable to a larger attack. By way of a general decomposition, we sign the marginal impact of transparency on regime change in several applications.

Social Mobility and Stability of Democracy: Re-evaluating De Tocqueville

Daron Acemoglu, Georgy Egorov and Konstantin Sonin

Session: Sun11-S

An influential thesis often associated with De Tocqueville views social mobility as a bulwark of democracy: when members of a social group expect to join the ranks of other social groups in the near future, they should have less reason to exclude these other groups from the political process. In this paper, we investigate this hypothesis using a dynamic model of political economy. As well as formalizing this argument, our model demonstrates its limits, elucidating a robust theoretical force making democracy less stable in societies with high social mobility: when the median voter expects to move up (respectively down), she would prefer to give less voice to poorer (respectively richer) social groups. Our theoretical analysis shows that in the presence of social mobility, the political preferences of an individual depend on the potentially conflicting preferences of her future selves, and that the evolution of institutions is determined through the implicit interaction between occupants of the same social niche at different points in time. When social mobility is endogenized, our model identifies new political economic forces limiting the amount of mobility in society because the middle class will lose out from mobility at the bottom and because a peripheral coalition between the rich and the poor may oppose mobility at the top.

Homo-Politicus: Evolution of Behavior Under Political Institutions

Jiabin Wu

Session: Sun11-S

This paper seeks to understand the role of political institutions in influencing the evolution of human behavior. In the model, a political institution provides the platform and a set of rules for the agents to battle over the relative representativeness of their strategies for the high positions in the social hierarchy. Such a political process affects the agents' payoffs, subsequently the evolution of their strategies. We investigate evolutionarily stable strategies under an exclusive and an inclusive political institution. We find that an exclusive political institution induces self-interest behavior for the low positions agents. On the other hand, an inclusive political institution induces altruistic behavior for the high position agents while it induces spiteful behavior for the low position agents. We further show that the results are robust when evolution operates on the preference level with incomplete information.

Sharing sequential profits in a network

Ruben Juarez, Chiu Yu Ko and Jingyi Xue

Session: Sun11-T

Consider a social planner redistributes the net-benefits of connected public facilities (such

as highways, rail-roads or irrigation canals) that can be built in different network configurations. Consider the planner has all information in the network and is interested in systematically selecting a path and share the surplus. We propose four natural axioms and we show that they characterize a family of path selection rules that selects efficient path(s), and the surplus is distributed in fixed proportions independent of the network. Alternatively, suppose the planner knows the structure of the network but not the marginal benefits of paths. The planner wants to find a sharing rule that incentivizes the agents to select an efficient path as a subgame perfect equilibrium in some games. We show that for a large class of games, most of the rules obtained under incomplete information coincide with the rules found in the case of complete information.

From spanning trees to arborescences: new and extended cost sharing solutions

Eric Bahel and Christian Trudeau

Session: Sun11-T

The paper examines minimum cost arborescence problems, which generalize the well-known minimum cost spanning tree (mcst) problems. We propose a new family of cost sharing methods that are easy to compute, as they closely relate to the network-building algorithm. These methods, called minimum incoming cost rules for arborescences (MICRAs), include as a particular case the extension of the folk solution introduced by Dutta and Mishra (2012). A simpler computational procedure thus obtains for this method. We also provide new axiomatizations of (a) the set of stable and symmetric MICRAs and (b) the folk solution. Finally, we closely examine two remarkable MICRAs. The first one relates to the cycle-complete rule for mcst problems introduced in Trudeau (2012). The second one contrasts with the folk rule by fully rewarding agents who help others connect to the source.

Money-Sharing and Intermediation in Networks

Ruben Juarez and Lining Han

Session: Sun11-T

We study the problem of transmission of a divisible resource to agents via a network of intermediaries. The planner has preferences over allocations of the resource to the agents. The planner is not directly linked to the agents but it can connect via intermediaries. Intermediaries differ in the types of agents they reach and the quality in which they reach agents. The planner solicits bids from intermediaries to use their links and selects which intermediaries to contract for the transmission of the resource. The intermediaries choose the fees in order to maximize the amount paid by the planner. We analyse the strategic behavior of the planner and the intermediaries. Necessary and sufficient conditions for the existence of a Subgame Perfect Nash Equilibrium (SPNE) and Efficient SPNE are

presented. This equilibrium depends on the network configuration, the quality of the intermediaries, and the planner's preferences.

Quantum Analysis of Decision and Interaction Systems

Ulrich Faigle and Michel Grabisch

Session: Sun11-U

The paper introduces activity systems as a general framework for modeling interaction and cooperation among agents, and analyses them through the tools of quantum theory. Remarkable examples of activity systems include classical coalitional games and networks of agents. In the former example, coalition formation and its evolution are the main problems we consider, while in networks activity systems are adequate to model influence among the agents. We introduce spectral decomposition of activity matrices, linear operators as well as waves and evolution of systems.

Multilinear extension of tau-values for cooperative games with fuzzy coalitions

Dian Qing Yang and Deng Feng Li

Session: Sun11-U

The aim of this paper is to develop a tau-value method for solving cooperative games with fuzzy coalitions, which is also referred as fuzzy cooperative games. In this method, using the multilinear extensive method, we define the tau-value for fuzzy cooperative games and prove its existence, uniqueness and other properties. Simple computational formulae of the tau-values for convex fuzzy cooperative games is deduced. Moreover, the relation between the tau-value and the fuzzy core is discussed. The research results show that the tau-value for the fuzzy cooperative game with multilinear extension form is an extension of the tau-value for crisp cooperative games. Especially, for the convex fuzzy cooperative games, the computational process of the tau-value can be further simplified.

Parameterized Bilinear Programming Methodology for Solving Triangular Intuitionistic Fuzzy Number Bimatrix Games

Jie Yang and Deng-Feng Li

Session: Sun11-U

The aim of this paper is to develop a new methodology for solving bimatrix games with payoffs of triangular intuitionistic fuzzy numbers (TIFNs), which are called TIFN bimatrix games for short. In this methodology, we define the concepts of the value-index and ambiguity-index and hereby develop a difference-index based ranking method, which is proven to be a total order. The parameterized bilinear programming models are derived from a pair of auxiliary TIFN mathematical programming models, which are used to determine solutions of TIFN bimatrix games. Validity and applicability of the models and

method proposed in this paper are illustrated with a practical example.

Matching and Markets

Chris Shannon

Session: Sun14-SP1

Matching problems are of central importance in many areas, including matching students to schools, interns to jobs in fields like law and medicine, and donors to patients in need of transplants. Many of these processes are centralized, or can be effectively centralized. Much of the work on such problems has focused on the design of such centralized exchanges and of algorithms for the implementation of matches with desirable properties. An important message in this work is that centralizing such exchanges with judicious market design can create large welfare gains. Other important matching problems instead take place in decentralized markets, including many labor markets and buyer-supplier markets. I will talk about a model that nests many common matching models within a general market framework, including one-to-one, many-to-one, and many-to-many matching, matching with contracts, and matching with incomplete information. I will talk about various decentralized equilibrium concepts for such markets and how these can shed light on properties of centralized exchanges as well.

Voting versus Lobbying

David Levine

Session: Sun14-SP1

We study a political contest between two groups. Two lobbying groups or political parties compete for a prize by providing or promising effort. We consider a number of different mechanisms for resolving the contest. Our focus is on groups of different sizes and when the larger or smaller group is more likely to be successful. Key to our results is the notion that effort provision might be a duty or a chore. For example, if there is a ballot referendum against farm subsidies, while it is costly to go to the polling place and take time to vote I view it as my civic duty, so I vote and the satisfaction of having discharged my duty more than offsets the direct cost of participating. By contrast, to engage in an anti-farm lobby I would need to find the appropriate organization, learn about them, join up - and they would have to vet me, process my application and so forth. Considerable cost would be incurred even as I contributed nothing to the lobbying effort. This kind of fixed cost we refer to as a chore. Our main finding is that the mechanism makes little difference but that the structure of cost does: duty favors larger groups and a chore favors smaller groups. Joint work with Andrea Mattozzi and Salvatore Modica.

Learning in nonatomic continuous time games

Pierre Cardaliaguet

Session: Sun14-SP2

Mean Field Games describe nonatomic games in continuous time. We describe a learning procedure for these games and show the existence of “stable equilibria” towards which the learning procedure converges. Based on papers with Saeed Hadikhanloo and with Ariela Briani.

Multiplayer Stochastic Games: Techniques, Results, and Open Problems

Eilon Solan

Session: Sun14-SP2

I will review some techniques that are used in the study of multiplayer stochastic games, present results that they prove and open problems that are waiting for solution. The techniques include the dynamic use of discounted equilibria, the dynamics of the Nash correspondence, and the stochastic Ramsey theorem.

Higher order evolutionary dynamics in population games

Jeff Shamma

Session: Sun14-SP3

Evolutionary dynamics model how a population of agents revise their strategies in reaction to shifting fitness levels. Depending on both the specific dynamics and underlying population game, long term behaviors can range from cycling to chaos to convergence, with convergence to Nash equilibrium of particular interest. One restriction of almost all evolutionary dynamics, (e.g., replicator dynamics, fictitious play, imitation dynamics, etc.) is that the number of state variables is equal to the number of population strategies. The introduction of auxiliary states, which results in higher order dynamics, can model effects such as latency, recency, or anticipation. Furthermore, prior work has shown that higher order dynamics can circumvent structural limitations of first order dynamics (e.g., uncoupled convergence to Nash equilibrium or dominated strategy elimination). This talk explores higher order dynamics from the perspective of so-called passive game dynamics. Passive dynamics are a class of evolutionary dynamics that complement the class of stable games (introduced by Hofbauer and Sandholm) in the sense that any passive game dynamic coupled with any stable game results in stable behavior. This perspective allows one to analyze both first order and higher order evolutionary dynamics in the same framework. Furthermore, it accommodates the analysis of higher order population games, where fitness levels exhibit path dependencies. We also show a sort of converse stability result: namely any evolutionary dynamic that stabilizes all (higher order) stable games must be passive.

Rapidly Adaptive Hedonic Utility

Arthur Robson

Session: Sun14-SP3

We consider a simple model of neural decision making in which there is a limited capacity to make fine distinctions. This implies that the evolutionarily optimal hedonic utility function must adapt to the circumstances. The new result here is that there are readily implementable mechanisms by which utility functions adapt rapidly, in real time. That is, if the distribution of rewards shifts, the utility function reacts, to maintain optimal use of the limited capacity to discriminate. Such rapid adaptation of utility is analogous to well-known properties of the visual system, and might well be implemented by similar neural circuitry. In the case that all that matters is the probability of error, the mechanism is particularly simple. If the criterion is instead to maximize expected fitness, we find a mechanism that is approximately optimal. Although such adaptive utility functions take an hedonic interpretation of preference seriously, and incorporate large swings in levels, they are at once approximately consistent with conventional economics. That is, the possibility of suboptimal choice stems only from the limited capacity to make fine distinctions. As this capacity improves, utility remains adaptive, but choice becomes fully optimal.

Optimal Auctions vs. Anonymous Pricing

Saeed Alaei, Jason Hartline, Rad Niazadeh, Emmanouil Pountourakis and Yang Yuan

Session: Sun16-A

For selling a single item to agents with independent but non-identically distributed values, the revenue optimal auction is complex. With respect to it, Hartline and Roughgarden (2009) showed that the approximation factor of the second-price auction with an anonymous reserve is between two and four. We consider the more demanding problem of approximating the revenue of the ex ante relaxation of the auction problem by posting an anonymous price (while supplies last) and prove that their worst-case ratio is e . As a corollary, the upper-bound of anonymous pricing or anonymous reserves versus the optimal auction improves from four to e . We conclude that, up to an e factor, discrimination and simultaneity are unimportant for driving revenue in single-item auctions.

Optimal Auctions with Convex Perceived Payments

Takehiro Oyakawa, Amy Greenwald and Vasilis Syrgkanis

Session: Sun16-A

Myerson derived a simple and elegant solution to the single-parameter revenue-maximization problem in his seminal work on optimal auction design, assuming the usual model of quasi-linear utilities. In this paper, we consider a slight generalization of this usual model—from linear to convex “perceived” payments. We study the optimal auction design problem

using this form of utility function in two settings: the robust setting, where conditions must always hold, and the Bayesian setting, where conditions need only hold in expectation. We show that total expected revenue need not coincide in these two problems. In the Bayesian setting, we show that only polynomially-many, and not exponentially-many, payment variables are required. We derive bounds, based on which we develop easily computable heuristics that approximate optimal auction designs. Our experiments demonstrate that our heuristics find near-optimal solutions more quickly than standard mathematical programming solvers.

Simple, Approximately Optimal Auctions for Interdependent Value Settings

Shuchi Chawla, Hu Fu and Anna Karlin

Session: Sun16-A

We study revenue maximization in settings where agents' values are interdependent: each agent receives a signal drawn from a correlated distribution and agents' values are functions of all of the signals. Previous work on characterizing optimal mechanisms in these settings requires many strong assumptions on the agents' value functions and value distributions. We introduce a variant of the generalized VCG auction with reserve prices and random admission, and show that this auction obtains strong revenue guarantees in ex-post equilibrium for any matroid environment. For value functions that are additively separable, our results require only a standard single-crossing property, but do not require any distributional assumptions. The results also hold in more general settings when the value functions satisfy a concavity-type condition.

Compare and despair: social comparison concerns in auctions

Joyce Delnoij

Session: Sun16-B

Social psychologists have argued that the tendency to compare ourselves to others may generate competitive behavior. In economics, the experimental literature has demonstrated that bidding behavior in first-price and second-price auctions is more competitive than predicted by standard auction theory. We show that this behavior can be explained by assuming that bidders are concerned with social comparisons. We adopt a model of interdependent preferences, where bidders derive utility (pride) from being better off than others and derive disutility (envy) from being worse off than others. We find that anticipating envy is necessary to generate overbidding. Furthermore, the more envious a bidder is, the more she will overbid. Surprisingly, anticipating pride does not generate overbidding, but rather decreases bids to the levels predicted by standard auction theory. Our model further predicts that the second-price auction generates higher expected revenues than the first-price auction.

An Experimental Evaluation of Bidders' Behavior in Ad Auctions

Gali Noti, Noam Nisan and Ilan Yaniv

Session: Sun16-B

We performed controlled experiments of human participants in a continuous sequence of ad auctions, similar to those used by Internet companies. The goal of the research was to understand users' strategies in making bids. We studied the behavior under two auction types: (1) the GSP auction and (2) the VCG payment rule, and manipulated also the participants' knowledge conditions: (1) explicitly given valuations and (2) payoff information from which valuations could be deduced. We found several interesting behaviors: (1) No convergence to equilibrium was detected; (2) Explicit "better-response" behavior; (3) GSP bidders do strategically shade their bids, but they tend to bid higher than the standard VCG-like equilibrium of GSP. (4) Bidders who are not explicitly given their valuations behave a little less "precisely", but mostly during an initial learning phase. (5) VCG and GSP yield approximately the same (high) social welfare, but GSP tends to give higher revenue.

Does a Buyer Benefit from Bad Reputation? Theory and Experiments on Auctions with Default

Dirk Engelmann, Jeff Frank, Alexander Koch and Marieta Valente

Session: Sun16-B

A major complaint of sellers in online auctions is that winning bidders often fail to pay and claim their item. Bids constitute a legally binding contract. Yet sellers can do little to enforce a bid. Instead, auction rules often allow sellers to approach the second-highest bidder with a 'second-chance offer' – a take-it-or-leave-it offer, to buy at this bidder's highest bid price. Furthermore, auction platforms also often let sellers leave negative feedback on a buyer. Both features however alter bidders' behavior in a way that imposes costs on sellers, as we show theoretically and by examining bidding in experimental auctions. All else equal, the availability of second-chance offers reduces bids. This lowers sellers' revenue also in auctions where no default occurs. In addition, buyer reputation systems create a strategic effect that rewards bidders who have a reputation for defaulting, counter to the idea of creating a deterrent against such behavior.

Salience and Horizontal Differentiation

R. Emre Aytimur

Session: Sun16-C

We study a horizontal differentiation model in which one of the two attributes of a product, product fit and price, is more salient for the consumer than the other. Which attribute is more salient depends on relative differences between the available products, and is determined endogenously as a result of firm strategies. We find that high (respectively, low)

marginal costs soften (respectively, harden) price competition of firms. We also find cost over-shifting for some parameter values. Both industry- and firm-level cost increases may be beneficial for firms.

Imitation and price competition in a differentiated market

Abhimanyu Khan and Ronald Peeters

Session: Sun16-C

We study the market outcome that evolves in the long-run when price-setting firms, that compete in a differentiated market, are driven by an imitation dynamic. The prices that evolve in the long-run depend on market differentiation and on the degree of oversight firms have on market decisions and outcomes. The unique symmetric pure Nash equilibrium price is always supported in the long-run, and it is the unique long-run market outcome for high and low levels of differentiation, when there is no oversight or even with limited oversight on market decisions and outcomes. For intermediate levels of differentiation, in addition to the Nash equilibrium price, there is a set of prices that may emerge in the long-run: while these other prices are below Nash equilibrium price when there is (almost) no oversight on market performances, they are above Nash equilibrium price when the oversight on market performances is more acute.

Sequential screening and the relationship between principal's preferences and agent's incentives

Daniel Dana and Annalisa Vinella

Session: Sun16-D

In sequential screening problems local incentive compatibility constraints are sufficient for implementability under some regularity conditions and the assumption of first-order stochastic dominance or mean-preserving spread (Courty and Li, 2000). In a setting with four possible cost distributions, two with equal expected values and different spreads and two with different expected values and equal spreads, we show that local incentive constraints are sufficient only when the marginal surplus is sufficiently convex. We further suggest that, in the same vein as in Consumption theory, the contractual choice can be regarded as mirroring the preference of the decision-maker for a lottery that occasions a higher (certain) cost but grants the possibility of facing more efficient (random) outcomes. Resting on this interpretation, we assess that the benefit of screening the agent in two stages, rather than in the contracting stage only, is higher when the marginal surplus is less concave / more convex.

Optimal Contracts with Random Auditing

Andrei Barbos

Session: Sun16-D

We study an optimal contract problem under moral hazard in a principal-agent framework where contracts are implemented through random auditing. This is a monitoring instrument which reveals the precise action taken by the agent with some nondegenerate probability r , and otherwise reveals no information. The agent's cost of performing the action depends on a random state of nature. This state is private information to the agent, but he can non-verifiably communicate it, allowing the contract to specify wages as a function of the agent's message. The optimal contract partitions the set of types in three regions. The most efficient types exert effort and receive a reward when audited. Moderately efficient types exert effort but are paid the same wage with an audit as without. The least efficient types do not exert effort. More intense monitoring increases the value of a contract when the agent is risk averse.

Competing Mechanisms in Markets for Lemons

Sarah Auster and Piero Gottardi

Session: Sun16-D

We study the competitive equilibria in a market with adverse selection and search frictions. Uninformed buyers post general direct mechanisms and informed sellers choose where to direct their search. We demonstrate that there exists a unique equilibrium allocation and characterize its properties: all buyers post the same mechanism and a low quality object is traded whenever such object is present in a meeting. Sellers are thus pooled at the search stage and screened at the mechanism stage. If adverse selection is sufficiently severe, this equilibrium is constrained inefficient. Furthermore, the properties of the equilibrium differ starkly from the case where meetings are restricted to be bilateral, in which case in equilibrium sellers sort across different mechanisms at the search stage. Compared to such sorting equilibria, our equilibrium yields a higher surplus for most, but not all, parameter specifications.

Is multilateral enforcement vulnerable to bilateral renegotiation?

S. Nageeb Ali, David Miller and David Yilin Yang

Session: Sun16-E

In a multilateral enforcement regime, a player who cheats on one partner is punished by many partners. But if partners can renegotiate in private, they can subvert the power of the multilateral punishment. We introduce a new notion of bilateral renegotiation proofness that applies to multilateral games with private monitoring. We characterize optimal bilateral renegotiation proof equilibria for a community engaged in bilateral joint production relationships. While players ability to renegotiate bilaterally is indeed socially

costly, it is perhaps not as costly as one might expect. We show that the proportional cost imposed by bil

Coalitional Bargaining: A New Concept of Value and Coalition Formation

Armando Gomes

Session: Sun16-E

We analyze the problem of coalition formation and surplus division. We propose a new non-cooperative game in which at every period there is a coalition formation stage followed by a negotiation stage. In contrast with the canonical Baron and Ferejohn (1989) model, we show that our equilibrium has several desirable properties, such as, dummy players have zero value and are never included in coalitions that form, and the model does not rely on an exogenously given proposer probability. We characterize the Markov perfect equilibrium of the game and show that the limit equilibrium is one where the coalitions that form in equilibrium maximize the average gain of each coalition member. We also discuss several applications to weighted majority games, providing a complete characterization of the equilibrium for all weighted majority games with less than eight players, and solve for the equilibrium of the European Union Council.

Hypothetical Bargaining and Envy-Free Gameplay

Mantas Radzvilas

Session: Sun16-E

Orthodox game theory is sometimes criticised for its failure to single out intuitively compelling solutions in certain types of interpersonal interactions. The theory of virtual bargaining provides a resolution in some such cases by suggesting a shift in decision-makers mode of reasoning from best-response reasoning to reasoning as hypothetical bargainers: hypothetical bargainers identify the strategy profiles that they would agree to realise via joint actions if they were engaged in open bargaining. I propose a general epistemic model of hypothetical bargaining, which suggests, how hypothetical bargainers may use the information about each others preferences over the strategy profiles of the game in identifying solutions of one-shot n-player non-cooperative games. I present an algorithm for identifying the hypothetical bargaining solutions of non-cooperative games, and show that suggested solution concept shares conceptual similarities with envy-free bargaining solution. I discuss the theoretical predictions of the model using a number of experimentally relevant examples.

Revenue from Matching Platforms

Philip Marx and James Schummer

Session: Sun16-F

We consider revenue maximization for a monopolistic matching platform. Specifically we

consider markets where the platform controls the agents' ability to form pairs that yield nontransferable value. A platform posts prices and commits to a matching procedure—a function of the agents' preferences. For certain matching procedures we derive the expected revenue of the platform as a function of prices, providing insights into optimal pricing. For instance, when preferences are uncorrelated, platforms should not price discriminate on the basis of the relative sizes of the two sides of the market; this result contrasts the idea of charging more to the long side of the market when there are network effects. When preferences are positively correlated, the platform typically charges more to the short side of an otherwise symmetric market. Additionally, we show that a pairwise-stability constraint is asymptotically (in market size) costless to the platform.

Dynamic Reserves in Matching Markets With Contracts: Theory and Applications

Orhan Aygun and Bertan Turhan

Session: Sun16-F

We study a matching problem where agents have preferences over institution-contractual term pairs. Each institution has a target distribution of its slots reserved for different contractual terms. If there is less demand for some groups of slots, then the institution is given the opportunity to redistribute its unassigned slots over other groups. The choice function we construct takes the capacities as functions of number of the vacant seats of groups considered earlier. We advocate the use of a cumulative offer mechanism (COM) with choice functions we designed as an allocation rule. In applications such as engineering school admissions in India where students are ranked according to test scores, we show that the COM with a monotonic capacity transfer scheme produces stable outcomes, is strategy proof, and respects improvements. The outcome of the COM with monotonic capacity transfer scheme Pareto dominates the outcome of the COM with no capacity transfer.

Take-it-or-leave-it contracts in many-to-many matching markets

Antonio Romero-Medina and Matteo Triossi

Session: Sun16-F

We introduce a sequential non-revelation mechanism for many-to-many matching markets with contracts, where hospitals make take-it-or-leave-it offers to doctors. The mechanism weakly implements the set of weak-setwise stable allocations in subgame perfect Nash equilibrium when hospitals have substitutable preferences and doctors have unilateral substitutable preferences. Thus, non-revelation mechanisms constitute a valid alternative to centralized revelation mechanisms. The set of equilibria of the game is a lattice which reflects, within equilibrium outcomes, an opposition of interests between the two sides of the markets. The analysis also reveals a first mover advantage absent in the model.

without contracts.

Sequential preference revelation in incomplete information settings

James Schummer and Rodrigo Velez

Session: Sun16-G

An agent's preference revelation obviously acts as input to a direct revelation mechanism. When such revelations are sequential, however, one agent's revelation may also act as a signal (to agents who have not yet reported) about his private information on all agents' types. Under certain conditions, an agent could even have a strict disincentive to truthfully report preferences even though outcomes are computed using a strategy-proof social choice function. We show that, under an independent-priors assumption, when a strategy-proof scf also satisfies a type of non-bossiness condition (satisfied by many but not all commonly analyzed such scf's), its sequential-mechanism counterpart preserves the robustness properties of strategy-proof direct revelation mechanisms that motivate their use in various market design settings. On the other hand, we show by example that these properties can fail to hold when preferences are correlated.

Circulation under Responsive Preferences

Peter Biro, Flip Klijn and Szilvia Papai

Session: Sun16-G

We study markets in which each agent is endowed with multiple units of an indivisible and agent-specific good. Monetary compensations are not possible. An outcome of a market is given by a circulation which consists of a balanced exchange of goods. Agents only have (responsive) preferences over the bundles they receive. We prove that for general capacity configurations there is no circulation rule that satisfies individual rationality, Pareto-efficiency, and strategy-proofness. We characterize the capacity configurations for which the three properties are compatible, and show that in this case the Circulation Top Trading Cycle (cTTC) rule is the unique rule that satisfies all three properties. We explore the incentive and efficiency properties of the cTTC rule for general capacity configurations and provide a characterization of the rule for lexicographic preferences. Finally we consider serial rules to restore Pareto-efficiency and Segmented Trading Cycle Rules to restore strategy-proofness.

The Curse of Poverty and the Blessings of Wealth

Lawrence Blume and Klaus Ritzberger

Session: Sun16-H

The paper studies a stochastic game among individuals who are struggling to survive. If productivity in a society is low, then the only equilibrium involves inefficiently selfish (autarkic) behavior. If productivity is sufficiently high, then there are several equilibria

that realize substantial welfare gains through reciprocal behavior. Yet, no equilibrium is fully efficient. Equilibria for productive societies are distinguished by how they treat the wealth distribution. While conservative societies preserve the distribution, egalitarian behavior further improves welfare by transfers. Yet, both conservative and egalitarian (productive) societies exclude the poorest, even though that involves a welfare loss. So, there are a social and an individual poverty trap. The first is technological, the second behavioral.

Perfect information games with infinitely many players each acting only once

Kutay Cingiz, János Flesch, Jean-Jacques Herings and Arkadi Predtetchinski

Session: Sun16-H

We study perfect information games in which the set of players is $\mathbb{N}$ and player t plays at time $t \in \mathbb{N}$. We provide a game that admits no subgame perfect ϵ -equilibrium for any $\epsilon > 0$ sufficiently small. Subsequently we show that an adaptation of the iterative method used in Flesch et al (2010) provides a necessary and sufficient condition for the existence of subgame perfect 0-equilibrium in pure strategies. This result implies that if the utility function of each player is upper semi-continuous, then there exists a subgame perfect 0-equilibrium in pure strategies.

The value of a draw in quasi-binary matches

Casilda Lasso de La Vega and Oscar Volij

Session: Sun16-H

A match is a recursive zero-sum game with three possible outcomes: player 1 wins, player 2 wins or there is a draw. Play proceeds by steps from state to state. In each state players play a “point game” and move to the next state according to transition probabilities jointly determined by their actions. We focus on quasi-binary matches which are those whose point games also have three possible outcomes: player 1 scores the point, player 2 scores the point, or the point is drawn in which case the point game is repeated. We show that when the probability of drawing a point is uniformly less than 1, quasi-binary matches have an equilibrium. Additionally, we can assign to each state a value of a draw so that quasi-binary matches always have a stationary equilibrium in which players’ strategies can be described as minimax behavior in the associated point games.

Nash equilibrium uniqueness in nice games with isotone best replies

Maria Carmela Ceparano and Federico Quartieri

Session: Sun16-J

We prove the existence of a unique pure-strategy Nash equilibrium in nice games with isotone chain-concave best replies and compact strategy sets. We establish a preliminary fixpoint uniqueness argument, thus showing sufficient assumptions on the best replies of a

nice game that guarantee the existence of exactly one Nash equilibrium. Then, by means of a comparative statics analysis, we examine the necessity and sufficiency of the conditions on marginal utility functions for such assumptions to be satisfied; in particular, we find necessary and sufficient conditions for the isotonicity and chain-concavity of best replies. We extend the results on Nash equilibrium uniqueness to nice games with upper unbounded strategy sets and we present dual results for games with isotone chain-convex best replies. A final application to Bayesian games is exhibited.

Nash Equilibrium in Games with Quasi-Monotonic Best-Responses

Rabah Amir and Luciano De Castro

Session: Sun16-J

This paper develops a new existence result for pure-strategy Nash equilibrium. In short, for a two-player game with scalar action sets, existence entails that one reaction curve be increasing and continuous and the other quasi-increasing (i.e, not have any downward jumps). The latter property amounts to strategic quasi-complementarities. The paper provides a number of ancillary results of independent interest, including sufficient conditions for a quasi increasing argmax, and new sufficient conditions for uniqueness offixed points. We present the main results in a familiar Euclidean setting for maximal accessibility. Finally, some commonly used models from applied microeconomic fields illustrate the broad and elementary applicability of the results.

Existence of Pure Strategy Equilibria in Finite Quasiconcave Games

Takahiro Watanabe

Session: Sun16-J

We show sufficient conditions for the existence of an equilibrium in pure strategies for games in which the set of strategies of each player is a finite integer interval. We define a best reply direction function and prove that an equilibrium in pure strategies exists if the best reply direction functions of each player satisfies a condition called direction preservingness. This result implies that an equilibrium in pure strategies exists if the payoff function of each player is quasiconcave on his own strategies and any difference between each player's payoffs when strategies of the other players increase by at most one unit is less than or equal to the half of the minimum non-zero marginal payoff of the own strategy. We apply the results to integer Cournot games with differentiated markets, in which each firm chooses an integer amount of the product and the price is also determined as an integer.

Pundits and Quacks: Learning about Analysts when Fundamental Asset Values are Unobserved

Jesper Rudiger and Adrien Vigier

Session: Sun16-K

Do asset prices aggregate investors' private information about the ability of financial analysts? We show that as financial analysts become reputable, the market can get trapped: Investors optimally choose to ignore their private information, and blindly follow analyst recommendations. As time goes by and recommendations accumulate, arbitrage based on the inferred ability of analysts may become profitable again. The market can thus be trapped at times and yet be able, in the long run, to sort the pundits from the quacks. However, this process is impaired when the set of assets is expanding such that new assets are traded often: in this case, the market might be trapped indefinitely.

Optimal Adaptive Testing: Informativeness and Incentives

Rahul Deb and Colin Stewart

Session: Sun16-K

We introduce a learning framework in which a principal seeks to determine the ability of a strategic agent. The principal assigns a test consisting of a finite sequence of questions or tasks. The test is adaptive: each question that is assigned can depend on the agents past performance. The probability of success on a question is jointly determined by the agents privately known ability and an unobserved action that he chooses to maximize the probability of passing the test. We identify a simple monotonicity condition under which the principal always employs the most (statistically) informative question in the optimal adaptive test. Conversely, whenever the condition is violated, we show that there are cases in which the principal strictly prefers to use less informative questions.

Reference Points and Learning

Alan Beggs

Session: Sun16-K

This paper studies learning when agents evaluate outcomes in comparison to a reference point. It shows that certain models of reinforcement learning lead to classes of recursive preferences.

Effort Provision and Optimal Prize Structure in Contests with Loss-Averse Players

Ayse Gul Mermer

Session: Sun16-L

This paper studies a multiple prize contest with reference dependent preferences a la Koszegi and Rabin (2006). The designer chooses the prize structure to maximize the

total expected effort. Contestants simultaneously undertake costly efforts to win prizes. Each contestant has private information about his ability, affecting his cost-of-effort. The prediction of the model is able to align the observed behaviour in recent laboratory experiments which is hard to reconcile under the assumption of standard preferences. More specifically high-ability contestants overexert effort while low-ability contestants exert very little or no effort in comparison to predictions with standard preferences. Moreover, the optimal prize allocation in contests differs markedly in the presence of reference dependent preferences. In particular, multiple prizes can become optimal when the cost-of-effort function is linear or concave, where standard preferences predict the optimality of a single prize. Several unequal prizes might be optimal when the cost-of-effort function is convex.

Optimal Feedback Design

Alex Smolin

Session: Sun16-L

I study a problem of optimal feedback provision. An agent of uncertain ability repeatedly supplies effort and a principal provides feedback on his performance. Feedback is valuable but may discourage the agent and dampen his effort. I show that a policy, optimal for the principal among all persuasion mechanisms, is coarse yet tractable. In each period, the principal only informs the agent whether her current belief on his ability is above a chosen cutoff. The agent is expected to exert effort above the cutoff and is threatened with no feedback for deviating. Depending on performance technology, optimal feedback can be provided through a tenure-track or performance standard policy. These results alert to adverse effects of increasing performance transparency in organizations and may explain some features of professional contracts.

Equilibria and Efficiency in Shared Effort Games

Gleb Polevoy, Stojan Trajanovski and Mathijs de Weerd

Session: Sun16-L

Shared effort games model investing resources in public projects and subsequently sharing the profits. Examples of such projects range from writing for Wikipedia to all-pay auctions like contests. In thresholded equal sharing (effort) games, an effort threshold defines which contributors receive their (equal) share. Thresholds between 0 and 1 model games like paper co-authorship and shared homework, where a minimum positive contribution is required before sharing in the profits. We fully characterize the conditions for a pure equilibrium existence for two-player shared effort games with linear project value functions and find the prices of anarchy and stability. For more players, our generalized fictitious play simulations show, when a pure equilibrium exists and what its efficiency is. The results about existence and efficiency of equilibria provide the likely strategy profiles

(especially as the generalized fictitious play converges there) and the socially preferred strategies to use when contributing to public projects.

On Symbols and Cooperation

Tom Potoms and Tom Truys

Session: Sun16-M

How are group symbols (e.g. a flag, Muslim veil, clothing style) helpful in sustaining cooperation and social norms? We study the role of symbols in an infinitely repeated public goods game with random matching, endogenous partnership termination, limited information flows and endogenous symbol choice. We characterize an efficient segregating equilibrium, in which players only cooperate with others bearing the same symbol. In this equilibrium, players bearing a scarcer symbol face a longer expected search time to find a cooperative partner upon partnership termination, and can therefore sustain higher levels of cooperation. We compare this equilibrium to other equilibria in terms of renegotiation proofness.

Inconspicuous Conspicuous Consumption

Juan Carlos Carbajal

Session: Sun16-M

A puzzling feature of conspicuous consumption, given its signaling role, is that it is not more conspicuous. For example, luxury goods often feature subtle, difficult-to-recognize branding. We analyze a model where consumers care about their reputation for wealth and social capital. In equilibrium, wealthy but poorly-connected consumers choose loud status goods, while wealthy, well-connected consumers choose subtle status goods to separate from poorly-connected consumers. The model thus explains why “old-money” types consume subtly, whereas “nouveau-riche” types consume loudly. It also addresses the stylized fact that subtly-branded status goods tend to be pricier than their loudly-branded equivalents.

Piracy versus monopoly in the market for conspicuous consumption

Michael Mandler

Session: Sun16-M

When luxury purchases signal the incomes of buyers, a monopoly will deliver signals efficiently. If competitors sell counterfeit copies of luxury goods at low prices, consumers will have to buy larger quantities to transmit the same signal, which wastes resources. Entrants do maximal harm when they produce indistinguishable replicas of existing luxury goods which causes prices to fall the furthest. Pooling, where agents do not signal, can deliver a welfare improvement over the separation that occurs under classical monopoly and competition. But only a powerful monopoly that can determine which goods are

marketed can enforce this outcome. Finally, there is a trade-off among the goods that can serve as income signals: the goods that signal efficiently display a large gap between marginal cost and the price a monopoly charges, but the same goods offer the greatest rewards to counterfeiting.

Individual preferences and networks

Penelope Hernandez, Guillem Martinez, Manuel Monos-Herrera and Angel Sanchez

Session: Sun16-N

We examine the interplay between a person's individual preference and the social influence others exert upon his choices. We provide a model of network relationships with conflicting preferences, where individuals are better off coordinating with those around them, but not all prefer the same action. We test our model in an experiment, varying the level of conflicting preferences between individuals and the cost structure associated to network formation. Our findings suggest that individual preferences are more salient than social influence when there exists a structure with a dominant out-group and a dominated in-group. This case leads to two undesirable outcomes: network segregation and social inefficiency. If, however, the dominant structure of the population is relaxed, integration is achievable under conditions of low conflict. This leads to denser and efficient networks.

Strategic influence in social networks

Michel Grabisch, Antoine Mandel, Agnieszka Rusinowska and Emily Tanimura

Session: Sun16-N

We consider a model of influence with a set of non-strategic agents and two strategic agents. The non-strategic agents have initial opinions, are linked through a connected network and update their opinions as in the DeGroot model. The two strategic agents have fixed and opposed opinions. They each form a link with a non-strategic agent in order to influence the average opinion in the network. This procedure defines a zero-sum game whose players are the strategic agents and their strategies are the non-strategic agents. We focus on the existence and characterization of pure strategy equilibria. The characterization of equilibrium emphasizes the influenceability of target agents and their centrality characterized by a new notion that we call intermediacy. If the strategic agents have the same impact, symmetric equilibria emerge as natural solutions. If the impacts are uneven, the high-impact agent focuses on central targets and the low-impact agent on influenceable ones.

Bonacich Measures as Equilibria in Network Models

Hannu Salonen

Session: Sun16-N

We investigate the cases when the Bonacich measures of strongly connected directed bi-

partite networks can be interpreted as a Nash equilibrium of a non-cooperative game. One such case is a two-person game such that the utility functions are bilinear, the matrices of these bilinear forms represent the network, and strategies have norm at most one. Another example is a two-person game with quadratic utility functions. A third example is an $m + n$ person game with quadratic utility functions, where the matrices representing the network have dimension $m \times n$. For connected directed bipartite networks we show that the Bonacich measures are unique and give a recursion formula for the computation of the measures. The Bonacich measures of such networks can be interpreted as a subgame perfect equilibrium path of an extensive form game with almost perfect information.

Ambiguity and Risk in Global Games

Takashi Ui

Session: Sun16-P

If players have ambiguous beliefs about the state in global games, rational behavior depends on ambiguity not only about the state but also about others behavior. The impact of ambiguity is most evident when one of the actions yields a constant payoff, which we call a safe action. Ambiguous information makes more players choose a safe action, whereas low-quality information makes more players choose an ex ante best response to the uniform belief over the opponents actions. If the safe action and the ex ante best response coincide, sufficiently ambiguous information generates a unique equilibrium, whereas sufficiently low-quality information generates multiple equilibria. In any case, the two types of information have opposite effects. In applications to financial crises, we demonstrate that news of more ambiguous quality triggers a liquidity crisis, whereas news of less ambiguous quality triggers a currency crisis.

Risk and Ambiguity in the Twin Crises

Satoshi Nakada and Kohei Sashida

Session: Sun16-P

We study the financial crisis model, where both banking and currency crises are correlated by the connection of two markets. Depart from classical financial crises models, we allow strategic complementarity not only within a group and but also in the two different sectors like Goldstein (2005). We also accommodate the situation where agents face ambiguous information about the underlying fundamental value. Under the model, we explore how degree of noise, risk (i.e., the variance of information about the fundamental value) and ambiguity, affects the possibility of the crises. We characterize when more/less risky and ambiguous information can reduce the possibility of correlated crises. Moreover, in the small limit of noise, when two crises are perfectly correlated we show that correlated crises can be prevented by manipulating the degree of risk and ambiguity. As a result, some policy implications to stabilize the economy can be drawn.

On the impossibility of protecting risk-takers

Toomas Hinnosaar

Session: Sun16-P

Risk-neutral sellers can extract high profits from risk-loving buyers with lotteries. To limit risk-taking, gambling is heavily regulated in most countries. I show that protecting risk-loving buyers is essentially impossible. Even if buyers are risk-loving only asymptotically, the seller can construct a non-random winner-pays auction that ensures unbounded profits. The profits are unbounded even if the seller cannot use any mechanism that resembles a lottery. Asymptotically risk-loving preferences are both sufficient and necessary for unbounded profits.

Local reasoning in dynamic games

Elias Tsakas and Andres Perea

Session: Sun16-Q

We introduce a novel framework for modeling bounded reasoning in dynamic games, based on the idea that at each history of the game each player pays attention to some - not necessarily all - histories. We refer to this phenomenon as local reasoning, and we show that several types of bounded rationality can be studied within this framework, such as limited memory or limited foresight. We study a standard form of reasoning within our framework, according to which each player tries to rationalize her opponents' past actions at the histories that she reasons about. As a result we obtain a generalized solution concept, called local common strong belief in rationality. We characterize the strategy profiles that can be rationally played under our concept by means of a simple iterative elimination procedure. Finally, we show that standard solution concepts are special cases of rationality and local common strong belief in rationality.

How Do People Reason In Dynamic Games?

Nadine Chlass and Andrs Perea

Session: Sun16-Q

Do individuals rationally choose the solution concept for a dynamic game or is their mode of reasoning a type-like predisposition? We show that an individuals propensity to forwardly or backwardly induct is a function of (i) her belief whether the opponents action was a trembling hand mistake or a rational choice, and (ii) her personality traits. In a two-stage dynamic game, the individual observes an action of a computerized opponent whose hand can tremble (stage 1) before both interact (stage 2). The opponents action in stage 1 discloses with some probability the opponents belief about the individuals choice in stage 2. The individual can either believe that (i) the opponent trembled in stage 1, or that (ii) the opponent made a rational choice. The individual consistently responds

to this belief if she solves stage 2 by backwards induction in the first, and by forward induction in the second case.

A new epistemic model

Miklos Pinter

Session: Sun16-Q

Meier (2012) gave a mathematical logic foundation of the purely measurable universal type space (Heifetz and Samet, 1998). The mathematical logic foundation, however, discloses an inconsistency in the type space literature: a finitary language is used for the belief hierarchies and an infinitary language is used for the beliefs. In this paper we propose an epistemic model to fix this inconsistency. We show that in the proposed model the universal knowledge-belief space exists, is complete and includes all belief hierarchies. Moreover, by examples we demonstrate that in our model the players can agree to disagree – the main result of Aumann (1976) does not hold –, and the conditions of Aumann and Brandenburger (1995) are not sufficient for Nash equilibrium. However, we show that if we substitute self-evidence (Osborne and Rubinstein, 1994) for common knowledge then we get at that both Aumann’s and Aumann and Brandenburger’s results hold.

The balanced contribution property for equal contributors

Yukihiko Funaki, Koji Yokote and Takumi Kongo

Session: Sun16-R

In this paper we introduce a weaker version of the balanced contribution property by Myerson(1980), and explore the class of solutions characterized by the axiom. Our new axiom, the balanced contribution property for equal contributors, states the if two players’ contributions to the grand coalition are the same, then their contributions to each other’s payoffs are the same. We prove that this axiom, together with efficiency and weak strategic invariance, characterizes the class of r-egalitarian Shapley values. This class includes the egalitarian Shapley values (Joosten(1960)) and the generalized solidarity values (Casajus and Huettner (2014)) as special cases. We also provide a non-cooperative implementation of the solution.

Asymmetric three agent majority pillage games

Colin Rowat, Manfred Kerber and Naoki Yoshihara

Session: Sun16-R

Pillage games (Jordan in J Econ Theory 131.1:2644, 2006, Pillage and property) are cooperative games which allow externalities between coalitions, and resources to contribute both to coalitions power and to their utility. Thus, they are well suited to modeling unstructured power contests. To this point, the pillage games literature has been entirely theoretical, partly due to a pervasive symmetry assumption that agents intrinsic

contributions to coalitional power is identical – a property unlikely to hold in applications. This paper exhaustively analyses an asymmetric three-agent pillage game related to the characteristic function form majority game. It finds that only eight configurations are possible for the core, which contains at most six allocations. For each core configuration, the stable set is either unique or fails to exist. Only one stable set contains an allocation in the interior of the allocation simplex, a degenerate symmetric case already known in the literature.

Recursive methods for discrete claims problems with social constraints

Jose-Manuel Gimnez-Gómez and Cori Vilella

Session: Sun16-R

In the current approach we consider claims problems with indivisible goods. Specifically, by applying the recursive procedures proposed by Gimenez- Gomez and Marco-Gil (2014) and Gimenez-Gomez and Peris (2014), we ensure the fulfillment of order preservation and balancedness, considered by many authors as minimal requirements of fairness. Moreover, we retrieve the discrete constrained equal losses and the discrete constrained equal awards rules (Herrero and Martinez, 2008). Finally, by the recursive imposition of a lower bound and an upper bound, we obtain the average between them.

Ethnic divisions, political institutions and the duration of declines

Kaj Thomsson and Richard Bluhm

Session: Sun16-S

We analyze the duration of large economic declines and provide a game-theoretic model of delayed recovery. Based on this model, we show that uncertain post-recovery incomes lead to a commitment problem which limits the possibility of cooperation in ethnically heterogeneous countries. We furthermore show theoretically that strong constraints on the executive solve this problem by reducing the uncertainty associated with cooperative behavior. We test the model using standard data on linguistic heterogeneity and detailed data on ethnic power configurations. Our findings support the key theoretical prediction: stronger constraints on the political executive shorten economic declines. The effect is large in ethnically heterogeneous countries but virtually non-existent in homogeneous societies.

Perception and Inclusiveness

Shyh-Fang Ueng

Session: Sun16-S

Being inclusive benefits not only a country but also its ruler. Why so many regimes are exclusive instead? This paper distinguishes between the distributions of current power and expected capability to master future contingencies to study the inclusiveness of ruling

coalition. The subgame perfect equilibrium (SPE) shows that (1)only groups whose ratio of current power and perceived capability to master future contingencies takes medium values will be included in the coalition; (2) when treason by member groups is feasible, the admissible interval for coalition member groups diminishes significantly; (3)if repressing rebellion preserves net gain for the incumbent power leader, the ruling coalition has various levels of inclusiveness; and (4)it is more inclusive if the incumbent power leader has a large power margin over that of other groups.

How Does an Authoritarian Regime Allow Citizens to Voice Opinion Publicly?

Jidong Chen and Yiqing Xu

Session: Sun16-S

Why would an authoritarian regime allow citizens to complain publicly if, as is often presumed, exchange of information among citizens invites social instability? This paper studies how an authoritarian regime allows citizens to voice opinion publicly, such as on social media, to strengthen its rule. We identify two functions of such communication process. First, it disorganizes the citizens or strengthens their disagreement if, through communication, they find themselves split over government policies. Second, if communication reveals that citizens share a high level of dissatisfaction, the government identifies the danger and improves the policies accordingly. We show that the government allows public communication if and only if it perceives sufficient heterogeneity among citizens. The model also illustrates that public communication could serve as a commitment device that ensures government responsiveness when it faces high dissatisfaction, which in turn makes the government better off than with private polling.

Pure Nash Equilibrium and Coordination of Players in Ride Sharing Games

Tatsuya Iwase and Takahiro Shiga

Session: Sun16-T

In this study, we formulate positive and negative externalities caused by changes in the supply of shared vehicles as ride sharing games. The study aims to understand the price of anarchy (PoA) and its improvement via a coordination technique in ride sharing games. A critical question is whether ride sharing games exhibit a pure Nash equilibrium (pNE) since the PoA bound assumes it. Our result shows a sufficient condition for a ride sharing game to have a finite improvement property and a pNE similar to potential games. This is the first step to analyze PoA bound and its improvement by coordination in ride sharing games. We also show an example of coordinating players in ride sharing games using signaling and evaluate the improvement in the PoA.

Potential Games are Necessary to Ensure Pure Nash Equilibria in Cost Sharing Games

Jason Marden, Ragavendran Gopalakrishnan and Adam Wierman

Session: Sun16-T

We consider the problem of designing distribution rules to share welfare (cost or revenue) among individually strategic agents. There are many known distribution rules that guarantee the existence of a (pure) Nash equilibrium in this setting, e.g., (weighted) Shapley values; however, a characterization of the space of distribution rules that guarantee the existence of a Nash equilibrium is unknown. Our work provides an exact characterization of this space for a specific class of scalable and separable games. Given arbitrary local welfare functions W , we prove that a distribution rule guarantees equilibrium existence for all games if and only if it is equivalent to a generalized weighted Shapley value on some ground welfare functions W' , which can be distinct from W . Accordingly, in order to guarantee equilibrium existence in all games with any fixed local welfare functions, it is necessary to work within the class of potential games.

Coalition formation and surplus sharing in repeated multi-coalitional games

Arnold Polanski and Fernando Vega-Redondo

Session: Sun16-T

We consider an infinite game, in which productive coalitions interact repeatedly over time. We characterize both, the terms of trade and the endogenous cooperation structure in this game when just three general axioms are satisfied: (1) the coalition structure formed is consistent with agents payoff expectations; (2) each coalition that forms distributes the entire surplus among its members; (3) in any coalition, all agents are treated symmetrically relative to their payoff expectations. Assuming the game ends after each date with a vanishing probability, we obtain unique shares and a unique cooperation structure that satisfy these conditions. In an application, we show how, in a complete network, a unique price arises and agents specialize in either buying or selling while, in an incomplete network, transactions occur, generally, at multiple prices and some agents become arbitrageurs that buy and sell at different prices.

A simple dynamic climate cooperation model with large coalitions and deep emissions cuts

Eugen Kovac and Robert Schmidt

Session: Sun16-U

A standard result from the game theoretic literature on international environmental agreements is that coalitions are either “broad but shallow” or “narrow but deep”. Hence, the stable coalition size is small when the potential welfare gains are large. We modify a standard climate coalition game by adding a - seemingly - small but realistic feature: we

allow countries to delay climate negotiations until the next “round” if a coalition forms but decides to remain inactive. It turns out that results are surprisingly different under this modification. In particular, a large coalition with deep emissions cuts forms if countries are sufficiently patient. Our results also indicate that countries should try hard to overcome coordination problems in the formation of a coalition. A more cooperative outcome may then be reached, and it may be reached more quickly.

Ecosystem restoration by multiple agents

Adam Lampert, Alan Hastings and James Sanchirico

Session: Sun16-U

A major threat on human well-being is the accelerated rate of ecosystem degradation. Restoration of degraded ecosystems entails cooperation among multiple agents such as land owners, agencies and sometimes countries. These agents may have incentives to contribute less (free-ride), which may lead to inefficient or incomplete treatment. Here we introduce a dynamic game approach to study how to restore ecosystems by multiple agents, taking into account the costs of both treatment and degradation over time. We assume no enforcement mechanisms and no binding agreements. We show that, under certain conditions, there exists a solution (subgame perfect Nash equilibrium) where all agents actively participate, albeit slowly enough, and no agent has an incentive to free-ride. This Nash equilibrium may coexist with an inefficient Nash equilibrium dictating no contribution by any agent. This implies that certain restoration projects may not require external investment as managers may self-organize to resolve their conflicts.

Knowing Your Opponent: Asymmetries and Auction Design

Andrew Mclellan

Session: Mon9-A

In many settings, bidders may differ in their information sources or ability to utilize a good. We model a common-value second-price auction in which bidders are given both a signal and a type and investigate equilibrium in multidimensional auctions. Our first result proves the existence of symmetric equilibrium when types are multidimensional. We also find sufficient conditions for equilibrium to be unique and strictly increasing. We then look at the impact of disclosing information about opposing bidders. We consider models where type corresponds to the precision of the signal or a private-value advantage. In both of these settings, publicly disclosing all bidder’s types decreases revenue compared to when types are private knowledge. Simple examples show that this decrease can be very large. Our finding suggests a practical and easily implementable information design recommendation which can restore stability to revenue of the auction.

First Price Auction with Asymmetrically Budget Constrained Bidders

Nina Bobkova

Session: Mon9-A

I solve a first price auction for bidders with asymmetrically distributed budget constraints and public valuations. I fully characterize the set of equilibria for this framework. I analyze the effect of asymmetry in the budget distributions on equilibrium bidding behavior and implications for the auctioneer's revenue. If bidders are sufficiently symmetric (there exists a threshold for the reverse hazard rates of budget distributions), the degree of asymmetry in the budgets has no influence on the equilibrium strategies: bidding the entire budget is the unique equilibrium strategy. However, if asymmetry gets sufficiently severe (at least one reverse hazard rate undercuts this threshold), mass points in the equilibrium strategies arise. I derive pure strategy weakly monotonic bidding functions and show, that under mild regularity conditions, the weaker bidder bids more aggressively than his stronger opponent. Furthermore, information disclosure about budget distributions for ex-ante symmetric bidders is never profitable for the auctioneer.

Market Power and Welfare in Asymmetric Divisible Good Auctions

Carolina Manzano and Xavier Vives

Session: Mon9-A

We analyze a divisible good uniform-price auction with two groups with a finite number of identical bidders. When an equilibrium exists it is unique and the relative market power of a group increases with the precision of its private information and decreases with its transaction costs. Consistent with the empirical evidence, we find that an increase in the transaction cost of a group of bidders induces a strategic response of the other group according to which they diminish their reaction to private information and submit steeper schedules. The “stronger” group (with more precision of private information, lower transaction costs and/or more oligopsonistic) has more market power and has to receive a higher subsidy to behave competitively. The deadweight loss increases with the quantity auctioned and with the degree of payoff and informational asymmetry when the strong group values the asset at least as the weak group.

Two-bidder all-pay auctions with interdependent valuations, including the highly competitive case

Lucas Rentschler and Theodore Turocy

Session: Mon9-B

We analyze symmetric, two-bidder all-pay auctions with interdependent valuations and discrete type spaces. Relaxing previous restrictions on the distribution of types and the valuation structure, we present a construction that characterizes all symmetric equilibria. We show how the search problem this construction faces can be complex. In equilibrium,

randomization can take place over disjoint intervals of bids, equilibrium supports can have a rich structure, and non-monotonicity of the equilibrium may result in a positive probability of allocative inefficiency when the value of the prize is not common. Particular attention is paid to the case in which an increase in a bidder's posterior expected value of winning the auction is likely to be accompanied by a corresponding increase for the other bidder. Such environments are “highly competitive” in the sense that the bidder's higher valuation also signals that the other bidder has an incentive to bid aggressively.

Repeated Dollar Auctions: A Multi-Armed Bandit Approach

Marcin Waniek, Long Tran-Thanh and Tomasz Michalak

Session: Mon9-B

We investigate the repeated version of Shubik's dollar auctions, in which the type of the opponent and their level of rationality is not known in advance. We formulate the problem as an adversarial multi-armed bandit, and we show that a modified version of the ELP algorithm, tailored to our setting, can achieve $O(\sqrt{ST})$ performance loss (compared to the best fixed strategy), where S is the cardinality of the set of available strategies, and T is the number of (sequential) auctions. We also show that under some further conditions, these bounds can be improved to $O(S^{1/4}\sqrt{T})$, and $O(\sqrt{T})$, respectively. Finally, we consider the case of spiteful players. We prove that when a non-spiteful player bids against a malicious one, the game converges in performance to a Nash equilibrium if both players apply our strategy to place their bids.

Spite and overbidding in second price all-pay auctions. A theoretical and experimental investigation

Oliver Kirchkamp and Wladislaw Mill

Session: Mon9-B

An extensive literature provides evidence for overbidding in auctions. Risk aversion, joy of winning, anticipated regret etc. do not always offer sufficient explanations. We show that the second-price all-pay auction presents a very interesting environment to study spite and overbidding. In equilibrium we should expect spiteful participants to increase their bids for small valuations and decrease their bids for high valuations. We measure spite and bidding behaviour for our participants and find that, indeed, the more spiteful participants also follow a bidding pattern which is theoretically in line with more spitefulness.

A theory of recommended price dispersion

Pim Heijnen, Marco Haan and Martin Obradovits

Session: Mon9-C

This paper contributes to the theory of recommended retail prices. We consider a model with two firms that compete by setting prices in a homogeneous product market, where

firms first set a recommended price, that serves as an upper bound on the actual retail price. The key element is that a fraction of consumers are partially informed and make a purchasing decision solely on basis of the recommended price. We show that if these consumers use a simple heuristic, then recommended retail prices lead to lower retail prices on average. The effect is less strong if consumers have rational expectations.

A Human Resource Theory of Persistent Productivity Dispersion

Moritz Meyer-Ter-Vehn, Simon Board and Tomasz Sadzik

Session: Mon9-C

We propose a labor market model for service and tech industries, where a firm's primary asset is its workforce. Firms attract applicants with high wages, and managers identify talent among the applicants. If talent is scarce, firm-applicant matching is positive assortative, with skilled managers posting high wages and attracting an unselected applicant pool; if talent is plentiful, matching is negative assortative, with skilled managers posting low wages and attracting an adversely selected applicant pool. In either case, negative assortative matching is efficient. We then embed this labor market model into a firm dynamics framework, and into a firm hierarchy framework. These model extensions explain persistent productivity dispersion between firms, and wage dispersion across firms and across hierarchy levels.

Spillovers between Skilled and Low Skilled Labor Migration in a Multi-Regional Setting

Mehmet Barlo and Omer Koru

Session: Mon9-C

We analyze spillover effects between movements of skilled and low skilled labor in a static multi-regional model featuring three factors of production: capital, labor, and land. While capital is perfectly mobile and land immobile, labor from one region can migrate to another with some origin-destination specific probability (induced by the associated immigration policies) after incurring a skill specific efficiency loss also determined by the origin and destination. In this setting, we characterize not only competitive equilibrium allocations of factors of production but also the associated migration levels. Furthermore, we show that policies of host regions favoring skilled labor from one particular region may trigger movements of low skilled labor from other regions even when all the other parameters, including those concerning low skilled labor movements, remain the same.

A signaling model of foreign direct investment attraction

Marcelo Griebeler and Elisa Wagner

Session: Mon9-D

Foreign direct investors face uncertainty about the economic and political conditions of

the host country. In a two period game, we allow the host country's government to mitigate such an uncertainty by sending a signal through fiscal policy. Our main finding states that a populist government may mimic a conservative one in order to attract foreign direct investment (FDI), and this choice depends mainly on its impatience degree and the originally planned FDI stock. We highlight the role of the government's reputation in attracting foreign capital and thus provide some policy implications. Moreover, our model explains why in some countries considered populist governments adopt conservative policies in the beginning of its terms of office.

Financial Contracting with Enforcement Externalities

Lukasz Drozd and Ricardo Serrano-Padial

Session: Mon9-D

Contract enforceability in financial markets often depends on the aggregate actions of agents. For example, high default rates in credit markets can delay legal enforcement or reduce the value of collateral, incentivizing even more defaults and potentially affecting credit supply. We develop a theory of credit provision in which enforceability of individual contracts is linked to aggregate behavior. The central element behind this link is enforcement capacity, which is endogenously determined by investments in enforcement infrastructure. Our paper sheds new light on the emergence of credit crunches and the relationship between enforcement infrastructure, economic growth, and political economy distortions.

Decentralized Clearing in Financial Networks

Pter Csóka and P. Jean-Jacques Herings

Session: Mon9-D

We consider a situation in which agents have mutual claims on each other, summarized in a liability matrix. Agents' assets might be insufficient to satisfy their liabilities leading to defaults. We assume the primitives to be denoted in some unit of account. In case of default, bankruptcy rules are used to specify the way agents are going to be rationed. A clearing payment matrix is a payment matrix consistent with the prevailing bankruptcy rules that satisfies limited liability and priority of creditors. Both clearing payment matrices and the corresponding values of equity are not uniquely determined. We provide bounds on the possible levels equity can take. We analyze decentralized clearing processes and show the convergence of any such process in finitely many steps to the least clearing payment matrix. As a policy implication, it is not necessary to process all the sensitive data simultaneously and run a centralized clearing procedure.

Bargaining Under Institutional Challenges

Leyla Derin Karakas

Session: Mon9-E

Standard legislative bargaining models assume that an agreed-upon allocation is final, whereas in practice, there exist mechanisms for challenging passed legislation when there is lack of sufficient consensus. Such mechanisms include popular vote requirements following insufficient majorities in the legislation. This paper analyzes a legislative bargaining game whose outcome can be challenged through a referendum. I study the effects of this institution on the bills passed in the legislature and analyze the incentives they provide for reaching grand bargains. The proposer party's trade-off between an expensive partner and a threatening opponent in the referendum summarizes the bargaining problem. The results indicate that it is possible to observe surplus coalitions formed in equilibrium even though smaller coalitions are sufficient for the passage of a bill and that measures of post-bargaining power do not necessarily translate into higher equilibrium payoffs. Moreover, disparities in campaigning resources incentivize challenge procedures.

Union bargaining power and product innovation: relevance of the preference function

Debasmita Basak, Andreas Hoefele and Arijit Mukherjee

Session: Mon9-E

We show the effects of the bargaining power of labour unions on product innovation under decentralised and centralised wage bargaining. In this context, we show the implications of preference function, which affects the market size. A higher union bargaining power increases innovation if bargaining is decentralised, the market expansion effect is weak and the cost of innovation is moderate but low. Otherwise, a higher union bargaining power reduces innovation. Hence, whether a higher union bargaining power increases or decreases product innovation depends on the type of wage bargaining, market expansion effect and the cost of innovation.

Initiation of Merger and Acquisition Negotiation with Two-Sided Private Information

Zhe Wang and Yi Chen

Session: Mon9-E

In a dynamic model of merger negotiation with two-sided private information two-sided endogenous initiation, this paper investigates (1) what determines the timing of M&A initiation, and (2) who initiates the M&A negotiation; (3) why bid premia are different between target-initiated deals and bidder-initiated deals. The key driving force for the results is that the timing of initiation can reveal information about the target's private signal of its stand-alone value, and the bidder's private signal about its valuation for

the target's firm. The model predictions are consistent with the empirical evidence that emphasizes the role of private information in deal-initiation.

Job Mobility of Couples when Distance Matters

Fatma Aslan and Jean Laine

Session: Mon9-F

We formalize job mobility procedure through a generalized Shapley-Scarf model of markets for finitely many pure indivisible goods without money, where individuals may be married and couples simultaneously apply for jobs. Moreover, we endow the set of jobs with a geographical structure in order to capture the fact that couples wish to live together. Married individuals value allocations taking into account both the satisfaction they get from their job and the distance to their mate. Two concepts of Core stability are defined where blocking coalitions should involve individuals with their mate. We prove that Core existence strongly rests upon the precise way married individuals value matchings, as well as the properties of the initial matching and the location structure. We show that Core existence strongly rests upon the precise way married individuals value matchings, as well as the properties of the initial matching and the location structure.

Pairwise matching in large economies

Christopher Kah and Michael Greinecker

Session: Mon9-F

We formulate a distributional form of the stable marriage problem for continuum economies in which matchings are joint distributions on the characteristics of girls and boys. Agents are allowed to choose from a match dependent menu of contracts that lies in a compact space. Our model accommodates both the classical marriage model and the assignment game with side-payments. Furthermore, we allow for widespread externalities that depend on statistical properties of matchings. Stable matchings exist in full generality. Every stable matching in the continuum problem is the limit of stable matchings in finite marriage problems. All matchings in distributional form can be purified to one-to-one matchings of individuals in an individualistic model.

The Tinder Stable Marriage Problem

Josue Ortega

Session: Mon9-F

I study the many-to-many matching problem induced by the popular dating app Tinder. I provide empirical evidence suggesting that its matching procedure is unstable, and show that its assignments can be setwise and even pairwise blocked. Any alternative stable mechanism either violates the users' privacy or has an unreasonably complex message space.

Non-manipulable rules for land rental problems

Alfredo Valencia-Toledo and Juan Vidal-Puga

Session: Mon9-G

We consider land rental problems where there are several communities that can act as lessors and a single tenant who does not necessarily need all the available land. A rule should determine which communities become lessors, how much land they rent and at which price. Our first result is a complete characterization of the family of rules that satisfy land monotonicity and non-manipulability under land reassignment. We also define two parametric subfamilies. The first one is characterized by adding a property of weighted standard for two-person. The second one is characterized by adding consistency and continuity.

Implementation of Efficient Investments in Mechanism Design

Kentaro Tomoeda

Session: Mon9-G

This paper studies the question of when we can eliminate investment inefficiency in a general mechanism design model with transferable utility. We show that when agents make investments only before participating in the mechanism, inefficient investment equilibria cannot be ruled out whenever an allocatively efficient social choice function is implemented. We then allow agents to make investments before and after participating in the mechanism. When ex post investments are possible and an allocatively constrained-efficient social choice function is implemented, efficient investments are implementable in subgame-perfect equilibria if and only if the social choice function is commitment-proof (a weaker requirement than strategy-proofness). Commitment-proofness ensures the efficiency of investments by suppressing the agents incentives to make costly ex ante investments which may work as a commitment device. Our result implies that in the provision of public goods, subgame-perfect implementation of efficient investments and efficient allocations is possible even given a budget-balance requirement.

Object Allocation via Immediate-Acceptance

Battal Dogan and Bettina Klaus

Session: Mon9-G

For the model of allocating (object) types to agents, where each type has a certain number of copies (the capacity) and each agent has a preference ranking over types and he should receive at most one copy of at most one type, we introduce a property, rank-respecting unavailable-type-invariance (rr-UTI), which requires that when the positions of the unavailable types (the types which have zero capacity) are shuffled at a preference profile in such a way that the relative rank of each type among the agents preferences is preserved,

the assignment should not change. We show that immediate acceptance mechanisms are the only mechanisms satisfying resource-monotonicity, weak non-wastefulness, consistency, favoring-higher-ranks, and rr-UTI.

A Bandit Model of Two-Dimensional Uncertainty - Rationalizing Mindsets

Inga Deimen and Julia Wirtz

Session: Mon9-H

We analyze a new type of bandit where an agent is confronted with two-dimensional uncertainty. The agent does not know whether ability or effort is required to succeed at a given task. Moreover, the agent does not know her own ability. In each period, after deciding whether to exert effort or not, the agent observes a success or a failure and updates her beliefs about both the task and her ability accordingly. In contrast to standard bandit models, the agent gains information even when she is not exerting effort. In this setting different agents react to failure in different ways; while some agents find it optimal to resign others prefer to increase their effort. We show that different effort costs and beliefs about the own ability and the production function together with Bayesian updating can explain differences in behavior; different ex-ante beliefs about the sources of success are not needed.

Dynamic inconsistency in games

János Flesch, Zsombor Mder, Ronald Peeters and Yianis Safaridis

Session: Mon9-H

Decision makers with time-inconsistent preferences have been studied in great detail in recent decades. Addressing the dearth of literature on time inconsistency in a strategic context, our work provides the foundations for dealing with two-player games with naive and sophisticated players. We model various types' beliefs explicitly, and then proceed to define equilibrium notions based on these belief hierarchies. Second-order beliefs of naive players turn out to be crucial, and lead to different equilibria even in relatively simple games. We provide several examples, including models of bargaining and bank runs, showing the applicability of our framework.

Continuous-Time Games with Imperfect and Abrupt Information

Benjamin Bernard

Session: Mon9-H

This paper studies two-player games in continuous time with imperfect public monitoring, where information may arrive both continuously, governed by a Brownian motion, and discontinuously, according to Poisson processes. For this general class of two-player games, we characterize the equilibrium payoff set via a differential equation of its boundary. The equilibrium payoff set is obtained from an iterative procedure similar to that

known in discrete time. In our setting, however, the resulting payoff set in each step of the iteration is characterized explicitly. Our analysis reveals the drastic influence of abrupt information on the equilibrium payoff set: because of the additional possibility for value burning, the equilibrium payoff set extends much closer to the efficient frontier and its boundary may contain additional straight line segments.

Unit Vector Games

Rahul Savani and Bernhard von Stengel

Session: Mon9-J

McLennan and Tourky (2010) showed that “imitation games” provide a new view of the computation of Nash equilibria of bimatrix games with the Lemke-Howson algorithm. In an imitation game, the payoff matrix of one of the players is the identity matrix. We study the more general “unit vector games”, which are already known, where the payoff matrix of one player is composed of unit vectors. Our main application is a simplification of the construction by Savani and von Stengel (2006) of bimatrix games where two basic equilibrium-finding algorithms take exponentially many steps: the Lemke-Howson algorithm, and support enumeration.

Strategic Characterization of the Equilibrium Index in Symmetric Games

Anne Balthasar and Bernhard von Stengel

Session: Mon9-J

In a symmetric two-player game, a symmetric equilibrium can only be dynamically stable if it has positive index. The sum of the indices of all equilibria is 1, so a unique equilibrium has index 1. The index is a topological notion related to geometric orientation, and defined in terms of the sign of the determinant of the payoffs in the equilibrium support. We prove a simple strategic characterization of the index conjectured by Hofbauer: In a nondegenerate symmetric game, an equilibrium has index 1 if and only if it is the unique equilibrium in a larger symmetric game obtained by adding further strategies (it suffices to add a linear number of strategies). Our proof introduces unit-vector games where one player’s payoff matrix consists of unit vectors, and applies in a novel way simplicial polytopes and a known result that any matrix with positive determinant is the product of three P-matrices.

The Index +1 Principle

Andrew McLennan

Session: Mon9-J

The fixed point index assigns an index of +1 or -1 to each fixed point of a generic function or correspondence, and these indices sum to +1. If an isolated equilibrium is stable with respect to any process of adjustment to equilibrium that is economically “natural,” then

the index of the equilibrium is $+1$. The index $+1$ principle asserts that consequently only index $+1$ equilibria are empirically relevant; we argue that this should be regarded as a fundamental principle of economic analysis. The index $+1$ principle is universally applicable to economic models in which equilibria are topological fixed points. It does not depend on insignificant details of model specification. The index $+1$ principle itself, and the hypothesis that processes of adjustment to equilibrium are natural, are strongly supported by experimental evidence. The index $+1$ principle can be seen as the multidimensional extension of Samuelson's correspondence principle.

Strategic Experimentation on a Common Threshold

Yi Chen

Session: Mon9-K

A dynamic game of experimentation is examined where players search for an unknown threshold. Players contribute to the rate of decline in a state variable, and the game ends with a costly breakdown once the state falls below the threshold. In the unique symmetric pure-strategy stationary Markov equilibrium, the state decreases gradually over time and settles at a cutoff level asymptotically, conditional on no breakdown. The cutoff depends on the patience, the cost of the breakdown, and the prior distribution of the threshold, but not on the number of players. In a discrete-time version of the game, the equilibrium time path of the state converges to that of the continuous-time model when period length tends to zero.

The Role of Heterogeneity in a model of Strategic Experimentation

Kaustav Das

Session: Mon9-K

In this paper, I examine the effect of introducing heterogeneity between players in a model of strategic experimentation. I consider a two-armed bandit problem in continuous time with one safe and another risky arm. I show that if the degree of heterogeneity between the players is high enough, then there exists a unique Markov perfect equilibrium in simple cutoff strategies. For moderate level of heterogeneity cutoff equilibrium exists along with other equilibria, but the cut-off equilibrium Pareto dominates other equilibria. For low level of heterogeneity, no cutoff equilibrium exists and at some instances, the most heterogeneous equilibrium Pareto dominates all other equilibria.

Restless Strategic Experimentation

Daria Khromenkova

Session: Mon9-K

I study a game of strategic experimentation with two-armed bandits in which the state of the world is restless, "reboots" at exponentially distributed random times. Players ob-

serve neither the initial state of the world nor reboot times, but may learn about whether the current state is good via news that arrives at exponential times. Unlike in standard good-news models of strategic experimentation in which the state is rested, there are parameters for which the encouragement effect is present and players experiment beyond the single-player threshold. There also exists a range of parameters for which the free-riding effect is mute and the equilibrium is efficient.

Selecting Contestants for a Rent-Seeking Contest: a Mechanism Design Approach

Jean-Francois Mercier

Session: Mon9-L

In this paper, a contest designer derives profits from aggregate effort exerted by the contestants. I develop a revelation mechanism that enables the contest designer to select a subset of contestants from a pool of candidates in a way that maximizes her profits, even though she is uninformed about the candidates' valuations for the contest prize. I prove the existence of an incentive compatible mechanism. I solve the designer's problem by using a 3-stage game where at Stage 0, the designer designs a mechanism, at Stage 1 the contestants participate in the mechanism then contestants are selected and at Stage 2, information is revealed and the selected contestants participate to a contest. Depending on the marginal cost that a contestant imposes on the designer, some candidates with a low valuation for the contested good may never be selected to the contest.

Iterative Revelation Mechanisms

Ryuji Sano

Session: Mon9-L

This paper considers dynamic resource allocation processes, called iterative revelation mechanisms, with quasi-linear dichotomous utilities and complete information. Agents gradually reveal their valuation through "ask-price" binary questions. The social planner identifies the efficient outcome, and monetary transfer is determined on a "pay-as-bid" basis. We show that the efficient allocation rule is implemented in a subgame perfect Nash equilibrium, regardless of details of an ask-price process. The analysis applies to the case with limited communication, and every strongly monotone allocation rule is implemented in equilibrium. We also show that if a resource allocation process is ex post incentive compatible, it is an ascending-price mechanism. In a single-object allocation problem, the English auction is a unique mechanism satisfying efficiency, ex post incentive compatibility, and pay-as-bid transfer.

A mechanism to pick the deserving winner

Anna Moskalenko

Session: Mon9-L

A group of individuals is choosing an individual (the winner) among themselves, when the identity of the deserving winner is a common knowledge among individuals. A simple mechanism of voting by veto is proposed as an alternative to the mechanism studied by Amorós (2011). Like Amorós'(2011), the suggested mechanism implements the socially desirable outcome (the deserving winner is chosen) in subgame perfect equilibria.

Disclosure and Choice

Elchanan Ben-Porath, Eddie Dekel and Barton Lipman

Session: Mon9-M

An agent chooses among projects with random outcomes. His payoff is increasing in the outcome and in the observer's expectation of the outcome. With some probability the agent can disclose the true outcome to the observer. We show that choice is inefficient: the agent favors riskier projects even with lower expected returns. If information can also be disclosed by a challenger who prefers lower beliefs of the observer, the chosen project is excessively risky when the agent has better access to information than the challenger, excessively risk-averse when the challenger has better access, and efficient otherwise. We also characterize the agent's worst-case equilibrium payoff.

Disclosure of Verifiable Information under Competition

Stefan Penczynski and Sihong Zhang

Session: Mon9-M

This study investigate experimentally the revelation of verifiable information in a market setting. We find that sellers often choose to report a selected set of information and buyers on average compensate for this by bidding less. A higher level of competition has a positive and significant effect on the revelation of information on the seller side. In both the monopoly and the competition setting, the buyers are on average not able to fully compensate the sellers' selection of evidence. The bids significantly exceed the values of the good in both treatments, leading to a payoff difference in favor of the sellers. 25% of the buyers' bids do not account for the selection in evidences.

Competition in Information Disclosure

Keiichi Kawai and Pak Hung Au

Session: Mon9-M

We analyze a model of competition in Bayesian persuasion in which two or more senders vie for the patronage of a receiver by disclosing information about their respective proposals. We focus particularly on binary state space, i.e., each senders proposal gives the

receiver either a high or low utility. With two (possibly asymmetric) senders, we fully characterize the generically unique equilibrium and show that its simple linear structure is similar to that of all-pay auction with complete information. A sender facing a stronger opponent engages in more aggressive disclosure in terms of second-order stochastic dominance. With multiple symmetric senders, an increase in the number of competing senders leads to a more aggressive disclosure, which converges to full disclosure as the number of senders goes to infinity. Finally, we show that the finding that equilibrium strategy must exhibit a linear structure remains valid locally for any finite state space model.

Sequential Collective Search in Networks

Niccolo Lomys

Session: Mon9-N

I study an observational learning model over general social networks where Bayesian agents endogenously acquire information through costly search. Agents arrive in sequence and take a single decision each. The qualities of the two feasible actions are a priori unknown to the agents. Each individual observes the actions of a stochastically generated neighborhood of individuals (network topology). Then, the agent engages in private sequential search to finally select an action among those he has sampled. Asymptotic learning occurs if search costs are not bounded away from zero, the network topology is sufficiently connected and: either neighborhood realizations convey little information about the network; or information asymmetries are described through beliefs over the states of a finite Markov chain. When the network topology is not sufficiently connected, asymptotic learning always fails. For search costs that are bounded away from zero, I introduce and study the weaker notion of maximal learning.

Core-stable Networks with Widespread Externalities

László Kóczy

Session: Mon9-N

We introduce a model for coalitional network stability in networks with widespread externalities. The network function form generalises the partition function form of cooperative games in allowing the network structure to be taken into account. The recursive core for network function form games generalises the recursive core for such environments and its properties also rhyme with the corresponding inclusion properties of the optimistic and pessimistic recursive cores and can be seen as a modification of pairwise stability to a coalitional setting where the involvement of more players allows for the – partial – internalisation of the externalities, but we also allow residual players to endogenously respond to any externalities that may affect them. We present a simple example of a favour network and show that the core is nonempty when players must pay transfers to intermediaries. This simple setting also models economic situations such as airline net-

works.

About Nash Equilibrium, Modularity Optimization, and Network Community Structure Detection

Mihai Suciu, Rodica Ioana Lung and Nomi Gaskó

Session: Mon9-N

The concept of community in complex networks, which is intuitively expressed as a group of nodes more densely connected to each other than to the rest of the network, has not been formally defined yet in a manner that encompasses all aspect ensuing from this intuitive description. Among existing approaches, a popular one consists in considering the network community structure as optimum value of a fitness function that reflects the modularity of the network. Recently, a new trend to model the problem as a game having the community structure as equilibrium has emerged. Both approaches are appealing as they allow the design of heuristic approaches to this problem and benefit from their adaptability and scalability. This paper analyzes the behavior of such a heuristic that is based on extremal optimization in combination with two possible game theoretic models that consider different payoff functions, in comparison with the corresponding optimization approaches.

Others' risk attitudes: lessons from a game of poker.

Philippos Louis and Dimitrios Xeferis

Session: Mon9-P

This paper uses a game of mini poker to highlight the importance of the typical assumption that players know each other's risk attitude. We solve the game under both perfect and incomplete information about risk types. With perfect information we fully characterise a unique equilibrium for all possible risk types and show that both bluffs and uncertain calls occur with positive probability for some types. In the second case player's beliefs about risk types are given by an arbitrary probability distribution over the set of all possible risk types. We prove existence and uniqueness, and fully characterise equilibrium. We find: a) the set of bluffing types and the set of types who make uncertain calls are non-degenerate and b) these sets are never identical and never disjoint but, for certain beliefs, the set of bluffing types is a proper subset of the set of types who make uncertain calls.

Heterogeneous risk/loss aversion in complete information all-pay auction

Zhuoqiong Chen, David Ong and Ella Segev

Session: Mon9-P

We extend previous work on complete information all-pay auctions to incorporate heterogeneous risk and loss averse utility functions. We provide sufficient and necessary

conditions for the existence of equilibria with a given set of active players and characterize those equilibria. Focusing on the equilibria in which all active players randomize continuously between zero and the (common) value of the prize, we found, surprisingly, that when players are heterogeneous in their risk(/loss) aversions, the more risk averse players either dropout or bid higher than the less risk averse players. Moreover, players' expected bids decrease with others' risk aversions, but increase with own risk aversions. If the risk aversion of a less risk averse player is increased, then total expected bid increases. When there are only two types of risk aversions, we show the sufficient condition for total expected bid to increase with the share of the more risk averse players.

Preferences and Decision Support in Competitive Bidding

Philippe Gillen, Christopher Zeppenfeld, Alexander Rasch and Nicolas Fugger

Session: Mon9-P

We examine bidding behavior in first-price sealed-bid and Dutch auctions, which are strategically equivalent under standard preferences. We investigate whether the empirical breakdown of this equivalence is due to (non-standard) preferences or due to the different complexity of the two formats, i.e., a different level of mathematical or individual sophistication. First, we elicit measures of individual preferences and secondly manipulate the degree of complexity by offering various levels of decision support. Our results show that the equivalence of the two auction formats only breaks down in the absence of decision support. This indicates that the empirical breakdown is caused by differing complexity between the two formats rather than non-standard preferences.

perfect quasi-perfect equilibrium

Larry Blume and Martin Meier

Session: Mon9-Q

In strategic-form games, that is, Selten's (1975) perfect equilibria are admissible. This is not true for extensive-form perfection. Quasi-perfect equilibria uses Selten's (1975) trembles to introduce a refinement of Nash equilibrium wherein each player puts infinitesimal weight on *other players's* strategies, but not her own. One might be sure of oneself while (infinitesimally) unsure of others. However, also quasi-perfection is not itself without problems, precisely because it ignores future infinitesimal uncertainties in one's own play. We introduce a refinement here perfect quasi-perfect equilibrium, that tries to take keep the advantages of both, perfect and quasi-perfect equilibrium, while at the same time avoids the disadvantages of these two concepts. Our idea is to force each player to consider infinitesimal deviations in his own future play, but to make them so unlikely that they are infinitely less likely than the combined likelihood of deviations by all other players.

Timeability of Extensive-Form Games

Sune K. Jakobsen, Troels B. Lund and Vincent Conitzer

Session: Mon9-Q

Extensive-form games constitute the standard representation scheme for games with a temporal component. But do all extensive-form games correspond to protocols that we can implement in the real world? We often rule out games with imperfect recall, which prescribe that an agent forget something that she knew before. In this paper, we show that even some games with perfect recall can be problematic to implement. Specifically, we show that if the agents have a sense of time passing (say, access to a clock), then some extensive-form games cannot be implemented; no matter how we time the game, some information will leak to the agents that they are not supposed to have. We say such a game is not exactly timeable and provide easy-to-check characterization of exactly timeable games. We hope to convince the reader that timeability should be a standard assumption, just as perfect recall is today.

Open Sequential Equilibria of Multi-Stage Games with Infinite Sets of Types and Actions

Roger Myerson and Philip Reny

Session: Mon9-Q

We consider how to extend Kreps and Wilson's 1982 definition of sequential equilibrium to multi-stage games with infinite sets of types and actions. A concept of open sequential equilibrium is defined by taking limits of strategy profiles that can consistently satisfy approximate sequential rationality for all players at arbitrarily large finite collections of observable open events. Existence of open sequential equilibria is shown for a broad class of regular projective games. Examples are considered to illustrate the properties of this solution and the difficulties of alternative approaches to the problem of extending sequential equilibrium to infinite games.

Coalitional Nash stability in hedonic coalition formation games

Seckin Ozbilgin

Session: Mon9-R

In this paper, we study hedonic coalition formation games in which each player's preference depends only on the members of her coalition. A concept Coalitional Nash stability which is stronger than both Nash stability and core stability is analyzed. Some domain restrictions which are sufficient for the existence of a coalitionally Nash stable coalition structure are introduced. Coalitional Nash stability under different membership property rights is also studied.

Inducing stability in hedonic games

Dinko Dimitrov and Emiliya Lazarova

Session: Mon9-R

In many applications of coalition formation games, a key issue is that some desirable coalition structures are not elements of the core of these games. In these cases, it would be useful for an authority which aims to implement a certain outcome to know how far from the original game is the nearest game where the desirable outcome is part of the core. This question is at the center of this study. Focusing on hedonic games, we uncover previously unexplored links between such games and transferrable utility games and develop a tailor-made solution concept for the transferrable utility game, the implementation core, to provide an answer to our question.

Step out - Step in Sequencing Games

Marieke Musegaas, Peter Borm and Marieke Quant

Session: Mon9-R

In this paper a new class of relaxed sequencing games is introduced: the class of Step out - Step in sequencing games. In this relaxation any player within a coalition is allowed to step out from his position in the processing order and to step in at any position later in the processing order. First, we show that if the value of a coalition in a relaxed sequencing game is bounded from above by the gains made by all possible neighbor switches, then the game has a non-empty core. After that, we show that this is the case for Step out - Step in sequencing games. Moreover, this paper provides a polynomial time algorithm to determine the values of the coalitions in Step out - Step in sequencing games.

A Dynamic Model of Electoral Competition with Costly Policy Changes

Hans Gersbach, Philippe Muller and Oriol Tejada

Session: Mon9-S

We consider an infinite-horizon model of elections where changes in policies are costly for citizens and parties. The so-called costs of change increase with the extent of the policy shift. If the initial level of policy polarization is low, we find that welfare is maximal—and policy polarization is minimal—for intermediate marginal costs of change. Moreover, non-zero costs of change are never welfare-reducing, provided that the future is sufficiently valuable to society. If the initial level of policy polarization is high, however, welfare is only maximal for low or zero costs of change. We also show that, in our framework, there exists a welfare-increasing re-election hurdle above 50% if and only if the initial level of policy polarization is intermediate and the social discount factor is sufficiently large.

Comparing Voting by Committees According to their Manipulability

R. Pablo Arribillaga and Jordi Massó

Session: Mon9-S

We consider the class of voting by committees to be used by a society to collectively choose a subset of a given set of objects. We offer a simple criterion to compare two voting by committees without dummy agents according to their manipulability. This criterion is based on the set-inclusion relationships of the two corresponding decisive and vetoer sets of agents. We show that the binary relation “to be as manipulable as” endows the set of equivalence classes of anonymous voting by committees (i.e., voting by quotas) with a complete upper semilattice structure, whose supremum is the equivalence class containing all voting by quotas with the property that the quota of each object is strictly larger than one and strictly lower than the number of agents. Finally, we extend the comparability criterion to the full class of all voting by committees.

Self-Categorization, Depersonalization and Rational Choice

Christopher Kops and Abhinash Borah

Session: Mon9-T

Social psychology, as opposed to economics, argues that individual behavior is socially determined. For instance, self-categorization theory (SCT) argues that an individual's cognition of self occurs through a process of drawing similarities with certain social categories (the ingroup) and distinctions from others (the outgroup). Further, individual behavior embodies a sense of depersonalization, reflecting group attitudes rather than inherent tastes. In this paper, we study whether the traditional notion of rational behavior in economics can be reconciled with this worldview. Specifically, we ask whether an individual who is born into a society of rational inhabitants, can learn to behave rationally based on observing these inhabitants' choices and internalizing this data through the prism of a process akin to self-categorization? We introduce a condition on this individual's ingroup-outgroup categorization that draws on the concept of a category prototype in SCT which allows us to answer this question in the affirmative.

Overcoming Coordination Failure in a Critical Mass Game

Aidas Masiliunas

Session: Mon9-T

We study whether coordination failure is more often overcome if players can easily disclose their actions. In an experiment subjects first choose their action and then choose whether to disclose this action to other group members, and disclosure costs are varied between treatments. We find that no group overcomes coordination failure when action disclosure costs are high, but half of the groups do so when the costs are low. Simulations with a belief learning model can predict which groups will overcome coordination failure,

but only if it is assumed that players are either farsighted, risk-seeking or pro-social. To distinguish between these explanations we collected additional data on individual preferences and the degree of farsightedness. We find that in the low cost treatment players classified as more farsighted more often deviate from an inefficient convention and disclose this action, while the effect of risk and social preferences is not significant.

Challenging Conformity: A Case for Diversity

Willemien Kets and Alvaro Sandroni

Session: Mon9-T

Why do diverse groups outperform homogeneous groups in some settings, but not in others? We show that while diverse groups experience more frictions than homogeneous ones, they are also less conformist. Homogeneous groups minimize the risk of miscoordination, but they may get stuck in an inefficient equilibrium. Diverse groups may fail to coordinate, but if they do, they tend to attain efficiency. This fundamental tradeoff determines how the optimal level of diversity varies with social and economic factors. When it is vitally important to avoid miscoordination, homogeneous groups are optimal. However, when it is critical to implement new and efficient practices, diverse groups perform better.

Why Consciousness?

Robert Aumann

Session: Mon1130

tba

Multiple Equilibria

Roger Myerson

Session: Mon1130

tba

Improving U.S. Presidential Elections

Eric Maskin

Session: Mon1130

tba

“Demand types”, Equilibrium, and Auctions

Paul Klemperer

Session: Mon14-SP1

I discuss a new way to understand agents’ preferences - “demand types” - developed in my work with Elizabeth Baldwin. Our methods give new results about when competitive equilibrium exists with indivisibilities. They also help develop extensions to the Product-

Mix Auction I invented for the Bank of England in response to the financial crisis. Other applications include coalition-formation and matching models.

Information Resale in Networks

Mihai Manea

Session: Mon14-SP1

We investigate how information (e.g., digital goods, innovation, news) is priced and diffused across the links of a network. Every player who acquires information enjoys an idiosyncratic consumption value and may subsequently replicate and resell it to uninformed neighbors. A partition of the network describes how profit division among players depends on the positions of the initial sources of information. Two nodes belong to the same block of the partition if they are connected by a unique path in an auxiliary network. Information enters each block not containing a seller through the same node - the dealer of the block. Dealers can acquire information from multiple neighbors and obtain it for free due to competition among sellers. Each seller has monopoly power over the buyers in his block and extracts a share of their values. Links within blocks constitute bottlenecks and are essential for connecting the network and diffusing information. Links bridging distinct blocks are redundant for connectivity and impose negative externalities on sellers.

Selling with Evidence

Vasiliki Skreta

Session: Mon14-SP2

Akerlof (1970) argues that the superior information often held by sellers leads to market failure, since high quality sellers are unwilling to sell at the prevailing market price. If sellers can certify their quality, information unravels because high quality sellers have the biggest incentive to certify in order to receive a high price. We consider a privately informed seller who can propose any selling mechanism to a buyer. Values are interdependent, so the seller's reservation value or cost and the buyer's valuation can depend both on the buyer's taste and on product characteristics. Product information is voluntarily and costlessly certifiable by the seller. While the seller's certification ability enlarges the set of feasible selling procedures because it relaxes his incentive constraints, it also makes deviations more compelling as a high-type seller can deviate and provide evidence of his quality. We characterise all feasible allocations under any certifiability structure, formulate the informed-principal mechanism-proposal game and describe a canonical certification and communication protocol. We show that there is always an ex-ante profit-maximizing selling procedure that is an equilibrium of the (interim) mechanism-proposal game. In general, posted prices are sub-optimal and in contrast to the case where the seller can only post prices, his ability to certify increases profits compared to the case where his product information is public, both from the ex-ante and the interim perspectives. The

unravelling outcome may not be an equilibrium even when all buyer types agree on the ranking of product quality. Under further assumptions analogous to ones in Maskin and Tirole (1990), we show that all equilibrium outcomes are ex-ante profit-maximising. Joint work with Frederic Koessler.

Welfare Maximization via Posted Prices

Michal Feldman

Session: Mon14-SP2

Posted price mechanisms are simple, straightforward, and strategyproof. We study two scenarios of combinatorial markets where sequential posted price mechanisms achieve optimal or nearly optimal welfare. The first scenario is matching markets with full information, where optimal welfare is obtained. The second is markets with submodular (and XOS) valuations with Bayesian information, where half of the optimal welfare is obtained. We distinguish between static and dynamic pricing, and present various extensions of the above findings. Finally, we mention surprising relations between price of anarchy results and posted price mechanisms. Based on joint works with Vincent Cohen-Addad, Alon Eden and Amos Fiat (2016), with Nick Gravin and Brendan Lucier (2015) and with Paul Duetting, Thomas Kesselheim and Brendan Lucier (2016).

Some thoughts on judgment aggregation

Shmuel Zamir

Session: Mon14-SP3

Following Dietrich (2014) we consider using choice by plurality voting (CPV) as a judgment aggregation correspondence. We notice that a result of Roberts (1991) implies that CPV is axiomatically characterized by anonymity, neutrality, unanimity, and (Young's) reinforcement. Following List (2004) and Dietrich (2015) we construct a sequential voting procedure of judgement aggregation which satisfies rationality, anonymity, unanimity, and independence of irrelevant propositions (with respect to a relevance correspondence that does not satisfy transitivity). We intend to characterize this aggregation procedure by a set of axioms. Joint work with Bezalel Peleg.

Fair Division with Additive Utilities

Herv Moulin

Session: Mon14-SP3

User-friendly websites applying theoretical methods to share private items require simple preference domains, such as linear preferences. I will survey recent research focusing on the familiar "equal opportunities" approach to fair division: there are good news and bad news. If the items are divisible goods the Competitive Equilibrium with Equal Incomes maximizes the Nash product of utilities and is normatively superior to its nemesis equal-

izing relative gains. It is characterized by the following invariance property: changing my bid on a good I am not consuming before or after the change, does not affect the allocation at all. If the items are indivisible, maximizing the Nash product still delivers an approximately envy-free division, thus respecting the spirit of the Competitive approach. If the items are divisible goods, the Competitive solution still identifies critical points of the Nash product of utilities, but there may be many such welfare-distinct outcomes (in the order of 2^n with n agents and n goods). The set of envy-free and efficient allocations can similarly have many connected components, implying that no efficient and envy-free division method can vary continuously in the parameters of the problem. A similarly unsettling picture comes up in the assignment problem where the total share of each participant is fixed: the Competitive solution is guaranteed to exist but may again deliver multiple divisions among which it appears difficult to provide a plausible selection argument. These results uncover some limits of single-valued deterministic fair division rules.

Monotonicity, Revenue Equivalence and Budgets

Ahuva Mu'Alem

Session: Mon16-A

We study multidimensional mechanism design in a common scenario where players have private information about their willingness to pay and their ability to pay. We provide necessary and sufficient conditions for the dominant-strategy incentive-compatible implementability of direct mechanisms for the general case where players can arbitrarily misreport their private budgets. Immediate practical applications of these results include simple complete characterizations for mechanisms with publicly-known budgets and for mechanisms where over-reporting the budget is not possible. The celebrated revenue equivalence theorem states that the seller's revenue for a broad class of standard auction formats and settings will be the same in equilibrium. Our main application is a revenue equivalence theorem for financially-constrained multidimensional bidders.

Competing Trade Mechanisms and Monotone Mechanism Choice

Markus Walzl

Session: Mon16-A

We analyze mechanism choices of competing sellers with private valuations and show the existence of monotone pure strategy equilibria where sellers with higher reservation value choose mechanisms with a lower selling probability and a larger revenue in case of trade. As an application we investigate the choice between posted prices and auctions and demonstrate that sellers refuse to offer posted prices as long as (risk-neutral) buyers do not differ with respect to their transaction costs in both trade institutions. If some buyers have lower transaction costs when trading at a posted price, it is optimal for sellers to

offer posted prices if and only if they have sufficiently high reservation value. We develop an empirical strategy to compare revenues of posted prices and auctions that takes selling probabilities explicitly into account, and confirm our theoretical predictions with data from eBay auctions on ticket sales for the EURO 2008 Football Championship.

Monotonicity and Revenue Equivalence Domains by Monotonic Transformations in Differences

Juan Carlos Carbajal and Rudolf Mueller

Session: Mon16-A

In a mechanism design setting with quasilinear preferences, a domain D of admissible valuations of an agent is called a monotonicity domain if every 2-cycle monotone allocation rule is truthfully implementable (in dominant strategies). D is called a revenue equivalence domain if every implementable allocation rule satisfies revenue equivalence. Carbajal and Muller (2015) introduced the notions of monotonic transformations in differences and showed that if D admits these transformations then it is a revenue equivalence and monotonicity domain. Here we show that various economic domains, with countable or uncountable allocation sets, admit monotonic transformations in differences. Our applications include public and private supply of divisible public goods, multi-unit auction-like environments with increasing valuations, allocation problems with single-peaked valuations, and allocation problems with externalities.

Reserve Prices in Private Value Auctions with Entry: Theory and Evidence

Diego Moreno, Jason Shachat and John Wooders

Session: Mon16-B

We study, both theoretically and experimentally, the impact of public and secret reserve prices in second price auctions where buyers have independent private values and heterogeneous entry costs. In such settings it is known that public reserve prices are more optimal than secret reserve prices. Paradoxically, secret reserve prices are commonly used in practice. We show that when the auctioneer is risk averse, optimal secret and public prices move closer together. In our experiment, we observe little difference in secret and publicly chosen reserves, and revenue is greater in the secret reserve. We propose several explanations in terms of bidder and auctioneer using boundedly rational behaviour.

Betting on Others' Bets: Unions of Surplus Extraction Mechanisms

Alia Gizatulina

Session: Mon16-B

We construct the generalized Cremer-McLean mechanism where i 's participation fee depends not only on the valuations reported by $-i$ at the second stage, but also on the choice of the participation fee by $-i$ at the first stage. Such construction allows to exploit the

convex hull property of beliefs whenever it appears in beliefs about beliefs rather than in beliefs about preferences. As such betting mechanism retrieves agents' entire hierarchies of beliefs, it reveals what is common knowledge among them. Hence, for any given countable collection of type spaces T^k , k in K , each T^k verifying the convex hull property within itself, the designer can propose a union of GCM mechanisms and extract the surplus across type spaces, i.e. regardless of absence of knowledge by the designer of agents' type space. We discuss when the technique of using a union of individual mechanisms is extendible to more general cases.

Robust Bidding

Vitali Gretschko and Helene Mass

Session: Mon16-B

Bidding in first-price auctions crucially depends on the beliefs of the bidders. We analyze bidding behavior in a first-price auction in which the knowledge of the bidders about the distribution of the values of their competitors is restricted to the range and the mean. To model this situation, we assume that under such uncertainty a bidder will expect to face the distribution of values that minimizes her expected payoff, given her bid is an optimal reaction to the bids of her competitors induced by this distribution. This introduces a novel way to endogenize beliefs in games of incomplete information. We find that that even though the worst case beliefs are type dependent in a non-monotonic way, an efficient equilibrium of the first-price auction exists.

Cournot vs. Walras: A Reappraisal through Simulations

Carlos Alós-Ferrer and Johannes Buckenmaier

Session: Mon16-C

Best-reply behavior in Cournot oligopolies generally leads to Cournot-Nash equilibrium, but imitative behavior selects the Walrasian equilibrium as the unique stochastically stable state. Previous work (Alós-Ferrer, 2004) showed that in the presence of non-trivial memory, imitative behavior leads to a non-trivial dynamics selecting all quantities between the Cournot and Walrasian outcomes. However, the scope of previous results was limited to specific assumptions on demand and cost functions, and did not provide information on the shape of the distribution of outcomes. We use computational simulations to address these limitations. We show that the selection result for non-trivial memory holds beyond the set of well-behaved Cournot games previously analyzed. Further, we shed light on the exact shape of the limit distribution in Cournot games. We find that it is highly skewed towards the Walrasian quantity. Although longer memory increases the importance of the Cournot equilibrium, the competitive outcome remains the dominant prediction.

Global Games With Strategic Substitutes

Rodrigo Harrison and Pedro Jara-Moroni

Session: Mon16-C

This paper proves an equilibrium selection result for a class of games with strategic substitutes. Specifically, for a general class of binary action, N-player games, we prove that each such game has a unique equilibrium strategy profile. Using a global game approach first introduced by Carlsson and van Damme (1993), important selection results apply to games with strategic complementarities. The present paper uses the same approach but removes the assumption of perfect symmetry in the “dominance region” of the players’ payoffs. Instead we assume that players are ordered such that asymmetric dominance regions are overlapped sequentially. This allows us to extend selection results to a class of games with strategic substitutes.

Cournot competition with an external supplier under capacity constraints and demand uncertainty

Stefanos Leonardos and Costis Melolidakis

Session: Mon16-C

We study a single product market with affine inverse demand function in which two producers/retailers, producing under capacity constraints, may order additional quantities from a single profit maximizing supplier. We express this chain as a two stage game and show that it has a unique subgame-perfect Nash equilibrium. If the supplier faces uncertainty about the demand intercept and whenever a Bayesian Nash equilibrium exists, the supplier’s profit margin at equilibrium is a fixed point of a translation of the MRL function of his belief under the assumption that his belief is non-atomic and the retailers are identical. If the supplier’s belief is of Decreasing Mean Residual Lifetime (DMRL), the game has a unique subgame-perfect Bayesian Nash equilibrium. Inefficiencies at equilibrium generated by the lack of information of the supplier are investigated, and examples are provided. Finally, the main results are generalized for more than two identical producers/retailers.

Threshold Bank-run Equilibrium in Dynamic Games

Romeo Matthew Balanquit

Session: Mon16-D

This study sets a bank-run equilibrium analysis in a dynamic and incomplete information environment where agents can reconsider attempts to run on the bank over time. The typical static bank-run model is extended in this paper to capture the learning dynamics of agents through time, giving bank-run analysis a more realistic feature. Apart from employing a self-fulfilling framework in this model, we allow agents to update over time their beliefs on the strength of the fundamentals that is not commonly known. In partic-

ular, we extend the bank-run model analyzed by Goldstein and Pauzner (2005) and build it on a dynamic global games framework studied by Angeletos et.al. (2007). We present here how a simple recursive setup can generate a unique monotone perfect Bayesian equilibrium and show how the probability of bank-run is affected over time by the inflow of information and the knowledge of previous state outcome.

Shadow Banks and Systemic Risk

Rui Gong and Frank Page

Session: Mon16-D

We answer the following question: Does regulating the banking network increase systemic risk in the entire financial network in the presence of unregulated shadow banks? To answer this question we construct a discounted stochastic game model of network formation. The stationary Markov network formation strategies of the players, then give rise to the equilibrium network formation dynamics. We then provide a formal definition of systemic risk based on the induced equilibrium dynamics, and therefore, a definition which takes into account the strategic interactions of financial institutions when facing different regulatory policies. Specializing our dynamic stochastic game model to a more basic model in which banks and shadow banks form a network including connections to the real economy, we show, via numerical simulations under various regulatory regimes, that imposing bank regulations not faced by shadow banks does indeed increase systemic risk throughout the financial network.

A Perfect Equilibrium Concept for the Multiplayer Bargaining Game

Luís Carvalho

Session: Mon16-E

In this work we introduce a Perfect Equilibrium notion, in vein of Selten(1975), for the unanimity multiplayer bargaining. The need for this concept is justified by the existence of some SPNE strategies where players use some dominated actions, vide Haller (1986). The new concept poses some conceptual and technical difficulties that we herein address.

A Non-cooperative Approach to Dynamic Bargaining

Francesca Flamini

Session: Mon16-E

Many negotiations (for instance, among political parties or partners in a business) are characterized by dynamic bargaining: current agreements affect future bargaining possibilities. We study such situations using bargaining games á la Rubinstein (1982), with the novelty that players can decide how much to invest, as well as how to share the residual surplus for their own consumption. We show that under certain conditions, there is a unique (stationary) Markov Perfect Equilibrium characterized by immediate agreement.

Moreover, standard results in bargaining theory can be overturned. For instance, despite the complexity of the bargaining game, there are equilibrium strategies as in an ultimatum, where the responder does not consume anything. Also, a more patient proposer may consume less than his opponent. Additionally, a higher discount factor for one player may decrease the MPE investment rates for both players.

Characterization and Implementation of Nash Bargaining Solutions with Non-Convex Problems

Cheng-Zhong Qin, Guofu Tan and Adam Wong

Session: Mon16-E

We consider bargaining problems that are star-shaped. Convex and comprehensive bargaining problems are star-shaped but not conversely. We present a class of economic environments generating star-shaped bargaining problems. We completely characterize single-valued solutions satisfying the Nash axioms on the class of star-shaped and compact bargaining problems. For the case with two players, we show that there are exactly two solutions with each being a selection of Nash product maximizers in favor of a given player across all bargaining problems. We design a non-cooperative extensive-form game to implement these solutions, and we extend our analysis to allow for asymmetries and for more than two players.

Mitigating Matching Externalities Via The “Old Boys’ Club”

Naomi Utgoff

Session: Mon16-F

This paper introduces a dynamic matching mechanism in which a persistent contracting relationship - an “old boys’ club” - occurs in ex post subgame perfect Nash equilibrium when the high school in the club is sufficiently patient. Matching occurs in two stages: first, contracting between the college and a high school; second, running a Vickrey auction in the simplified post-contracting admissions market. The mechanism provides the second best total surplus among several mechanisms in a repeated college admissions market in which externalities preclude solutions using standard mechanism and market design techniques. An “old boys’ club” emerges between one college and a sufficiently patient single high school as a consequence of contract enforcement rather than ex ante bias on the part of the college. Members of the club benefit at the expense of the non-contracted high school.

Welfare and Incentives in Partitioned Matching Markets

Bertan Turhan

Session: Mon16-F

In many real-life two-sided markets, one side of the markets is partitioned into groups.

Groups run their own admission process independently of one another. For such markets Manjunath and Turhan introduce iterative deferred acceptance algorithm that yields a stable matching (possibly different from extremal ones depending on partitions). In this paper, we study the effect of partition structures on agents' welfare and incentives under this stable mechanism in the context of marriage model. The algorithm finds the men-optimal stable matching under the coarsest partition of the set of women and the women-optimal stable matching under the finest partition of the set of women. We find that when women partition gets finer, men get weakly worse off. Also, if women partition gets finer, the iterative deferred acceptance rule becomes more manipulable for men. Our results have significant policy implications especially in school choice problems when stability is the primary policy goal.

Assignment Games with Externalities

Jens Gudmundsson and Helga Habis

Session: Mon16-F

We examine assignment games, where matched pairs of firms and workers create some monetary value to distribute among themselves. In the majority of this literature, externalities - in the sense that a pair's value depends on the pairing of the others - have been neglected. However, in most applications a firm's success depends on the success of its rivals. Thus, it is natural to ask how the classical results on assignment games are affected by the introduction of externalities? The answer is dramatically. We find that a problem may have no stable outcome, stable outcomes can be inefficient, efficient outcomes can be unstable, and the set of stable outcomes may not form a lattice. We show that stable outcomes always exist if agents are "pessimistic". This is a knife-edge result: there are problems in which the slightest optimism by a single pair erases all stable outcomes.

When are strategy-proof and efficient rules possible in objects allocation with money?

Tomoya Kazumura and Shigehiro Serizawa

Session: Mon16-G

We consider the problem of allocating sets of objects to agents and collecting payments. Each agent has a preference relation over the set of pairs consisting of a set of objects and a payment. Preferences are not necessarily quasi-linear. Non-quasi-linear preferences describe environments where the wealth effect is non-negligible: the payment level changes agents' willingness to pay for swapping sets. Preferences satisfy the object monotonicity, that is, when the payment level is fixed, agents always prefer to receive more objects. We investigate when it is possible to design strategy-proof and efficient rules, that is, on which domains such rules exist, and show that (i) for two agents, each "r-partially-quasi-linear" domain is a maximal domain for efficiency and strategy-proofness, and (ii) for more than

two agents, if a domain includes a class of r-partially quasi-linear preferences, no rule is efficient and strategy-proof.

Strategy-proof location of public facilities

Jorge Alcalde-Unzu and Marc Vorsatz

Session: Mon16-G

Agents frequently have different opinions on where to locate a public facility. While some agents consider the facility a good and prefer to have it nearby, others dislike it and would like to see it built far away from their own locations. To aggregate agents' preferences in these situations, we propose a new preference domain according to which each agent is allowed to have single-peaked or single-dipped preferences on the location of the facility, but in such a way that the peak or dip is situated in her own location. We characterize all strategy-proof rules in this general framework and show that they are also group strategy-proof. Finally, we characterize for some focal cases the rules that additionally satisfy Pareto efficiency.

Information Disclosure under Strategy-proof Social Choice Rules

Antonio Nicolo and Salvador Barber

Session: Mon16-G

We consider collective decision problems where some agents have private information about alternatives and others don't. Voting takes place under strategy proof rules. Prior to voting, informed agents may or may not disclose their private information, thus eventually influencing the preferences of those initially uninformed. We provide general conditions on the voting rules guaranteeing that informed agents will always be induced to disclose what they know. In particular, we apply this general result to environments where agent's preferences are restricted to be single-peaked or separable, and characterize the strategy proof rules that ensure information disclosure in these settings.

Repeated Games with Recursive Utility

Jaekook Park

Session: Mon16-H

This paper studies repeated games in which players evaluate payoff streams by recursive utility. Focusing on pure strategies, we investigate feasible payoffs and subgame perfect equilibrium payoffs of a repeated game. Previous studies have shown that, with recursive utility, non-stationary paths can yield repeated-game payoffs that cannot be generated by convex combinations of constant paths. We first characterize the set of feasible payoffs in the repeated game using the idea of self-generation. Then, we present a folk theorem that provides conditions on recursive utility under which any sequentially individually rational path can be supported in a subgame perfect equilibrium when players are sufficiently

patient. Lastly, we discuss the role of alternating paths, providing examples to illustrate that players' attitude toward time variability can affect their behavior in repeated games.

Perturbed repeated games

Chantal Marlats

Session: Mon16-H

Does the modeler neglect some equilibria if he ignores unlikely and temporary changes of the payoff matrix in repeated relationships? This question is addressed in this paper by offering a robustness test for predictions in finitely repeated games. It is shown that the set of feasible and rational payoffs is the unique robust equilibrium payoff set, when the horizon is large and the discount factor tends to 1. Consequently, cooperation can arise as an equilibrium behavior in a game arbitrarily close to the standard prisoners dilemma, if the horizon is finite but sufficiently long and if players are sufficiently patient.

What You Get is What You See; Repeated Games with Observable Payoff

Galit Ashkenazi-Golan and Ehud Lehrer

Session: Mon16-H

We consider two-player repeated where the players observe their own payoffs. We prove that any strictly efficient payoff can be obtained as sequential equilibrium payoff, when costly communication is available and the players are sufficiently patient.

Decentralized Dynamics and Fast Convergence in the Assignment Game

Bary Pradelski

Session: Mon16-J

We study decentralized learning dynamics for the assignment game. At random points in time firms and workers match, break up, and re-match in the search for better opportunities. We propose a simple learning process in which players have no knowledge about other players' payoffs or actions and they update their behavior in a myopic fashion. Behavior fluctuates according to a random variable that reflects current market sentiment: sometimes the firms exhibit greater price stickiness than the workers, and at other times the reverse holds. We show that this stochastic learning process converges in polynomial time to the core. While convergence to the core is known for decentralized dynamics this paper is the first to prove polynomial time convergence, a crucial feature from a practical standpoint. The proof relies on novel results for random walks on graphs, and suggests a fruitful connection between the theory of random walks and matching theory.

Gains in evolutionary dynamics: a unified rational framework

Dai Zusai

Session: Mon16-J

In this paper, we investigate gains from strategy revisions in deterministic evolutionary dynamics in continuous population. To clarify the gain from revision, we construct an evolutionary dynamic from optimal decision with stochastic (possibly restricted) available action set and switching cost. Many of major non-imitative dynamics can be constructed in this framework. We formally define expected gains and obtain several general properties of the expected gain function, which leads to Nash stability in contractive games—generalization of concave potential games. The unified framework allows us to apply the Nash stability to mixture of heterogeneous populations, whether heterogeneity is observable or unobservable. This extends the known positive result on evolutionary implementation of social optimum through Pigouvian pricing to the presence of heterogeneity and non-aggregate payoff perturbations.

Convergence of “Best-response Dynamics” in Zero-sum Stochastic Games

David Leslie, Steven Perkins and Zibo Xu

Session: Mon16-J

Given a two-player zero-sum discounted-payoff stochastic game, we introduce three classes of continuous-time best-response dynamics: open-loop best-response dynamics, stopping-time best-response dynamics, and closed-loop best-response dynamics. We show the global convergence of the latter two classes to the set of optimal strategy profiles, which can thus be viewed as a dynamical proof of the existence of value in these games. We show the convergence of the first class when the players are sufficiently impatient. We also show that the payoffs in a modified closed-loop best-response dynamic converge to the asymptotic value in a zero-sum stochastic game.

Collective Choice in Dynamic Public Good Provision: Real versus Formal Authority

Renee Bowen, George Georgiadis and Nicolas Lambert

Session: Mon16-K

Two heterogeneous agents exert effort over time to complete a project and collectively decide its scope. A larger scope requires greater cumulative effort and delivers higher benefits upon completion. To study the scope under collective choice, we derive the agents preferences over scopes. The efficient agent prefers a smaller scope, and preferences are time-inconsistent: as the project progresses, the efficient agents preferred scope shrinks, whereas the inefficient agents preferred scope expands. In equilibrium without commitment, the efficient agent obtains his ideal project scope with either agent as dictator and under unanimity. In this sense, the efficient agent always has real authority.

Conditional Contribution Mechanisms for the Provision of Public Goods in Dynamic Settings - Theory and Experimental Evidence

Andreas Reischmann

Session: Mon16-K

Many mechanisms have been developed to solve the free-rider problem in private public good provision. I present a new class of mechanisms, the Conditional Contribution Mechanisms (CCM). These mechanisms give all agents the possibility to condition their contribution on the total level of contribution provided by all agents. Their dynamic incentive structure makes the CCMs particularly suited for repeated public goods. I prove for a very general class of environments that all equilibria of the CCMs under a new variant of Better Response Dynamics, called Unexploitable Better Response Dynamics (UBRD), are Pareto efficient. I further present a first experimental study of one mechanism's performance compared to the performance of the Voluntary Contribution Mechanism. I find that a significantly higher contribution rate can be observed when the CCM is used. Furthermore, all stable outcomes of the CCM, which are observed in the experiment, are in line with the prediction of UBRD.

Full agreement and the provision of threshold public goods

Edward Cartwright and Federica Alberti

Session: Mon16-K

The experimental evidence suggests that groups are inefficient at providing threshold public goods. This inefficiency appears to reflect an inability to coordinate over how to distribute the cost of providing the good. So, why do groups not just split the cost equally? We offer an answer to this question by demonstrating that in a standard threshold public good game there is no collectively rational recommendation. We also demonstrate that if full agreement is required in order to provide the public good then there is a collectively rational recommendation, namely, to split the cost equally. Requiring full agreement may, therefore, increase efficiency in providing threshold public goods. We test this hypothesis experimentally and find support for it.

Managing Competitions Using Information: Disclosure Policy in Contests with Heterogeneous Players

Qian Jiao, Jaimie Lien and Jie Zheng

Session: Mon16-L

How can managers in organizations utilize asymmetric information among workers to motivate them in a competition? We consider the information disclosure policy of the manager as a contest designer in an all-pay auction, where one competitor's ability is public information, and the other competitor's ability is private information. In order to

optimally motivate the contestants, the manager will reveal the private information of the unknown competitor when the publicly known competitor's ability is sufficiently low. The information asymmetry among contestants creates a tradeoff between ability-based advantage, and information-based advantage, which managers can invoke when attempting to maximize the total effort of competing employees. However, in the case where the private competitor's ability is not directly verifiable, an incentive problem may exist when enforcing the disclosure or concealment policy.

Budget-Constrained Multi-Battle Contests: A New Perspective and Analysis

Chu-Han Cheng, Po-An Chen and Wing-Kai Hon

Session: Mon16-L

In a multi-battle contest, each time a player competes by investing some of her budget in a component battle to collect a value if winning the battle. There are multiple battles to fight, and the budget gets consumed over time. The final winner in the overall contest is the one who first reaches some amount of total value. Examples include R & D races, sports competition, elections, and many more. We model such budget-constrained contests as zero-sum games where each component battle is a first-price or all-pay auction. We focus on analyzing the 2-player budget ratio that guarantees the winning of the player under study against the other omnipotent player. In various settings, we give efficient dynamic programs to find the optimal budget ratios and the corresponding bidding strategies. Our definition of games, budget constraints, and emphasis on budget analyses provide a new perspective and analysis in the related context.

Information and endogenous delegation in a rent-seeking contest

Lambert Schoonbeek

Session: Mon16-L

We consider a two-player rent-seeking contest for a prize of common value. The players only know that the prize is high or low, with given probabilities. Each player can hire a delegate to act on his behalf. After a delegate is hired, she privately observes the true value of the prize. In this setup, we demonstrate that delegation can occur in equilibrium. We derive the conditions under which, respectively no player, only one player, or both players delegate in equilibrium.

Talking to Influence

Michele Dell'Era

Session: Mon16-M

This paper formalizes the idea that experts enjoy exerting influence and explores its implications for experts' communication (e.g. policy and financial advice). An expert who enjoys exerting influence benefits from inducing a client's action which differs from the

client's action in absence of expertise. We find that influence tempts the expert to exaggerate the observed state and send messages far from the client's ex-ante optimal action (in absence of expertise). The incentive to exaggerate is stronger, the further away is the state from the client's ex-ante optimal action. When communication is truthful, the expert's incentive to exaggerate translates into less accurate communication. Messages close the client's ex-ante optimal action are hence more informative than messages far from it. In an extension we also consider the case in which the client enjoys being influenced.

The Value of Mediated Communication

Andres Salamanca

Session: Mon16-M

Kamenica and Gentzkow (2011) consider a model in which a sender chooses a public communication device for signaling his information to an uninformed receiver, who then takes an action that affects the welfare of both individuals. In their model, the sender is fully committed to truthfully communicate the signal to the receiver, so that they abstract from incentive compatibility issues. By considering mediated communication, we provide an analytical framework overcoming this overly restrictive assumption. We use the concept of virtual utility to develop a geometric approach to the sender's optimization problem. We characterize the optimal value of persuasion from the concavification of a virtual non-revealing function over beliefs. We apply our approach to a model of information transmission based on Crawford and Sobel (1982). We provide necessary and sufficient conditions for the sender to benefit from his private information.

Bilateral transactions with evidence

Martin Gregor

Session: Mon16-M

We introduce contractible participation into a multiple-expert persuasion game. Prior to persuasion, communication has to be approved by both the decision-maker and the expert in a bilateral transaction. We analyze a trading protocol in which the decision-maker is a discriminating price-setter and a protocol in which the decision-maker is a price-taker. For both protocols, we identify necessary equilibrium conditions in the form of signs of appropriately constructed bilateral surpluses. We construct the surpluses for ex ante transactions (transactions before experts learn evidence) in general and for interim transactions (transactions after experts learn evidence) in the case of binary independent signals. We identify when the surplus underestimates or overestimates bilateral and multilateral efficiency of the transaction. We also apply surpluses to find substitutable and complementary pairs of transactions.

Optimal targeting strategy in a network under complementarities

Gabrielle Demange

Session: Mon16-N

The goal of the present paper is to analyze the optimal targeting strategies of a planner (say a monopolist) who aims to increase the aggregate action of agents (consumers' purchase). Agents are embedded in a social network and their actions influence each other. Actions are complements, determined by their exposure to neighbors's actions through a response function. The description includes strategic settings and models of mechanical influence as in contagion or mimesis. When the response function is linear, the optimal targeting strategies are explicit, characterized by well-known centralities indices. When the response function is not linear, concave or convex, new features pertaining to the pattern of the agents' attention and the joint impact between pairs determine the optimal targeting. The value of information on the impact structure is shown to be (almost always) positive and related to some form of heterogeneity between agents.

Networks of Complements

Moshe Babaioff, Liad Blumrosen and Noam Nisan

Session: Mon16-N

We consider a network of sellers, each selling a single product, where the graph structure represents pair-wise complementarities between products. We study how the network structure affects revenue and social welfare of equilibria of the pricing game between the sellers. We prove positive and negative results, both of "Price of Anarchy" and of "Price of Stability" type, for simple graphs (lines, cycles) as well as more general ones (trees, graphs). We describe best-reply dynamics that converge to non-trivial equilibrium in several families of graphs, and we use these dynamics to prove the existence of approximately-efficient equilibria.

Hotelling Games on Networks: Existence and Efficiency of Equilibria

Gatan Fournier and Marco Scarsini

Session: Mon16-N

We consider a Hotelling game where a finite number of retailers choose a location, given that their potential consumers are distributed on a network. Retailers compete only on location, therefore each consumer shops at the closest store. We show that when the number of retailers is large enough, the game admits a pure Nash equilibrium and we construct it. We then compare the equilibrium cost borne by the consumers with the cost that could be achieved if the retailers followed the dictate of a benevolent planner. We perform this comparison in term of the induced price of anarchy, i.e., the ratio of the worst equilibrium cost and the optimal cost, and the induced price of stability, i.e., the ratio of the best equilibrium cost and the optimal cost. We show that, asymptotically in

the number of retailers, these ratios are two and one, respectively.

Equilibrium under Ambiguity (EUA) for Belief Functions

Adam Dominiak and Juergen Eichberger

Session: Mon16-P

We study Equilibria under Ambiguity (EUA) with optimism and pessimism as introduced in Eichberger & Kelsey (2014) for the case of beliefs modelled by belief functions. We show existence of equilibria for finite games with an arbitrary number of players and both general and specific ambiguity about the opponents' strategy choice. We illustrate by examples the potential of this approach to model behavior which cannot be obtained as a Nash equilibrium.

Ambiguity in Discontinuous Games

Philippe Bich

Session: Mon16-P

We introduce a strategic game model with ambiguity as follows: each player fears some possible modification of the expected strategies of the other players (for example because they are not sure of the rationality of the other players), and has a pessimistic behaviour. But each player can insure himself against such modifications, the level of insurance being related to ambiguity. The main results of the paper are 1) The insurance and the pessimistic behaviour of each player has a "smoothing effect", and entails the existence of a Nash equilibrium under weak assumptions 2) When the level of insurance goes to 0, we get maxmin equilibria at the limit 3) When the level of insurance goes to infinity, we get Nash equilibria of standard strategic games (without pessimistic behaviour), even in large classes of discontinuous games as better-reply secure games. Technically, the smoothing effect described below is related to Moreau-Yosida regularization.

Analyzing games with ambiguous types using the MINthenMAX decision model

Ilan Nehama

Session: Mon16-P

In many common interactive scenarios, participants lack information about other participants, and specifically about the preferences of other participants. In this work, we model an extreme case of information absence we term type-ambiguity: when a participant lacks information enabling him to form a belief on the preferences of others. Under type-ambiguity, one cannot analyze the scenario using the Bayesian framework, and needs to model participants using a different decision model. We present the MINthenMAX decision model under ambiguity. This model is a refinement of Walds MiniMax principle, which we show to be too coarse. We characterize MINthenMAX as the finest refinement

of the MiniMax principle that satisfies properties we claim are necessary for games with type-ambiguity. Finally, we define and analyze the corresponding equilibrium concept when all players follow MINthenMAX. We demonstrate this equilibrium by applying it to two common economic scenarios: Coordination games and Bilateral trade.

Forward induction reasoning versus equilibrium reasoning

Andrs Perea

Session: Mon16-Q

In the literature on static and dynamic games, most rationalizability concepts have an equilibrium counterpart. In two-player games, the equilibrium counterpart is obtained by taking the epistemic conditions of the rationalizability concept and adding the following correct beliefs assumption: (a) each player believes that the opponent is correct about his beliefs, and (b) each player believes that the opponent believes that he is correct about the opponent's beliefs. This paper shows that there is no equilibrium counterpart to the forward induction concept of extensive-form rationalizability (Pearce (1984), Battigalli (1997)), epistemically characterized by common strong belief in rationality (Battigalli and Siniscalchi (2002)). The reason is that there are games where the epistemic conditions of common strong belief in rationality are logically inconsistent with the correct beliefs assumption. In fact, we show that this inconsistency holds for “most” dynamic games of interest.

Invariant extensive-form rationalizability

Christina Pawlowitsch and Rida Laraki

Session: Mon16-Q

We bring together two ideas: rationalizability in the extensive form (Pearce, 1984) and invariance-the notion that the solution of a game in extensive form should be invariant under any equivalence transformation of that extensive form. We focus on a particular class of equivalence transformations: those that leave the associated reduced normal form unchanged. We show that rationalizability in the extensive form can be decomposed into a process that operates on families of truncations of the associated reduced normal form. We demonstrate that rationalizability in the extensive form is invariant under interchange of simultaneous moves and coalescing of moves, but that it is not invariant under addition of a superfluous move. Yet, for a given reduced normal form, there exists a set of strategy profiles that is contained in the set of extensive-form rationalizable strategy profiles of any extensive form that has that reduced normal form: the invariant extensive-form rationalizable set.

Minimum cost spanning tree problems with multiple sources: the folk rule

Gustavo Bergantiños, Youngsub Chun and Leticia Lorenzo

Session: Mon16-R

In this paper we define minimum cost spanning tree problems with multiple sources. We extend the different definitions of the folk rule, defined for classical minimum cost spanning tree problems, to this new context.

Spare parts pooling games under a critical level policy

Loe Schlicher, Marco Slikker and Geert-Jan van Houtum

Session: Mon16-R

We consider an environment in which several service providers with possibly criticality differences can collaborate by pooling their spare parts. Every collaborating group of service providers uses a critical level policy that focusses on the long-term average cost. We examine the allocation of the collective cost savings for such pooled situation by studying an associated cooperative game, which we call a criticality game. We analyze various properties of these criticality games.

Characterizations of solutions to highway cost allocation problems

Peter Sudhölter and Jos Zarzuelo

Session: Mon16-R

A highway problem is a cost sharing problem that arises if each player demands consecutive sections of a common resource. We show that the core, the prenucleolus, and the Shapley value on the arising class of TU highway games possess characterizations by intuitive properties formulated without referring to the associated games. The main axioms for the core and nucleolus are consistency properties, related to traditional axioms, on reduced highway problems that arise by eliminating a player and using her charge to maintain a certain part of her sections. The Shapley value is characterized either using individual independence of outside changes or using the new contraction property. Together with the axiom of aggregating the shares of all agents of any player, the axiomatizations of the core and the value may be expanded to generalized highway problems (the associated games are positive and vice versa) in which players may demand non-connected parts.

Information Aggregation in Democratic Mechanisms

Volker Britz and Hans Gersbach

Session: Mon16-S

We examine whether and how democratic procedures can achieve socially desirable public good provision in the presence of profound uncertainty about benefits of public goods, i.e., when citizens are able to identify the distribution of benefits only if they aggregate their private information. Some members of the society, however, are harmed by socially

desirable policies and aim at manipulating information aggregation by misrepresenting their private information. We show that information can be aggregated and a socially desirable policy can be implemented under a new class of democratic mechanisms involving a sample group. These mechanisms reflect the principles of liberal democracy, are procedurally efficient, and involve a conditional tax privilege of sample group members. This tax treatment motivates sample group members to reveal private information truthfully before voting takes place. Depending on the distance between two feasible public good levels, the optimal mechanism involves either one or two voting rounds.

Strategic vote trading in power-sharing systems

Dimitrios Xefteris and Nicholas Ziros

Session: Mon16-S

This paper studies decentralized vote trading in a power-sharing framework that follows the rules of strategic market games. In particular we study a two-party election, in which prior to the voting stage voters are free to trade votes for money. Voters hold private information about both their ordinal and cardinal preferences, whereas their utilities are proportionally increasing in the vote-share of their favorite party. In this framework we prove generic existence of a unique full trade equilibrium (an equilibrium in which nobody refrains from vote trading). We moreover argue that vote trading in such systems unambiguously improves voters' welfare.

Who Should Cast the Casting Vote? Using Sequential Voting to Amalgamate Information

Steve Alpern and Bo Chen

Session: Mon16-S

Can a team of non-communication agents coordinate so as to achieve some common goal? Earlier approaches have centred on rendezvous search (where the goal is meeting) and spatial dispersion (with the opposite goal). Here we study how they can best amalgamate their private information about a binary state of Nature. The agents are heterogeneous in their ability, the quality of their private information. They cannot possibly to directly communicate their information, but instead can only vote between the two states. We first describe possible methods of sequential majority voting and then analyse a particular one: The first $n-1$ jurors vote simultaneously and, in the case of a tie, the remaining juror has the casting vote. We prove that when $n = 3$ (a common situation for a tribunal of three judges), the probability of a correct verdict is maximized when the agent of median ability has the casting vote.

Smooth Calibration, Leaky Forecasts, Finite Recall, and Nash Dynamics

Dean Foster and Sergiu Hart

Session: Mon16-T

We propose to smooth out the calibration score, which measures how good a forecaster is, by combining nearby forecasts. While regular calibration can be guaranteed only by randomized forecasting procedures, we show that “smooth calibration” can be guaranteed by “deterministic” procedures. As a consequence, it does not matter if the forecasts are “leaked”, i.e., made known in advance: smooth calibration can nevertheless be guaranteed (while regular calibration cannot). Moreover, our procedure has “finite recall”, is stationary, and all forecasts lie on a finite grid. We also consider related problems: online linear regression, weak calibration, and uncoupled Nash dynamics in n -person games that result from smooth calibrated learning.

Testable Forecasts

Luciano Pomatto

Session: Mon16-T

Forecasters’ are routinely evaluated using statistical tests. This creates an incentive for forecasters to strategically distort their predictions in an effort to appear knowledgeable. A growing literature has shown the manipulative effects of these incentives: most known statistical tests are ineffective at discriminating between forecasters who are knowledgeable and forecasters who are uninformed but strategic. This adverse selection problem can be solved by restricting the domain of permissible forecasts. This paper provides sufficient and necessary conditions under which a domain of permissible forecasts can be effectively tested. These conditions have a natural Bayesian interpretation. The result subsumes different existing contributions in the literature. It follows from the result that it is without loss of generality to restrict the attention to standard likelihood-ratio tests. In addition, it provides a novel connection between the problem of testing strategic forecasters, Bayesian statistics, and the classical Neyman-Pearson paradigm.

Distributional Perfect Equilibrium in Bayesian Games with Applications to Auctions

Elnaz Bajori

Session: Tue9-A

In second-price auctions with interdependent values, bidders do not necessarily have dominant strategies. Moreover, such auctions may have many equilibria. In order to rule out the less intuitive equilibria, we define the notion of distributional perfect equilibrium for Bayesian games with infinite type and action spaces. We prove that every Bayesian game has a distributional perfect equilibrium provided that the information structure of the game is absolutely continuous and the payoffs are continuous in actions for every type.

We apply distributional perfection to a class of symmetric second-price auctions with interdependent values and demonstrate that a specific type of equilibrium is perfect, while many of less intuitive equilibria are not.

The Winners Curse: Conditional Reasoning & Belief Formation

Christian Koch and Stefan Penczynski

Session: Tue9-A

In explaining the winners curse, recent approaches have focused on one of two cognitive processes: conditional reasoning and belief formation. We provide the first joint experimental analysis of the two obstacles. First, we observe significant differences in behavior between a simple common-value auction and a transformed version of this auction that differs in not requiring conditional reasoning. Second, assistance in belief formation leads to significant behavioral changes in both games. The two effects are of similar magnitude and amplify each other when present jointly. We conclude that the combination and the interaction of the two cognitive processes in auctions lead to relatively low strategic sophistication compared to other domains. The study's focus on games' objective cognitive challenges is potentially useful for predictions across games and complements the common focus on behavioral models and their explanatory power.

On Monotone Strategy Equilibria in Simultaneous Auctions for Complementary Goods

Matthew Gentry, Tatiana Komarova, Pasquale Schiraldi and Wiroy Shin

Session: Tue9-A

We explore existence and properties of Bayesian Nash equilibrium in simultaneous first-price auctions for complementary goods. We introduce a novel partial order on types and apply methodology in Athey (2001), McAdams (2003) and Reny (2011) to demonstrate existence of monotone equilibria when the bid space is finite. We then apply this finding to demonstrate two new results on monotone equilibria in continuous bid spaces. The first one establishes existence of monotone equilibria in a setting similar to Krishna and Rosenthal (1996), where a single global bidder bids for multiple objects against a set of local bidders bidding for single objects only. The second considers equilibria with communication as in Jackson, Simon, Swinkels and Zame (2002), showing that in our setting their statements on distributional strategies can be refined to be monotone. Finally, we discuss conditions under which these results can be extended to all-pay, second-price and other standard simultaneous auctions.

Entry with Two Correlated Signals

Alex Barrachina, Yair Tauman and Amparo Urbano

Session: Tue9-B

We analyze the effect of industrial espionage on limit-pricing models. We consider an incumbent monopolist engaged in R&D trying to reduce his cost of production and deter a potential entrant from entering the market. The R&D project may be successful or not and its outcome is a private information of the incumbent. The entrant has an access to an Intelligence System (IS) of a certain precision that generates a noisy signal on the outcome of the R&D project, and she decides whether to enter the market based on two signals: the price charged by the incumbent and the signal sent by the IS. Assuming that the precision of the IS is exogenous and common knowledge, for intermediate values of the IS precision, the set of pooling equilibria is non-empty even with profitable entry and the entrant enters if the IS tells her the R&D project was not successful.

Industrial Espionage in Duopoly Games

Maria Kozlovskaya

Session: Tue9-B

We consider an information acquisition game between duopolists, who can learn about unobservable demand from two sources: market research and industrial espionage. The latter provides a noisy signal of the competitor's private information. In equilibrium firms pick an action which is a weighted average of their signals. The weight on espionage increases in the complementarity of the players' actions, but is lower than the weight placed on the market research. If the coordination motive is not strong enough, or the market research technology is sufficiently precise, the players will not engage in espionage. Spying under price competition is beneficial for the industry, and the economy as a whole: aggregate profit and social welfare increase as the precision of the spying device improves. The same is true under quantity competition if and only if the espionage technology is already more accurate than the alternative market research technology.

Optimal Commitment

Thomas Weber

Session: Tue9-C

We examine a generic three-stage game for two players with alternating moves, where the first player can choose the level of adjustment cost to be paid in the last period for modifying the action she announced in the first period. We show that the improvement under optimal commitment can exceed the difference between the standard first-mover and second-mover payoffs. The approach is nonparametric and uses optimal control theory. Findings are illustrated using several practical examples, such as a Cournot duopoly.

Optimal income taxation with no government commitment

Steven Slutsky and Jon Hamilton

Session: Tue9-C

We consider optimal nonlinear income taxation in a Stiglitz two type framework with a single period where the government cannot commit to announced policies. Individuals announce their types to the government which then sets taxes. Two crucial factors are the degree to which the government desires to carry out redistribution and how much it discounts the welfare of individuals it believes may have misrevealed their type. These traits are fixed attributes of the individual in charge of the government who is chosen in a prior stage election. If the redistributive intentions of the government are too strong, its ability to redistribute may be weak. In the initial voting stage, this may create an extremists dilemma between purity and pragmatism where a voter who has a strong preference for redistribution may have to vote for a candidate whose preferences for redistribution are much less in order for any redistribution to occur.

Dynamics of Innovation: Cooperation and Retardation

Suvi Vasama

Session: Tue9-C

We study dynamics of risky innovations when the firms need constantly update the product to be able to sell new versions to the consumers. The firms face uncertainty about the consumers' valuation for the product, and the consumers' willingness to buy depends on the firms' product development efforts. Product development is costly and the expected net benefit is only positive if the consumers like the update. The firms have the opportunity to wait until the others introduce new features in the product and to copy them only if the consumers like them. The possibility to wait and observe the other firms' success creates incentives to free-ride on their development efforts. We find that when the firms' are sufficiently pessimistic about the consumers' valuation for the product, free-riding leads to an inefficiently low development effort. The innovation is retarded, leading to an inefficiently short lifetime when compared to the efficient benchmark.

What drives price dispersion and market fragmentation across U.S. stock exchanges?

Yong Chao, Chen Yao and Mao Ye

Session: Tue9-D

We propose a theoretical model to explain two salient features of the U.S. stock exchange industry: (i) the proliferation of stock exchanges offering identical transaction services; and (ii) sizable dispersion and frequent changes in stock exchange fees, highlighting the role of discrete pricing.

Horizontal Coordination and Transparency of Information

Yunus Topbas and Unal Zenginobuz

Session: Tue9-D

Rational agents might choose to invest in a certain kind of capital in a period in the hope of making higher returns from their investments made in consecutive periods. We examine the impact of such an interaction on the incidence of coordination failure and accordingly social welfare. In our set-up, investment complementarities are present both within periods (call vertical complementarity) and between periods (call horizontal complementarity). In particular, other than the underlying economic fundamental, the return on investment depends on its aggregate level in that period as well as the aggregate investment made in the previous period. The results suggest that full transparency is optimal at the social level as long as agents have an access to relatively more precise private information and complementarities are sufficiently low. More transparency otherwise reduces social welfare as the gain from better vertical coordination is outweighed by the loss resulted from lesser horizontal coordination.

Game Analysis of the Corporate Internet Information Disclosure

Lin Lin, Wei Zheng and Yan Pan

Session: Tue9-D

Nowadays, corporate websites have become a major communication channel between the management team of corporations and the existing or potential investors. However, the corporations internet information disclosure can be a double-edged sword that some may lead drastic fluctuations in stock prices and have an impact on information users and stakeholders. In fact, the corporate internet information disclosure is a game in the capital market. This paper tries to research a way to analyze the advantages and disadvantages of internet information disclosure. This research will contribute to improve the information disclosure level in internet environment and strengthen the management of corporate information disclosure.

Bargaining and Rentseeking

Haruo Imai and Hannu Salonen

Session: Tue9-E

We consider Baron-Ferejon type majoritarian bargaining model with recognition probabilities determined by Tullock contest. While there is no symmetric perfect equilibrium with pure investment strategies, we show that there are asymmetric perfect equilibria with pure investment strategies (when discount factor is close to 1). One difficulty is caused by the possibility that there are players who receive less payoffs than the payoff of the critical player whose recognition probability is the q -th largest with q being the quota for the majority. To avoid this difficulty, we make use of the limit game as the

discount factor tends to 1, even though the convergence of the game is not uniform, since one can verify that for these equilibria approximate the equilibria of discounted games. In this asymmetric equilibrium, there is always a player who has higher probability and not always invited to be a member of the majority coalition.

Transforming Games with Affinities from Characteristic into Normal Form

Cesarino Bertini, Cristina Bonzi, Gianfranco Gambarelli, Nicola Gnocchi and Ignazio Panades

Session: Tue9-E

As is known, while introducing games in extensive form in their basic book of 1944, von Neumann and Morgenstern also supplied a method for transforming such games into normal form. Once more in that book, the same authors provided a method for transforming games from characteristic function form into normal form, although limited to constant-sum games. In 2007 Gambarelli proposed a generalization of this method to variable-sum games. Gambarelli introduced a solution for the game in characteristic function form, made up of the set of Pareto-Optimal payoffs generated by Nash Equilibria of the transformed game. In this paper, the above transformation method is generalized to the case in which each players requests vary according to the coalition being addressed. Theorems regarding the existence of a solution are proved. Software for the automatic generation of the solution is supplied.

Bargaining and Buyout

Joosung Lee

Session: Tue9-E

To analyze players' strategic alliance behavior, we introduce a new noncooperative coalitional bargaining model, in which each player can buy out other players with upfront transfers. We find that delay in bargaining generically occurs and we uncover the role of an essential player in a transferable utility game, or a veto player in a simple game, in preventing efficient outcomes. In an application to legislative bargaining with vote buying, if a veto player and a non-veto player coexist, then a non-winning coalition forms as an intermediate bargaining step and the final winning coalition is not necessarily minimal. We fully characterize the set of the equilibrium outcomes in three-player simple games and compare it with well-known cooperative power indices.

College assignment as a large contest

Aaron Bodoh-Creed and Brent Hickman

Session: Tue9-F

We develop a model of college assignment as a large contest wherein students with heterogeneous abilities compete for seats at vertically differentiated colleges through the

acquisition of productive human capital. We use a continuum model to approximate the outcomes of a game with large, but finite, sets of colleges and students. By incorporating two common families of affirmative action mechanisms into our model, admissions preferences and quotas, we can show that (legal) admissions preference schemes and (illegal) quotas are outcome and incentive equivalent. We also assess the welfare costs of using human capital accumulation to compete for college admissions. While competition is necessary to generate a (welfare enhancing) assortative match, the welfare losses from the accumulation of human capital solely to compete for a better college seat may be larger on average than the gains from assortativity.

Cumulative offer process with continuous transfers

Koji Yokote

Session: Tue9-F

The Kelso and Crawford (1982) model of job matching has been a basis for the analysis of two-sided many-to-one markets. They proved the existence of a stable matching in both the market with discrete transfers and the market with continuous transfers. The cumulative offer process can be applied to the former market, but not to the latter market. Thus, the algorithm provides no explicit shape of a competitive price vector. The purpose of this paper is to introduce a new algorithm that can be directly applied to the market with continuous transfers. We show that our new algorithm, the cumulative offer process with continuous transfers, finds the maximal competitive price vector in finite steps. Our result offers a clear insight into how the maximal competitive price vector is determined.

School Choice with Voucher

Mustafa Oguz Afacan

Session: Tue9-F

School vouchers, which are used for the private school expenses of kids of low income parents, are in use in twelve states and Washington D.C. A common feature of student placement systems with vouchers is that private schools and public schools have their own separate admission processes. While economic theory teaches us that a unified centralized admission process including both private and public schools is more efficient, it has been silent as to how such a centralized mechanism should be. This paper attempts to fill this gap by offering the first unified school choice model with vouchers. We introduce a stability notion and propose a stable and constrained efficient mechanism design. Our mechanism fails to be strategy-proof. This, however, is not a problem of the mechanism as no mechanism is both stable and strategy-proof at the same time.

Cost allocation rules for elastic single-attribute situations

Frank Karsten, Marco Slikker and Peter Borm

Session: Tue9-G

Many cooperative games, especially ones stemming from resource pooling in queueing or inventory systems, are based on situations in which each player is associated with a single attribute (a real number representing, say, a demand) and in which the cost to optimally serve any sum of attributes is described by an elastic function (which means that the per-demand cost is non-increasing in the total demand served). For this class of situations, we introduce and analyze several cost allocation rules: the proportional rule, the serial cost sharing rule, the benefit-proportional rule, and various Shapley-esque rules. We study their appeal with regard to fairness criteria such as coalitional rationality, benefit ordering, and relaxations thereof. After showing the impossibility of combining coalitional rationality and benefit ordering, we show for each of the cost allocation rules which fairness criteria it satisfies.

For the Object Allocation Problem, Efficiency, the Partial Endowment Lower Bound, and Decomposability Characterize TTC

William Phan and Patrick Harless

Session: Tue9-G

Each agent holds a discrete resource (object). A governing authority wishes to reshuffle (possibility in a probabilistic fashion) these objects amongst the agents taking into account which agent is currently holding which object. We propose the x -endowment lower bound : a parameterized family of properties which weakens the endowment lower bound (also known as individual rationality). We consider probabilistic rules which are decomposable : convex combinations of efficient and group strategy-proof rules. Theorem 1 shows when efficiency is preserved when we mix only Serial Priority rules. As a corollary to this, we identify each value of x for which we can construct rules that satisfy efficiency, the x -endowment lower bound, and can be decomposed into Serial Priority rules. Theorem 2 states that for most values of x , efficiency, the x -endowment lower bound, and decomposability characterize Gales Top Trading Cycles.

Welfare Comparison of Allocation Mechanisms under Incomplete Information

Ethem Akyol

Session: Tue9-G

We study the problem of allocating n objects to n agents without monetary transfers in a setting where each agent's preference is privately known. We show that when each agent's ranking over objects is independent of other agents' rankings and each possible ranking is equally likely, the celebrated Random Serial Dictatorship mechanism is unambiguously welfare inferior to another allocation method, the Random Boston mechanism,

when the number of agents and objects is large. More precisely, every type of every agent has a higher interim utility under the Random Boston mechanism. This result also has an implication about the welfare comparison of two widely used allocation methods for school choice, the Deferred Acceptance (DA) mechanism and the Boston mechanism: When each school ranks students identically, the Boston mechanism is welfare superior to the DA mechanism in the same strong manner in large markets.

The Characterization of the Limit Communication Equilibrium Payoff Set with General Monitoring

Takuo Sugaya

Session: Tue9-H

Many cartels, especially in the industry where monitoring is imperfect and private, involve third-party facilitators, who organize meetings, distribute agreed market shares, collect and verify data, detect deviations, and moderate tensions. Motivated by this observation, we study repeated games with general private monitoring and mediator, and characterize the limit set of sequential communication equilibrium as the discount factor goes to one. As a corollary, we prove the folk theorem with a weak identifiability condition.

Equilibrium Payoffs for Pure Strategies in Repeated Games

Mitri Kitti

Session: Tue9-H

Equilibrium payoffs corresponding to subgame perfect equilibria in pure strategies are characterized for infinitely repeated games with discounted payoffs. The equilibrium payoff set of a game is a fixed-point of set-valued operators introduced in the paper. The new operator formalism is utilized in showing the folk theorem for repeated games with unequal but constant discount rates. When the players become more patient, the equilibrium payoff set converges to a particular fixed-point of an asymptotic operator. The limit sets for constant discount rates can be used in analyzing the outer limit of equilibrium payoffs when the discount factors increase but discount rates are not fixed.

Stability of the Equilibrium Payoff Set in Repeated Games

Asaf Plan

Session: Tue9-H

The set of equilibrium payoffs of an infinitely repeated game is the greatest fixed point of the generation map, B , as shown by Abreu, Pearce and Stacchetti (1990). Generally regarding a fixed point, there are several familiar questions of stability: Is the fixed point attractive? Is it essential, in the sense that nearby maps have nearby fixed points? This paper takes up these questions regarding stability of the equilibrium payoff set in repeated games. The payoff set is attractive from above and varies upper semicontinuously in the

parameters of the game. Under some conditions it is attractive from below and lower semicontinuous, and under other conditions not. Under some conditions, appending a small continuation payoff set to the finitely repeated game yields approximately the same initial payoff set as that of the infinitely repeated game, because the latter's payoff set is widely attractive.

Riemannian game dynamics and reinforcement learning

Panayotis Mertikopoulos and William Sandholm

Session: Tue9-J

We study a class of evolutionary game dynamics under which the population state moves in the direction that agrees most closely with current payoffs. This agreement is defined by means of a Riemannian metric which imposes a geometric structure on the set of population states. By supplying microfoundations for our dynamics, we show that this metric provides a state-dependent but payoff-independent specification of the saliences and similarities of available strategies. Similarly to the replicator and the projection dynamics (the archetypal examples of this class), all Riemannian dynamics satisfy certain basic desiderata (such as global convergence in potential games). Moreover, when the underlying metric satisfies a Hessian integrability condition, the dynamics preserve many further properties of the replicator and projection dynamics. We also examine the close connections between these Hessian dynamics and reinforcement learning in games, extending and elucidating a well-known link between the replicator dynamics and exponential reinforcement learning.

Imitative Dynamics for Games with Continuous Strategy Space

Man Wah Cheung

Session: Tue9-J

This paper studies imitative dynamics for population games with continuous strategy space. We define imitative dynamics—which include the replicator dynamic as a special case—as evolutionary dynamics that satisfy the imitative property and payoff monotonicity. Our definition of payoff monotonicity is different from the one defined in Oechssler and Riedel (2002). We find that our definition is better at capturing the notion of payoff monotonicity for the finite strategy case (cf. Weibull (1995)), and Oechssler and Riedel (2002)'s definition is closer to aggregate monotonicity in the sense of Samuelson and Zhang (1992). We provide sufficient conditions for imitative dynamics and general evolutionary dynamics to be well-defined. Finally, we extend general properties of imitative dynamics as well as global convergence and local stability results in potential games from finite strategy settings to continuous strategy settings.

Evolutionary Selection against Iteratively Weakly Dominated Strategies

Axel Bernergrd and Erik Mohlin

Session: Tue9-J

This paper provides sufficient conditions under which aggregate monotonic selection dynamics selects against strategies that do not survive iterated elimination of weakly dominated strategies. The conditions are satisfied by e.g. Bertrand duopolies, first price auctions, the finitely repeated Prisoners' Dilemma, and the p-beauty contest. The condition implies evolutionary selection against iteratively strictly dominates strategies.

Locating public bads in an interval

Abhinaba Lahiri, Hans Peters and Ton Storcken

Session: Tue9-K

We consider the decision of placing two public bads in a region, modelled by a line segment. Residents of the region have single-dipped preferences over different locations in the region. Our set of alternatives are collection of pairs of locations. Each agent can have any strict preference over the set of alternatives which can be written as a separable extension of some single-dipped preference. A social choice function or rule takes a profile of reported preferences over the set of alternatives as input and selects a pair of locations. All rules satisfying strategy-proofness and Pareto optimality are characterized. These rules pick only boundary locations.

Locating a public good on a sphere

Swarnendu Chatterjee, Hans Peters and Ton Storcken

Session: Tue9-K

It is shown that in a model where agents have single-peaked preferences on the sphere, every Pareto optimal social choice function that is strict or coalitional strategy-proof, is dictatorial.

Multidimensional free-mobility equilibrium: Tiebout revisited

Alexey Savvateev, Constantine Sorokin and Shlomo Weber

Session: Tue9-K

The paper provides consistent mathematical framework for the seminal Tiebout free-mobility model (1956). Our setting supports continuum of consumers with multidimensional preferences and finite number of strategic public good providers. We accommodate the most general assumptions: providers' production function may have variable returns to scale, our framework is rich enough to incorporate possible externalities, spillovers, scale economies, network effects, etc.; consumers utility may depend on choice of other agents in almost arbitrary way. We focus on equilibrium existence, however the questions of efficiency and stability are not left behind.

Group-contests with endogeneous claims

Antoni Rubí-Barceló and Daniel Cardona

Session: Tue9-L

Before group members individually decide their efforts in a contest to set a policy, groups are allowed to make some concessions to their opponent by choosing a less controversial policy to lobby for. When valuations over the set of policies follow a linear function, we show that concessions are never profitable when the contest success function is homogeneous of degree zero but they are when it is of difference form. Surprisingly, concessions might be detrimental for the members of the group that does not make them. Comparing this situation with another where efforts are decided collectively at a group level allows us to remark the effect of positive externalities of effort as the key cause of this damage.

Contests for Revenue Share

Uriel Feige, Ron Lavi and Moshe Tennenholtz

Session: Tue9-L

In a framework of contest design, we study capacity-constrained competition and analyze its resulting revenue shares. Our analysis contrasts the near-symmetric case, where firms have similar supply sizes, and the extremely asymmetric case, where one large firm dominates the market. In particular, we show that while in the near-symmetric case simple contests provide near optimal equilibrium revenues for all sellers, in the asymmetric case a large firm can design more complicated contests that result in disproportionally low equilibrium revenues for her smaller opponents.

The Value of Public Information in Common-Value Tullock Contests

Ezra Einy, Diego Moreno and Benjamin Shitovitz

Session: Tue9-L

Consider a symmetric common-value Tullock contest with incomplete information in which the players' cost of effort is the product of a random variable and a deterministic real function of effort, d . We show that the Arrow-Pratt curvature of d ; R_d ; determines the effect on equilibrium efforts and payoffs of the increased flexibility/reduced commitment that more information introduces into the contest: If R_d is increasing, then effort decreases (increases) with the level of information when the cost of effort (value) is independent of the state of nature. Moreover, if R_d is increasing (decreasing), then the value of public information is non-negative (non-positive).

Communication situations with partially verifiable information: an experimental approach

Valeria Burdea, Maria Montero and Martin Sefton

Session: Tue9-M

We study the effect of verification control in a communication game with partially verifiable information. In this game, an informed party (the sender) sends a two-dimensional message to a decision-maker (the receiver), but only one dimension of the sender's claim can be verified. We use laboratory experiments to compare strategic behaviour in situations where the receiver chooses which aspect to verify and cases where the sender has this verification control. We find that both parties benefit when the receiver is the one who decides which dimension to verify. This is not due to more informative messages but rather to lower skepticism on the receiver's part when the verified dimension is in accord with the message sent. The findings of this study provide guidance for potential employers, judges or investors as to which decision-making environment promotes fewer erroneous choices.

Career Concerns and Policy Intransigence - A Dynamic Signalling Model

Caroline Thomas

Session: Tue9-M

We investigate the reasons why a political leader (manager) may be reluctant to abandon her chosen project, when she is concerned both about social welfare and the electorate's (shareholders') beliefs about her ability. The quality of the project is correlated with her ability, and there is ex ante symmetric information. However, news regarding the project arrives gradually over time and is privately observed by the leader, who may choose whether and when to cancel the project, so that we have a dynamic signalling model. We find that the inefficiency caused by career concerns varies with the information structure.

Rumours and Cheap Talk

Bartosz Redlicki

Session: Tue9-M

This paper studies how rumours spread by word of mouth. I develop a model of diffusion of unverifiable information in a population of two types of biased agents. Each agent cares about his own action and the actions of others. One agent observes a signal of the state of the world and communicates it by cheap talk to an agent whom he meets, thus starting a chain of communication. I show that truthful diffusion of information is possible under certain conditions on, among others, the preferences of agents, the distribution of types in the population, and the assortativity of meetings. Depending on the characteristics of the population, a widely spread rumour follows one of two types of diffusion: (1) with a large number of informed agents and a small proportion of uninformative messages, or (2)

with a small number of informed agents and a large proportion of uninformative messages.

On dynamic stability of equilibrium in network game with production and externalities

Vladimir Matveenko, Alexei Korolev and Anastasia Alfimova

Session: Tue9-N

We consider a network game with production and externalities, which describes a situation typical for many economic, social, and political systems. In the first period of time each of the agents in a network receives endowment and distributes it between consumption and investment. In the second period the agents consumption depends on her own investment as well as on investments of her neighbors in the network. The agents payoff is determined by her consumption in the two periods. We introduce adjustment dynamics into the model and study the problem of stability of the game equilibrium. An important fact which we find is a special role of conditions, which are referred here as the presence and the absence of productivity, both in the static and in the dynamic frameworks. We find instability of the inner equilibrium and convergence to a new corner equilibrium and, correspondingly, stability of the latter.

The Effect of Entry on R&D Networks

Nikolas Tsakas and Emmanuel Petrakis

Session: Tue9-N

We study the effect of potential entry on the formation and stability of R&D networks considering farsighted firms. In particular, we seek to understand whether the incentives for forming R&D collaborations may be altered by the presence of a potential entrant, as well as which are the factors that affect these incentives. We find that an incumbent firm might be willing to sustain an otherwise undesirable collaboration in order to prevent the entry of a new competitor, as well as to refrain from establishing an otherwise desirable collaboration, expecting to form a more profitable collaboration with the entrant. We also find that entry may lead an inefficient incumbent firm to exit the market.

Strategic Formation of Customer Relationship Networks

Sonja Brangewitz, Claus-Jochen Haake and Philipp Möhlmeier

Session: Tue9-N

We analyze the stability of networks when two firms strategically form costly links to customers. We interpret these links as customer relationships that enable trade to sell a product. Equilibrium prices and equilibrium quantities are determined endogenously for a given network of customer relationships. We investigate in how far the degree of substitutability of the firms' products and the costs of link formation influence the equilibrium profits and thus have an impact on the incentives to strategically form relationships to

customers. For networks with n customers we analyze local stability regions for selected networks and determine their limits when n goes to infinity. We establish the existence of locally stable networks for complementary or independent products. We also relate local and Nash stability for selected networks with n customers. For networks with three customers we characterize locally stable networks. In particular, existence is guaranteed for any degree of substitutability.

Good Lies

Massimo Scotti and Filippo Pavesi

Session: Tue9-P

Decision makers often face uncertainty about the ability and the objectives of their advisors. If an advisor is sufficiently concerned about establishing a reputation for being skilled and unbiased, the advisor truthfully reports his private information about the decision-relevant state. However, truthful revelation may not necessarily maximize the expected payoff of the decision maker. There is a trade-off between the amount of information revealed about the decision-relevant state and what the decision maker learns about the advisor's type. While in a truth-telling equilibrium the decision maker learns only about the ability of the advisor, in an equilibrium with some misreporting the decision maker learns about both the ability and the objectives of the expert. In other words, while reputational concerns improve discipline, they nevertheless reduce sorting. Therefore, if a decision maker places enough weight on future choices relative to present ones, equilibria with some lying may be preferred to truth-telling.

Individual preferences across contexts

Hande Erkut

Session: Tue9-P

Economists focus on Dictator Game giving in monetary domain rather than in non-monetary domain although investigation of giving in non-monetary domain has also economic value. This study aims to make a systematic comparison of generosity and rationalizability of individual preferences in a modified dictator game across monetary and non-monetary domains with positive and negative framing using laboratory experiments. The rationalizability of preferences is measured using the severity of Generalized Axiom of Revealed Preferences (GARP) violations as in previous studies (e.g. Andreoni and Miller, 2002; Davis et al. 2012). Results suggest that generosity and GARP violations (in amount and severity) are larger in non-monetary domain than in monetary domain and that the high level of generosity in non-monetary treatments cannot be fully explained by the high level of GARP violations.

Sequential preferences and sequential rationality

Marciano Siniscalchi

Session: Tue9-Q

Sequential rationality requires that players maximize their conditional expected payoff at all information sets, including those that are not reached during any given play of the game, and those the player does not expect to be reached. However, planned choices and conditional beliefs at such information sets cannot be verified or elicited in an incentive-compatible way. Thus, there is a tension between sequential rationality and the revealed-preference methodology. This paper addressed this tension by proposing a new choice criterion, “sequential preference.” A strategy that is maximal for sequential preference is sequentially rational in the traditional sense. However, if players conform to the sequential-preference model, their planned choices and conditional beliefs can be elicited using a variant of the strategy method (Selten, 1967). These results thus demonstrate that dynamic games can be analyzed consistently with the tenets of revealed preference.

Weak Dynamic Consistency

Sophie Bade

Session: Tue9-Q

The behavior of strongly dynamically consistent agents who follow through with any ex ante optimal plan, whether it involves mixed strategies or not, cannot be distinguished from the behavior of Bayesian agents. This observational equivalence does not hold for weakly dynamically consistent agents who only follow through on ex ante optimal pure strategies. Applying these results to games and mechanism design with ambiguity averse agents, I show that the predictions of such models may differ substantially from the predictions of models with Bayesian agents if we only assume weakly dynamically consistent behavior. If we assume strongly dynamically consistent behavior the equilibria of games and the social choice functions implementable by mechanisms with ambiguity averse agents do not differ from their counterparts with Bayesian agents.

Incomplete Information Games with Ambiguity Averse Players

Eran Hanany, Peter Klibanoff and Sujoy Mukerji

Session: Tue9-Q

We study incomplete information games involving players who perceive ambiguity about the types of others and may be ambiguity averse as modeled through smooth ambiguity preferences (Klibanoff, Marinacci and Mukerji, 2005). Our focus is on multi-stage games with observed actions and on equilibrium concepts satisfying sequential optimality – each player’s strategy must be optimal at each stage given the strategies of the other players and the player’s conditional beliefs about types. We show that for the purpose of identifying strategy profiles that are part of a sequential optimum, it is without loss

of generality to restrict attention to beliefs generated using a particular generalization of Bayesian updating. We propose and analyze two strengthenings of sequential optimality. Examples illustrate new strategic behavior that can arise under ambiguity aversion. Our concepts and framework are also suitable for examining the strategic use of ambiguity.

Cooperative games with externalities and probabilistic coalitional beliefs

Giorgos Stamatopoulos and Paraskevas Lekeas

Session: Tue9-R

This paper revisits cooperative games with externalities, i.e. games where the payoff of each coalition depends on the partition of the outside players. We construct the characteristic function of a coalition assuming its members have probabilistic expectations over the coalitional behavior of the outsiders, i.e., they assign various probability distributions on the set of partitions they can form. We apply this framework to the class of aggregative normal form games and we derive conditions on the payoff functions and the probability distributions that guarantee the non-emptiness of the core of the corresponding cooperative games.

Shapley's Conjecture on the Cores of Abstract Market Games

Zhigang Cao, Chengzhong Qin and Xiaoguang Yang

Session: Tue9-R

Shapley (1955) introduced the model of abstract market game. Players are partitioned into two groups such that any two players in the same group are substitutes and those from different groups are complements. The model is a generalization of several familiar models of games including the assignment game. Shapley conjectured that all abstract market games possess cores. We show that the conjecture is true if the number of players is no bigger than 4 or one side is monopoly, but in general the structure of abstract market games is not strong enough to guarantee the nonemptiness of the core. In addition, the stable set may touch both the seller facet and the buyer facet of the imputation set at infinitely many rather than single points. We establish necessary and sufficient additional conditions for symmetric abstract market games to possess cores.

A monotonic and merge-proof rule in minimum cost spanning tree situations

María Gómez-Rúa and Juan Vidal-Puga

Session: Tue9-R

We present a new model for cost-sharing in minimum cost spanning tree problems to allow planners to identify how many agents merge. Under this new framework, in contrast to the traditional model, there are rules that satisfy the property of merge-proofness. Furthermore, strengthening this property and adding some others, such as population monotonicity and solidarity, makes it possible to define a unique rule that coincides with

the weighted Shapley value of an associated cost game.

Paths to Victory in Presidential Elections: The Setup Power of Noncompetitive States

Steven Brams and Marc Kilgour

Session: Tue9-S

In U.S. presidential elections, voters in noncompetitive states seem not to count and have zero power, according to standard measures of voting power because they cannot influence the outcome in their states. But the electoral votes of these states are essential to a candidate's victory, so they do count, but in a different way. We propose a simple model that enables us to measure the setup power of voters in noncompetitive states by modeling how these states structure the contest in the competitive states, as illustrated by the 2012, 2008, 2004, and 2000 presidential elections. We define three measures of setup power: winningness, vulnerability, and fragility, and show how they pinpoint the advantages of the candidate ahead in electoral votes in the noncompetitive states. In fact, this candidate won in all four elections.

The effects of polling systems on electoral competition

Carlos Alós-Ferrer and Georg Granic

Session: Tue9-S

This paper investigates experimentally the effects of different polling systems on the structure of electoral competition. We study a divided majority problem with a unique Condorcet loser and a unique Condorcet winner. The electoral process is modeled through a repeated game with a plurality voting election as the stage game. Voters have no information about other voters' preferences but can observe past election outcomes. We show that the polling system employed to conduct pre-election polls can impact the electoral competition. An approval voting poll preceding plurality voting elections increases the viability of the Condorcet winner in comparison to a plurality voting poll or having no-polls preceding elections. The approval voting poll increases the vote share of the Condorcet winner in the elections and increases the number of elections the Condorcet winner wins. Voting groups also reach higher welfare levels.

Common value elections with private information and informative priors

Javier Rivas and Friederike Mengel

Session: Tue9-S

We study efficiency and information aggregation in common value elections with continuous private signals and informative priors. We show that small elections are not generally efficient and that there are equilibria where some voters vote against their private signal even if it provides useful information and abstention is allowed. This is not the case in

large elections, where the fraction of voters who vote against their private signal tends to zero. In an experiment, we then study how informativeness of priors and private signals impact efficiency and information aggregation in small elections. We find that there is a substantial amount of voting against the private signal. Moreover, while most experimental elections are efficient, voting behaviour reveals little about voter's private information.

Unexpected, hence unfair? The neural response to expectancy violations in the Ultimatum Game

Carlos Alós-Ferrer, Sabine Hügelschäfer and Maria Theobald

Session: Tue9-T

We investigated the processes underlying the violation of social norm expectations in the Ultimatum Game (UG) by using measurements of electrocortical activity in the human brain. Participants' EEGs were recorded while they took part in a series of one-shot UGs in the role of the responder. Prior to the task, they reported their expectations about proposer offers. Results showed that expectations significantly determined acceptance behavior in the UG. The medial frontal negativity (MFN), an event-related potential associated with conflict monitoring, reward prediction errors, and social pain, was significantly associated with expectations. The higher participants' initial expectations about the offers they were to receive, the larger was their MFN amplitude following unequal offers. Our findings imply that the MFN reflects the degree of social norm violation, and might serve as an emotional signal to bias behavior to enforce the social norm.

Evolution of Fairness and Group Formation in Multi-Player Ultimatum Games

Takeshi Nishimura, Akira Okada and Yasuhiro Shirata

Session: Tue9-T

Group formation is a fundamental activity in human society. Humans often exclude others from a group and divide the group benefit in a fair way only among group members. Such an allocation is called in-group fair. Does natural selection favor an in-group fair allocation? We investigate the evolution of fairness and group formation in a three-person Ultimatum Game (UG) in which the group value depends on its size. In a stochastic model of the frequency-dependent Moran process, natural selection favors the formation of a two-person subgroup in the low mutation limit if its group value exceeds a high proportion (0.7) of that of the largest group. Stochastic evolutionary game theory provides theoretical support to explain the behavior of human subjects in economic experiments of a three-person UG.

Taming Selten's Horse with Impulse Response

Tibor Neugebauer, Abdolkarim Sadrieh and Reinhard Selten

Session: Tue9-U

We experimentally test the prediction of the perfect equilibrium concept in the three-player game Seltens Horse (Selten 1975). At first sight, our data show little support of the perfect equilibrium and rather favor the intuitively unreasonable equilibrium. The observed dynamics of the game, however, are in line with learning direction theory whose impulse response dynamics converge on the perfect equilibrium. We tentatively conclude that the observed dynamics are in line with a convergence on the perfect equilibrium, but convergence takes time.

Multiple Decision Processes in Cournot Oligopolies: Evidence from Response Times

Carlos Alos-Ferrer and Alexander Ritschel

Session: Tue9-U

We analyze response times in an experimental Cournot oligopoly and obtain evidence suggesting that two prominent behavioral rules codetermine behavior in this setting. On the one hand, imitation of successful behavior is an intuitive behavioral rule corresponding to a more automatic process. On the other hand, myopic best reply is a deliberative rule corresponding to a more controlled process. While the previous literature has indirectly deduced the relevance of imitation from convergence properties observed in the lab, our evidence rests on the analysis of process data of individual decisions, independently of convergence. Our response-time predictions, derived from a formal dual-process model, point to a non-trivial asymmetry which is readily found in the data. We conclude that a dual view of behavior incorporating both rational optimization and evolutionary ideas on bounded rationality might provide a useful synthesis and help improve our understanding of how economic decisions are made.

Focal points and payoff information in tacit bargaining

Andrea Isoni, Anders Poulsen, Robert Sugden and Kei Tsutsui

Session: Tue9-U

Schelling proposed that payoff-irrelevant cues may systematically affect the outcome of tacit bargaining games. Early evidence supports this hypothesis, but suggests that payoff asymmetries may hurt focal point reasoning. We extend the investigation to tacit bargaining games in which players have imperfect information about each others payoffs, and this is common knowledge. When players know only their own payoffs, they fail to ignore unhelpful payoff information, and the effects of payoff-irrelevant cues on coordination and efficiency are relatively small. When no exact information about payoffs is provided, payoff-irrelevant cues have larger effects, but potential payoff asymmetries are

still detrimental.

The Unreasonably Productive Interaction of the Theories of Games and Computation

Christos Papadimitriou

Session: Tue11-SP1

The computational nature of the platforms of key economic transactions, as well as the rising importance of incentives in networked computation, have led the two fields of Game Theory and the Theory of Computation to look closer into each other and often to engage in joint research. As a result, two decades later both fields have grown richer in insights and methodology, in wisdom and power. This talk will focus on certain key problems in this unexpectedly fertile research interface, in which significant progress was recently made: How are learning algorithms affected if the data providers - or the data itself - are strategic? Can we compute an approximate Nash equilibrium fast? And what are the principles of the optimal design of multidimensional mechanisms and online ad auctions?

Scarf's Lemma and Stable Matchings

Rakesh Vohra

Session: Tue11-SP1

The elegance and simplicity of Gale and Shapley's deferred acceptance algorithm (DA) has made it the algorithm of choice for determining stable matchings in a variety of settings. Each setting has imposed new demands on the algorithm. Among them are to how to handle complementarities and distributional constraints. However, the simplicity of the DA makes it difficult to accommodate these new considerations except in special cases. In this talk I will outline an alternative approach based on Scarf's lemma for tackling such problems. Based on joint work with Thanh Nguyen.

Optimal Dynamic Matching

Leeat Yariv

Session: Tue11-SP2

We study a dynamic matching environment where individuals arrive sequentially. There is a tradeoff between waiting for a thicker market, allowing for higher quality matches, and minimizing agents' waiting costs. The optimal mechanism cumulates a stock of incongruent pairs up to a threshold and matches all others in an assortative fashion instantaneously. In decentralized settings, a similar protocol ensues in equilibrium, but expected queues are inefficiently long. We quantify the welfare gain from centralization, which can be substantial, even for low waiting costs. We also evaluate welfare improvements generated by transfer schemes and by matching individuals in fixed time intervals. Joint work with Mariagiovanna Baccara and SangMok Lee.

Dynamic Matching Auctions: Experimentation and Cross-Subsidization

Alessandro Pavan

Session: Tue11-SP2

We study mediated many-to-many matching in dynamic two-sided markets in which agents' private valuations for potential partners evolve stochastically over time, either as the result of exogenous shocks, or as the result of learning through experimentation. In many environments, the platform's profit-maximizing mechanism takes the form of a dynamic matching auction in which, in each period, agents submit bids for each possible partner and where the matches with the highest joint virtual score are implemented. The virtual score of each match is either myopic or takes the form of an index, accounting for the endogenous changes in the partners' expected match values. Each score depends only on the partners' current bids, the number of past interactions between the partners, and the partners' membership status (which captures vertical differentiation in preferences). Despite the complexity of the environment and the discrepancy between the agents' and the platform's value of experimentation, under the profit-maximizing equilibrium, bidding is straight-forward and myopic. We also contrast matching dynamics under profit maximization with their counterparts under welfare maximization. When all agents benefit from interacting with all other agents from the opposite side, profit maximization involves fewer and shorter interactions. This conclusion, however, need not extend to environments where certain agents dislike certain interactions. Joint with Daniel Fershtman.

Buyer-Optimal Demand and Monopoly Pricing

Daniele Condorelli and Balazs Szentes

Session: Tue11-SP3

This paper analyzes a bilateral trade model where the buyer's valuation for the object is uncertain and she observes only a signal about her valuation. The seller gives a take-it-or-leave-it offer to the buyer. Our goal is to characterize those signal structures which maximize the buyer's expected payoff. We identify a buyer-optimal signal structure which generates (i) efficient trade and (ii) a unit-elastic demand. Furthermore, we show that every other buyer-optimal signal structure yields the same outcome as the one we identify, in particular, the same price. Based on joint work with Daniele Condorelli and Anne-Katarin Roesler.

Cooperation in the Finitely Repeated Prisoners Dilemma

Guillaume Frchette

Session: Tue11-SP3

More than half a century after the first experiment on the finitely repeated prisoners dilemma, evidence on whether cooperation decreases with experience, as suggested by

backward induction, remains inconclusive. We will explore a meta-analysis of prior experimental research and the results of a new experiment to elucidate how cooperation varies with the environment in this canonical game. We will describe forces that affect initial play (formation of cooperation) and unraveling (breakdown of cooperation). First, contrary to the backward induction prediction, the parameters of the repeated game have a significant effect on initial cooperation. We will identify how these parameters impact the value of cooperation - as captured by the size of the basin of attraction of Always Defect - to account for an important part of this effect. Second, despite these initial differences, the evolution of behavior is consistent with the unraveling logic of backward induction for all parameter combinations. Importantly, despite the seemingly contradictory results across studies, we will establish a systematic pattern of behavior: Subjects converge to using threshold strategies that conditionally cooperate until a threshold round; and conditional on establishing cooperation, the first defection round moves earlier with experience. Simulation results generated from a learning model estimated at the subject level provide insights on the long-term dynamics and the forces slowing down the unraveling of cooperation.

A Fundamental Strategic Equilibrium for N-Person Cooperative Games: Characterization and major consequences

Gabriel Turbay

Session: Tue14-Pos

A fundamental equilibrium is identified and mathematically characterized for all n-person cooperative games with transferable utility. Among several equilibria that may emerge as internally stable bargaining scenarios with an effective balanced support for a system of realizable claims (joint-strategies), the fundamental equilibrium is a system of externally stable extended imputations that satisfies coalitional rationality. The mathematical characterization is made in terms of linearly-balanced collections, admissible utility transfers, strategic independence based on bargaining alternatives, and two theorems on the alternative for matrices: The Fredholm alternative, and the Farkas lemma. The fundamental equilibrium is shown to have a value level equal to the von Neumann and Morgenstern number —?2— associated with every cooperative game and is obtainable from the solution of a well-known associated dual pair of linear programming problems. Existence, uniqueness, invariance, strategic dominance, and optimality properties are demonstrated. Some major game theoretical consequences and economic implications are briefly discussed.

Graphical Algorithms for the Nucleolus of Binary Assignment Games

John Hardwick

Session: Tue14-Pos

An assignment game is a cooperative game with its player set divided into two groups, where a coalition receives a positive payoff only if it contains at least one player from both groups. In other words, it concerns a bipartite matching, with a payoff defined for each pair (payoffs for larger coalitions are determined additively). The 1994 paper by Solymosi and Raghavan gives an algorithm for finding the nucleolus (an optimal solution) of such a game. In this paper, we examine the special case in which the payoffs for each pair take binary values, an indicator of whether or not the pair is compatible. For this case, we present two new, simpler algorithms which capitalize on the graphical aspect of the previous one. These algorithms require $O(n^4)$ operations. We also discuss sociological implications of this solution, considering each pair's split of the payoff to be their relationship's balance of power.

Incumbent Competition and Private Agenda

Anne Marie Go

Session: Tue14-Pos

Consider two politicians who decide whether to follow what they believe the public wants, choose the option that secures their private gain. Laws are passed when the politicians reach a unanimous decision. The public only rewards a politician when a law is passed, or when the politician is the only one whose action coincides with the public decision. We find that if the politicians are good enough decision-makers, a sufficiently high public regard in policy implementation given moderate private agenda payoffs pushes the politicians to take the action that generates a public benefit, implementing a socially optimal law. For very low decision-making skills, at sufficiently high policy rewards, we find that they vote for the same action to pass a law regardless of what the public wants. This gives rise to politicians converging to a decision that neither provides them with a private benefit nor follows exactly the public decision.

Interval least square prenucleolus and nucleolus of interval cooperative games and properties

Deng-Feng Li and Jia-Cai Liu

Session: Tue14-Pos

Cooperative games with coalitions values represented by intervals, called interval cooperative games for short, are discussed in this paper. The main purpose of this paper is to develop fast and effective quadratic programming methods for computing interval least square prenucleolus and nucleolus of interval cooperative games. Firstly, based on the square excess which can be interpreted as a measure of the dissatisfaction of coalitions,

we construct an auxiliary quadratic programming model for interval least square prenucleolus of any interval cooperative game and derive its analytical solution, which is used to determine players interval payoffs. Then, two iteration algorithms are developed to compute the interval least square nucleolus of interval cooperative games based on the derived analytical solution of the interval least square prenucleolus. Finally, we study some useful and important properties of the interval least square prenucleolus and nucleolus such as existence and uniqueness, efficiency, additivity, symmetry, and anonymity.

The Double-Channelled Effects of Experience in Individual Decisions: Experimental Evidence

Peiran Jiao

Session: Tue14-Pos

Evidence in psychology and experimental games suggests that people tend to overweight personal experience relative to descriptive information and observations. However, little is known about the relative importance of experience in individual economic decisions. The present paper investigates this issue using an experimental investment task with choice feedback and belief elicitation. The experiment creates tension between the Bayesian strategy and experience-based learning. We document the double-channelled effects of experience: controlling for beliefs, participants significantly relied on experience, behaving consistently with the law of effect, i.e. repurchasing more assets from which they gained than lost; additionally, experience also distorted beliefs, inducing more optimism on assets from which they gained and pessimism on unowned assets. We then structurally estimated the parameters of the reinforcement-learning model and found it significantly added predictive power to expected utility models. These results can inform theories of individual sequential decisions and the design of behavioral interventions.

Favoritism in public procurement auctions: model of endogenous entry

Maria Ostrovnaya and Elena Podkolzina

Session: Tue14-Pos

Governments of different countries try to lower the entry cost in public procurement in order to decrease public spending. The purpose of this paper is to examine how the entry cost influences favoritism and procurement prices in the corrupt environment. We adapt the model of selective entry and find that lower entry cost always reduces the contract price paid by the benevolent procurer, but at the same time may make favoritism more stable. Thus the entry cost does not affect the contract price paid by the corrupt procurer or increase it. We illustrate this result using case study on gasoline procurement in Russia where the entry cost of companies was decreased by e-procurement reform. This allows us to examine how changes in entry costs influence competition of companies and procurement prices in auctions.

Extensive games with offers for incentive payments: an emergence of non-cooperative cooperation

Valentin Goranko

Session: Tue14-Pos

I consider an enrichment of the framework of extensive form games, where players can make during the game unilaterally binding offers for transfer of utilities to the player who is to make a move, in order to provide an incentives for that player to deviate from a Backward Induction prescribed strategy for a common benefit. I characterise the solutions of such games for the 2-player case with perfect information and then extend the framework to coalitional interplay offers in N-player games, where the problem reduces in general to solving multi-party bargaining and coalitional games, requiring deeper analysis for which this paper is just a starting point.

Conformism on internet: coordination on public and private information.

Gabriel Mogiljanski

Session: Tue14-Pos

I use a normal quadratic game à la Calvo-Armengol and al (2015) to find a theoretical explanation to buzzes on internet. More precisely I solve a game with strategic complementary, public and private information and information acquisition. I find the existence of the unique symmetric linear equilibrium and derive some comparative static with respect to it: an increase of the size of the population leads individuals to accord more importance to public information relatively to private information. I compare this equilibrium to a planner equilibrium and find that in the competitive equilibrium there is an over-weighting on the public information, following our interpretation of the model this over-weighting is a Buzz.

Do quantum strategies always win?

Colin Benjamin and Namit Anand

Session: Tue14-Pos

In a seminal paper, Meyer [David Meyer, Phys. Rev. Lett. 82, 1052 (1999)] showed that a player using a quantum strategy can win against a classical player 100% of the time in the penny flip game. Here we make a slight modification to this game, with the two players sharing an entangled state to begin with. We have the quantum player making unitary transformations to his qubit while the classical player makes use of a mixed strategy wherein he either flips or not his qubit with some probability “p”. The 100% win record of a quantum player is drastically reduced and for a particular probability “p” the classical player can even win against the quantum player. This is of possible relevance to the field of quantum computation as we show that in this quantum game of preserving versus

destroying entanglement a particular classical algorithm can beat the quantum algorithm.

Social Optimum Problem in Funding Public Goods by Means of Lotteries

Daniil Shvets

Session: Tue14-Pos

In the paper the existing microeconomic/Game Theory models (such as John Morgans) of financing public good by means of lotteries are analysed. Several other models are proposed so as to compensate certain shortcomings of the above-mentioned models. Those models are based on the assumption that lottery organiser knows the welfare function of each participant of a lottery except the moral component. The analysis of the classical and newly introduced models allows one to make the following conclusions (the major ones). 1. It is proved that the socially optimal level of providing public good is achievable. 2. The newly introduced notion of relative expectations along with taking into consideration the influence of advertising and the moral utility factor for the participants of a lottery provides a new approach to the free-rider problem.

Who should evaluate the fairness: an interactive approach in multi-portfolio optimization problem from clients' perspective

Jing Fu

Session: Tue14-Pos

In this paper, an interactive multi-portfolio optimization framework is proposed from the perspective of self-interested clients. A key distinction of this approach from the classical methods is a built-in factor in the expected return related to client preferences on the bunched trading, which is termed as information pool and helps prompt the perceived fairness. It allows the clients, who should be the ultimate evaluator of fairness, to be enrolled in the interactive optimization process, differing from the approach centrally decided by the portfolio manager. Instead of the traditional share-based pro rata fashion, the manager split the market impact cost in accordance to a novel concept called relative contribution, which correctly captures the market impact of each individual account. The numerical study suggests that this interactive approach outperforms the relevant prominent solutions in literature, and information pooling does improve the portfolio performances.

Delegation Games

Cigdem Akbulut Merchant, Thijs Jansen and Arie van Lier

Session: Tue14-Pos

In this paper, we use the VFJS model proposed by Vickers (1985), Ferstman and Judd (1987) and Sklivas (1987). We find that even an inefficient firm can obtain higher profits than its rival if it compensates its manager with a market share or relative profit incentive

whereas its rival is just owner-led. We consider duopolies where the efficient firm remunerates its manager with a market share incentive and the rival firm uses a sales, relative profit or market share incentive. We find that the efficient firm could achieve Stackelberg Leadership profits if the difference between marginal costs of two firms exceeds a certain benchmark. Finally, we determine that the less efficient firm owner always prefers to use a managerial bonus based on relative profits. If the difference between marginal costs is large enough then the more efficient firm owner always prefers to use a managerial bonus based on market share.

Rules to negotiate proportions when multiple references exist

Amparo Mármol and Miguel A. Hinojosa

Session: Tue14-Pos

Proportionality is a primary principle generally accepted when dividing a commodity between a set of agents who are evaluated with respect to a certain characteristic. The proportional rule provides a result in which all the agents obtain the same proportion with respect to their references. When multiple characteristics are considered, there is no obvious way to define proportionality. In this paper we incorporate the extensions of two crucial properties which are inherent to proportionality: the proportions obtained with respect to the different references cannot be improved simultaneously, and the result does not depend on the scale in which each of the characteristics is measured. In our approach, the choice of a single allocation for the division problem is understood as a negotiation between parties, each one “supporting” one of the characteristics. This fact permits the design of specific rules for multiple reference division problems based on the axiomatic bargaining solutions.

A Nonlinear Programming Approach to compute Interval Cores of Interval Multiobjective Cooperative Games with Considering Importance of Coalitions and Objectives

Fei-Mei Wu and Deng-Feng Li

Session: Tue14-Pos

The aim of this paper is to develop a nonlinear programming method for solving interval multiobjective cooperative games in which importance of objectives and coalitions are taken into consideration. Firstly, we define the concepts of interval cores of interval multiobjective cooperative games and satisfactory degrees of comparing intervals with inclusion and/or overlap relations. Then, we construct an auxiliary nonlinear programming model for computing interval cores of interval multiobjective cooperative games in which importance of objectives and coalitions are considered. The derived auxiliary nonlinear programming model can be directly and easily solved. The proposed ranking method of intervals is an important development of existing interval ranking methods. Furthermore,

the proposed model and method of interval cores for interval multiobjective cooperative games is an extension of that for classical cooperative games. The effectiveness, feasibility and applicability of the proposed model and method are illustrated with a real example.

Pareto optimal strategies for matrix games with payoffs of intuitionistic fuzzy sets

Jiangxia Nan, Dengfeng Li and Jingjing An

Session: Tue14-Pos

The aim of this paper is to develop an effective methodology for solving matrix games with payoffs of intuitionistic fuzzy sets (IFSs). In this methodology, a new ranking order relation of IFSs is proposed and the concept of Pareto Nash equilibrium solutions of matrix games with IFS payoffs is firstly defined. It is proven that the solutions of matrix games with IFS payoffs are equivalent to those of a pair of bi-objective programming models. The models and method proposed in this paper are illustrated with a numerical example and compared with other methods to show the validity, applicability and superiority.

Auctions with Interdependency and Capacity Constraint: Assets Allocation on the Brazilian Power Transmission Sector

Lucas Motta and Francisco Ramos

Session: Tue14-Pos

The Brazilian electricity sector adopted the auction mechanism to allocate the assets of transmission lines. The results are impacted by interdependence and the capacity constraint. We develop a theoretical model to evaluate these issues in a procurement auction sequence. The theoretical model shows that the joint action of interdependence and of capacity restriction decreases the competitiveness of the participants and the payoff of auctioneers. Using switching regression model, we found that the interdependence affected the probability of winning and the behavior of the bidding. In addition, plans for rapid expansion of the grid can be frustrated if these effects are not considered

Computing Mixed Bayesian Nash Equilibria for Double Games

Abbas Edalat and Samira Hossein Ghorban

Session: Tue14-Pos

The competitive behavior of a given number of rational agents who simultaneously invest their resources in varying proportions in a number of different environments can be modeled by a new class of games called Multi-Games (MGs). In particular, multi-games model the investment in various continental and national markets in a global economy. Different environments are denoted as basic games. The total payoff for each player is assumed to be a convex combination of the rewards with the respect to the investment weights of basic games. When the players' investment weights in the basic games are, with

a given conditional probability distributions, their private information or types, then a class of Bayesian games is obtained. In this paper, we derive an efficient algorithm to find a Bayesian Nash equilibrium for a class of multi-games called completely mixed regular double games.

Making Sense of Unexpected Moves in Games: From Mistaken Beliefs to Beliefs about Mistakes

Aleks Knoks and Eric Pacuit

Session: Tue14-Pos

The epistemic program in game theory aims at making explicit the assumptions that underlie the basic concepts of the discipline. Thus far, this literature has not had much to say about the so-called “trembling hand mistakes” in games. This paper aims to fill in this lacuna. We argue that the idea of players who can make and reason about mistakes fits well with the overall direction of the epistemic program. We present an extension of Robert Stalnaker’s epistemic models of extensive games with simultaneous moves, in which the players can make trembling hand mistakes. In particular, this means that when a player observes an unexpected move, she has to figure out whether it is a result of a deliberate choice or simply a mistake. We show how our models of beliefs in games sheds new light on the relationship between backward and forward induction.

Vertical Product Differentiation under Counterfeiting

Margarita Gladkova and Nikolay Zenkevich

Session: Tue14-Pos

The paper considers the market of software products. Regularly this markets are suffering from dealing with a problem of counterfeit or pirate products that are sold. Taking this into account the paper is solving the problem of price equilibrium on this market. The software company set the price and the quality of the software product while the counterfeit or pirate company suggest the consumers the product of the lower quality. First the general model is analyzed and price equilibrium is defined. Second, the monopoly case is considered separately and optimal software price is defined. Finally, it is supposed that there are two companies that produces original software on the market who differentiate in quality, and there are two pirate companies who produces this software. The duopoly case is analyzed and equilibrium prices for competing companies are obtained in the explicit form.

Phenomenon of a “snag” in financial markets and its analysis via the cooperative game theory

Ondrej Cernik and Radim Valencik

Session: Tue14-Pos

The paper describes the development of financial markets and changes in the nature of economic growth using the theory of cooperative games. It turned out that various applications and contexts correspond to numerous possible solutions of standard tasks, e.g. Nash (S, d) bargaining problem. We show that under conditions of sufficiently effective financial markets the question of the relationship between efficiency and equality, which is typical of the theory of social welfare, may be replaced by the question of making full utilization of investment opportunities associated with the acquisition, preservation and application of human capital. Sufficiently efficient functioning of financial markets (in the above mentioned sense) assumes also good functioning of such financial market instruments, e.g. human capital contracts associated with the use of transferred prices and mediated utilization of transferred prices. The development of financial markets in the above direction is prerequisite to economic growth.

Reformulation of Nash Equilibrium with an Application to Interchangeability

Yosuke Yasuda

Session: Tue14-Pos

The paper provides a reformulation of Nash equilibrium based on optimization approach. The set of Nash equilibria, if it is nonempty, is identical to the set of optimizers of a real-valued function, which connects the equilibrium problem to the optimization problem. Using this characterization, we study the interchangeability of Nash equilibria, and show that existing results on two-person (i) zero-sum games and (ii) supermodular games can be derived, in a unified fashion, by the lattice structure on optimal solutions.

A non-cooperative equilibrium with multiple deviators

Dmitry Levando

Session: Tue14-Pos

The paper suggests a non-cooperative game, where the number of potential deviators is a fixed parameter and demonstrates the existence of an equilibrium in the game. The maximum size of a deviating set of players is equal to the number of deviators and modifies the set of strategies in the game. A central planner offers a list of possible coalition structures over the set of all strategies in the game. Individual payoffs are defined for every structure analogous to state-contingent payoffs in finance. The constructed game includes intra and inter group externalities for every coalition structure. We construct a noncooperative stability criterion to describe the commitment of players to an equilibrium for every fixed number of deviators. It may serve as a way to measure trust for the

equilibrium.

Optimal strategy and effort input in group work evaluation

Giuseppe Bova and Mehdi Chowdhury

Session: Tue14-Pos

This model applies the model for team performance developed by Holmstrom (1982) to a setting in which the good produced by the team is a public good. It shows that when the team good is a public good, for example an essay mark then the team members are inclined to exert the efficient level of effort and no free-riding occurs. Contrary to this results, group members are not willing to acknowledge each others contribution since this diminishes the value they can assign to their own contribution.

When is Bad “Bad Enough”? A Linearization Framework for Analyzing Benefits of Coordination under Externalities

Anna Klis

Session: Tue14-Pos

This paper addresses the problem of determining when coordination is beneficial. I describe a negative externality game containing a “worsening parameter and develop a framework linearizing this parameter for tractable examination. The worsening parameter can be classified according to “own effect” – changing the marginal utility of a players own action, “opponent effect” – altering the marginal externality, or “submodular effect” strengthening the games submodularity. Using this framework, I examine the sufficient conditions for parameter changes to move non-cooperative and cooperative solutions in opposite directions. In a symmetric game, an increase in own effect will increase the distance between utility and action level of the non-cooperative and cooperative solutions. In a non-symmetric game, there are sufficient conditions on the second derivatives which give this pattern as well. I argue that situations behaving in this manner have more benefit to coordination through the increased range in actions.

Does Contamination affect Residential Property Values

Asha Sadanand and Jack Williamson

Session: Tue14-Pos

This paper concerns property value diminution (PVD) of residential properties contaminated by a commercial / industrial source or a spill. Although long-term, negative price effects might seem inevitable, transaction data fail to confirm negative price effects when properties have been cleaned up. We develop an economic model which shows how this can occur. In our model individuals are free to purchase units of housing in just one of two neighbourhoods, and all units of housing are identical. A pollution event occurs which partially contaminates of one of the two neighbourhoods. Some individuals face life event

such as a job change. Moving is optional and individuals may commute. Owners are better informed about the contamination of their house than buyers. Buyers can, however, determine the information by paying a search cost. We present a worked example in which, depending on search and commute costs, property value diminution may not occur.

Equilibria with vector-valued utilities and preference information. The analysis of a mixed duopoly

Amparo María Mármol, Luisa Monroy, María Ángeles Caraballo and Asunción Zapata

Session: Tue14-Pos

This paper deals with the equilibria of games when the agents have multiple objectives and therefore, their utilities cannot be represented by a single value, but by a vector containing the various dimensions of the utility. Our approach is based on the incorporation into the model of information about the preferences of the agents, together with additional decision rules. This allows us to identify the equilibria according to this preferential information. The potential application of the theoretical results is shown with an analysis of a mixed oligopoly in which the agents value additional objectives other than their own benefit. These objectives are related to social welfare and to the profit of the industry. The flexibility of our approach provides a general theoretical framework to analyse a wide range of strategic economic models.

A Network Approach to International Relations

Yuke Li

Session: Tue14-Pos

This paper develops a network approach to studying issues in international relations and terms it a “network theory”. The theory consists of a resource-allocation game on fixed networks, and based on the outcomes of which, a relation-formation game as well as a dynamical system perspective of relation dynamics. The theory is the basis for deriving new understandings into several topics in international relations, such as liberal peace, balancing and effectiveness of alliances. This paper covers the theory, and discusses the application of liberal peace.

Banking and Sovereign Debt Crisis: The role of strategic complementarities

Lucia Esposito

Session: Tue14-Pos

This paper investigates in a theoretical framework the determinants of the “diabolic loop” between sovereign and bank credit risk that was the distinctive feature of the financial instability which spread out from 2009 to 2012 in the periphery of the euro area. In the proposed model there are strategic complementarities within and between the group of bank creditors and the group of sovereign creditors. The negative feedback loop originates

from the fact that banks' holdings of sovereign bonds, being liquid assets, may be sold or not rolled-over in case of liquidity shortage. In the unique equilibrium of this model, as the private information that agents receive becomes very precise, the correlation between the probability of a banking crisis and a sovereign debt crisis approaches one and depends solely on bank balance sheet variables.

Evolutionary dynamics in a continuous space

Li You, Katharina Schüller, Frank Thuijsman and Philippe Uyttendaele

Session: Tue14-Pos

We apply a simulation model to examine evolutionary population dynamics based on random interactions between individuals, within global and local neighbourhoods. Interactions occur in a continuous two-dimensional space. These interactions yield fixed numbers of offspring that are based on a given fitness matrix. These offspring are randomly placed within a certain spatial radius from the parents. Besides, we use a control mechanism to make sure that the neighbourhood population density does not grow too high. We compare our simulation results with theoretical population development as predicted by the replicator dynamics, and also compare it with practical results derived in an experimental set-up. Our results support the theoretical analysis of models with global interactions and also imitate real-life situations with local interactions in a realistic way. Next to this, we study the influence of several parameters on population development, like individual lifetime, radius of interaction, radius of placing offspring, etc.

Corruption and Political Marketing: A Game Theoretic Approach

Emmanuel Albuquerque and Francisco Ramos

Session: Tue14-Pos

We consider a game between a non-benevolent incumbent politician and a bureaucrat, where both can illegally appropriate public resources. The corrupt politician uses the resources to finance political campaigns and the bureaucrat to buy goods and services. Any illegal withdraw from the treasury diminishes the politician's capability to improve social welfare. Politicians care about votes, bureaucrats care about money, and voters care about social welfare and are influenced by campaigns. We analyze the role of society's educational level and of different punishing structures. We find that: i) the bigger the appropriation by the bureaucrat, the smaller the optimal appropriation by the politician; ii) the more educated the politician's constituency, the less lenient to corruption he will be; and iii) the more sensitive to marginal increases in corruption the punishing structure is, the smaller the players' optimal appropriation.

Equilibria under passive beliefs for multi-leader-follower games with vertical information: existence results

Maria Carmela Ceparano and Jacqueline Morgan

Session: Tue14-Pos

We consider multileaderfollower games where the actions chosen by any leader are observed by only one exclusive follower. Many realworld situations can be modeled in such a way, for example see Pagnozzi and Piccolo (2012), where competing manufacturers delegate retail decisions to exclusive retailers offering a private contract. Such games, called multileaderfollower games with vertical information, may have an infinity of Nash equilibria but it is not possible to refine using the concept of subgame perfect Nash equilibrium since the associated extensive forms have no proper subgames. This motivated the introduction of selections of Nash equilibria based on the beliefs that each follower has about the actions chosen by the leaders rivals of his own leader. We illustrate the effectiveness of the concept for a general model and we investigate the existence of such a selection for significative classes of problems satisfying conditions of minimal character on possibly discontinuous data.

Individual utility and social choice generated by choice of attitudes

Andrei Matveenko

Session: Tue14-Pos

We construct foundations for utility function and models of consumer behavior, voters behavior, and social choice which are based on model of attitude choice. The key idea of our approach is that the consumers decision in any situation of choice has dual nature: it relates both (1) choice of bundle of characteristics of goods from set of choice which characterizes the particular situation, and (2) choice of an attitude (vector of weights of characteristics) from behavior menu. We show that in the Nash collective bargaining model, arbitrator possesses a social behavior menu and acts in a similar way as an individual. Social behavior menu consists of vectors of average attitudes of the members of the collective. We provide examples of formation of the individual behavior menus as results of an evolutionary process and of spreading of attitudes in network. By use of our approach we develop Hillmans political economy games.

Target-based solutions for Nash bargaining

Lorenzo Bastianello and Marco Licalzi

Session: Tue14-Pos

We revisit the Nash model for two-person bargaining. A mediator knows agents ordinal preferences over feasible proposals, but has incomplete information about their acceptance thresholds. We provide a behavioural characterisation under which the mediator recommends a proposal that maximises the probability that bargainers strike an agreement.

Some major solutions are recovered as special cases; in particular, we offer a straightforward interpretation for the product operator underlying the Nash solution.

Equilibrium Profits in Perfectly Competitive Screening Markets

Yehuda Levy and Andre Veiga

Session: Tue14-Pos

We study local equilibria resulting from perfect competition among a fixed number of firms in a screening market. A condition that guarantees zero profits to all firms at the given local equilibrium prices is the existence of a linear ordering on the available alternatives that dictates the preferences of the firms in those cases in which consumers display indifference; this condition is shown to hold in classical models of insurance markets. A partial converse, giving robust conditions under which this condition is violated and positive profits result, is also presented.

Collusion and Signaling in Auctions with Interdependent Values

Peter Troyan

Session: Tue16-A

The standard mechanism design approach to collusion in auctions posits a disinterested third party who designs and implements the mechanism. However, in many environments, collusion agreements are likely to be both proposed and executed by the involved parties. When this is the case, the standard approach may be inadequate, as it neglects potential information leakages. We model collusion in a second-price auction by having one informed bidder propose to another. We find that all-inclusive cartels will be unable to extract all of the surplus from the seller, and equilibrium outcomes will generally be (socially) inefficient. While both bidders are better off than without colluding, we exhibit a first-mover (relative) disadvantage: information leakages and a corresponding winners curse cause the proposer to be worse off than the receiver. Introducing outside competition compounds this winners curse and reduces the potential gains to collusion, resulting in substantially higher revenues for the seller.

How to Boost Revenues in First-Price Auctions? The Magic of Disclosing Only Winning Bids from Past Auctions

Philippe Jehiel, Peter Katuscak and Fabio Michelucci

Session: Tue16-A

Consider a long-term auctioneer who repeatedly sells identical or similar items and who might disclose selective information about past bidding. We present a theory that yields different predictions about bidding depending on the information bidders are provided with. We focus on the disclosure of all bids and of winning bids only. Our theory is based on a selection bias: some bidders who are presented with historical winning bids

mistakenly best-respond to that distribution, failing to realize that winning bids are not representative of all bids. In the steady state, this bias results in higher bids and auction revenue than when all bids are presented. Our experimental test confirms the qualitative predictions of the theory. On the theory side, our findings challenge the predictive power of Bayesian Nash Equilibrium based on rational bidders. On the market design side, they underline the role of historical market information as a key design choice.

Auction cartels and the absence of efficient communication

Gyula Seres

Session: Tue16-A

This paper examines the feasibility of collusive mechanisms in single-unit auctions. A model is built up with private and common value information asymmetry and continuous type space. We show that an incentive compatible bid coordination mechanism (BCM) does not exist if common value uncertainty is present. This result contradicts actual antitrust cases where common effects or resale opportunities created uncertainty about valuations, but a price-fixing cartel was formed. We solve the puzzle by relaxing the assumption that all bidder types truthfully reveal their private information. The introduced Bayesian bid coordination mechanism (BBCM) exists if the main source of information asymmetry is private value. In that case, a designated ring member can signal high valuation and suppress competition. Our results demonstrate the rationale behind cartel mechanisms with pre-auction knockouts.

Common Values and the Coase Conjecture: Inefficiencies in Frictionless Contract (Re-)Negotiation

Vitali Gretschko and Achim Wambach

Session: Tue16-B

We analyze the contracting problem of a principal who faces an agent with private information and cannot commit to not renegotiate a chosen contract. We propose an infinite horizon negotiation protocol in which renegotiation is frictionless and there are no restrictions on how many times the contracts can be renegotiated. We provide a general characterization of renegotiation-proof outcomes and show that those outcomes are supported by a Perfect Bayesian Equilibrium of the negotiation game. The general characterization of renegotiation-proof outcomes provides a powerful and simple to use tool for finding such outcomes in specific environments. We proceed by applying the results to adverse selection environments with private and common values. We show that with private values and common values of the 'Spence' type only fully efficient and separating contracts can be renegotiation proof. With common values of the 'Rothschild-Stiglitz' type inefficient and (partial) pooling contracts may constitute renegotiation-proof outcomes.

Damaged Durable Goods, Upgrades and the Coase Conjecture

Basak Altan

Session: Tue16-B

This study analyzes a damaged good market for a perfectly durable good in an infinite horizon, discrete time game. We characterize Markov perfect equilibria of this game under different buyer upgrade possibilities as a function of the common discount factor, the length of the time period between successive price changes, and the quality levels of the goods. We establish that introducing a lower quality good works as a commitment device only if consumers holding a durable good cannot re-enter the market. When a buyer can upgrade the product, we establish that for all parameter values the Coase conjecture survives.

Mergers with Horizontal Subcontracting

Jan Bouckaert and Geert Van Moer

Session: Tue16-C

Horizontal subcontracting outsourcing activities to competitors stifles competition to the extent that subcontractors capture the subcontracting surplus. In our framework, price-competing firms choose the subcontracting terms to maximize profits. A merger does not create cost savings at the industry level because of efficient subcontracting before the merger. It does, however, reduce the merged parties in-house costs. Merging is therefore (i) profitable because it credibly limits the amount paid to subcontractors, and (ii) price-reducing as it decreases outsiders profits from subcontracting.

Long-term Causal Effects in Multiagent Economies

Panos Toulis and David Parkes

Session: Tue16-C

The effect of a treatment in a multiagent economy is causal if the treated economy would be different relative to the control economy. Causal effects measured in an equilibrium of the economy, the long-term causal effects, are more representative of the value of such treatments. However, the statistical estimation of long-term causal effects is difficult because it has to rely, for practical reasons, on short-term experimental data. We propose a methodology to estimate long-term causal effects, which relies on a model of agent behavior that plays a two-fold role. First, it predicts how agents would behave under different assignments, and, second, it predicts how agents would behave in a long-run equilibrium. These two prediction tasks enable the estimation of long-term causal effects under suitable assumptions, which we state explicitly.

Multiproduct trading with a common agent under complete information: Existence and characterization of Nash equilibrium

Amparo Urbano and Ivan Arribas

Session: Tue16-C

This paper focuses on oligopolistic markets in which indivisible goods are sold by multi-product firms to a continuum of homogeneous buyers, with measure normalized to one, who have preferences over bundles of products. By analyzing a kind of extended contract schedules that discriminate on exclusivity, the paper shows that pure strategy efficient equilibria always exist in such settings. There may also exist inefficient equilibria in which the agent chooses a suboptimal bundle. Inefficient equilibria can be ruled out by either assuming that firms are pricing unsold bundles at the same profit margin as the bundle sold at equilibrium, or imposing the solution concept of subgame perfect strong equilibrium, which requires the absence of profitable deviations by any subset of principals and the agent. We provide a characterization of the equilibrium pure strategies and show that each principal's set of equilibrium contracts of minimum cardinality may contain at least three offers.

Communicating Subjective Evaluations

Matthias Lang

Session: Tue16-D

Should principals explain and justify their evaluations? Suppose the principal's evaluation is private information, but she can provide justification by sending a costly unverifiable message. If she does not provide justification, her message space is restricted, but the message is costless. I show that the principal justifies her evaluation to the agent if the evaluation indicates bad performance. The justification assures the agent that the principal has not distorted the evaluation downwards. In equilibrium, the wage increases in the agent's performance, when the principal justifies her evaluation. For good performance, however, the principal pays a constant high wage without justification.

Optimal Information Disclosure and Collusion

Andreas Asseuer

Session: Tue16-D

This paper studies optimal information disclosure under the threat of collusion. A principal seeks to procure a good from one of two agents who can collude against the principal. The first agent has a publicly known cost of production and the second agent's cost is his private information. The principal decides how much information the first agent receives about the costs of the second agent. In the choice of the optimal disclosure policy, the principal faces a trade-off: More information disclosure makes the elicitation of private information easier but facilitates collusion at the same time. It is optimal for the principal

to partially disclose information. Under the optimal information structure, none of the agents receives a positive information rent.

Collusion and Optimal Contract in a Hierarchy with Multiple Agents

Xiaogang Che

Session: Tue16-D

We analyze a principal-supervisor-multiple agent hierarchy, in which information is soft and the supervisor may make a mistake that observes a wrong signal on the agents' effort levels. The supervisor and the agents can collude against the principal. We show that supervision is still valuable in the hierarchy, and the principal sends the supervisor according to both the output level and the effectiveness of the supervision technology. More interestingly, the characterization of optimal contract involves two features that collusion-proof implementation is always optimal with low output. If, however, high output is realized, tolerating a certain scope of collusion between the supervisor and a subset of the agents to take place would be beneficial, as this can 'correct' potential mistakes from the supervisor and help in providing incentives to the agents.

Reward Schemes

David Lagziel and Ehud Lehrer

Session: Tue16-E

An investor has some funds invested through investment firms. She also has additional funds to allocate among these investment firms according to the firms' performance. While the investor tries to maximize her total expected earnings, each investment firm tries to maximize the overall amount of funds it will be allocated to manage. A reward scheme is a rule that determines how funds are to be allocated among the investment firms based on their past performance. A reward scheme is optimal if it induces the (self-interested) firms to act in accordance with the interests of the investor. We show that an optimal reward scheme exists under quite general conditions.

Pre-Distribution: Bargaining over Incentives with Endogenous Production

Andrzej Baranski

Session: Tue16-E

This article sets forth a model of multilateral negotiations with alternating offers and voting in which members bargain over the distribution of equity shares prior to engaging in joint production. We endogenize the origin of the fund to be divided among members of a group and analyze how the committee size, voting rule, and impatience of players affect total production via the equity agreements reached. We focus on the trade-off between rent-sharing and rent-generating incentives faced by bargaining partners, an aspect that is absent in the standard divide-the-dollar games but that is certainly present in multiple

economic settings.

How to apply penalties for avoiding delays in projects

Gustavo Bergantiños and Leticia Lorenzo

Session: Tue16-E

A planner wants to carry on a project involving several firms. In many cases the planner, for instance the Spanish Administration, includes in the contract with the firms some penalties to be paid by the firms in case the project is delayed. We discuss two ways of include penalties. In the first one penalties are applied only when the whole project is delayed. In the second one is applied always. We compare both. The optimal penalty (for the planner) is larger in the second one. The utility of the planner is always larger or equal in the second one. The utility of the firms is always larger or equal in the first one.

Random paths to exchange-stability

Azar Abizada

Session: Tue16-F

We study one-sided matching problem, also known as roommate problem, where a group of people need to be paired in order to be assigned to certain location. We assume that number of rooms are limited and thus no student can live by himself. Each student has strict preferences over only their roommates. Central notion in matching is stability. We consider exchange-stability of Alcalde

FutureMatch: Combining Human Value Judgments and Machine Learning to Match in Dynamic Environments

John P. Dickerson and Tuomas Sandholm

Session: Tue16-F

Motivated by our experience running the computational side of a large nationwide kidney exchange, we present FutureMatch, a framework for learning to match in a general dynamic model. FutureMatch takes as input a high-level objective decided on by experts, then automatically (i) learns based on data how to make this objective concrete and (ii) learns the “means” to accomplish this goal—a task, in our experience, that humans handle poorly. It learns the potentials of elements of the current input graph offline, translates these to weights, and performs a computationally feasible batch matching that incorporates dynamic, failure-aware considerations through the weights. We validate FutureMatch on real fielded kidney exchange data. It results in higher values of the objective. Furthermore, even under economically inefficient objectives that enforce equity, it yields better solutions for the efficient objective (which does not incorporate equity) than traditional myopic matching that uses the efficiency objective.

Ex-Ante Stable Lotteries Have Small Support

Jan Christoph Schlegel

Session: Tue16-F

We study the allocation of indivisible objects (e.g. school seats) by lotteries. Agents have preferences over different objects and have different priorities at different objects. For this model, a lottery is ex-ante stable if there does not exist an agent-object pair such that we can increase the probability of matching this pair at the expense of agents who have lower priority at the object and of objects which are less preferred by the agent. We show that ex-ante stable lotteries have small support. The number of pairs in the support depends on how many indifferences in the priorities the lottery exploits. In the extreme case where no object is matched with positive probability to two equal priority agents the lottery is almost degenerate. Otherwise the size of the support is determined by the number of equal priority agents that are matched to the respective objects.

A Unified Approach to Iterated Elimination Procedures in Strategic Games

Xiao Luo

Session: Tue16-G

We study the existence and uniqueness (or order independence) of iterated elimination procedure from a choice-theoretic viewpoint. We show a general existence result of iterated elimination procedure on an abstract reduction system. We identify a sufficient condition of “Monotonicity*” for the order independence and, in (in)finite games, we provide a full characterization of Monotonicity*. Our approach is applicable to any form of iterated elimination processes in arbitrary strategic games, e.g., iterated strict dominance, iterated weak dominance, rationalizability, etc. As a by-product, we offer a solution to Dufwenberg and Stegeman’s (2002) puzzle on order dependence of iterated strict dominance in infinite games.

Maximin Equilibrium: A Minimal Extension of Maximin Strategies

Mehmet Ismail

Session: Tue16-G

Maximin strategies disregard mutually beneficial or harmful situations in general, which relates to most economic interactions. To capture this, we introduce a new concept, maximin equilibrium, that extends the maximin strategy solution to non-strictly competitive games by incorporating individual rationality constraint—players would not harm others unless it’s in their self-interest. In particular, the maximin equilibrium value coincides with the minimax value in zero-sum games. We show that every finite game possesses a maximin equilibrium. As an example, maximin equilibrium selects the two Pareto dominant Nash equilibria in the battle of the sexes game; however, it may select a Pareto dominated solution such as the Nash equilibrium in the prisoner’s dilemma. Both

concepts may, nevertheless, give different predictions, as we illustrate in the so-called inheritance game.

Two-person Pairwise Solvable Games

Toshimasa Maruta, Takuya Iimura and Takahiro Watanabe

Session: Tue16-G

A game is solvable if the set of Nash equilibria is nonempty and interchangeable. A pairwise solvable game is a two-person symmetric game in which any restricted game generated by a pair of strategies is solvable. We show that the set of equilibria in a pairwise solvable game is interchangeable, that a pairwise solvable game is solvable if it is quasiconcave at the diagonal, and that if in addition the game is finite then an iterated elimination of weakly dominated strategies converges precisely to the set of all Nash equilibria. In particular, the game is dominance solvable. Applying these results to relative payoff games, we establish simultaneous existence of Nash equilibrium and evolutionary equilibrium in a class of pairwise solvable games. All the results are applicable to symmetric contests, such as the rent-seeking game and the rank-order tournament, which are shown to be pairwise solvable.

Repeated Games Revisited: An Ordinal Perspective

Yonatan Aumann and Erel Segal-Halevi

Session: Tue16-H

The existing repeated games models (e.g. limit-of-means, discounted sum, and overtaking) presume that the preferences in the repeated game are determined, in one way or another, by the sum of the utilities of the stage games. The utilities in the stage game, however, are von Neumann Morgenstern (NM) utilities, for which (we argue) the conceptual meaning of adding utilities across separate games is unclear. Furthermore, we show that by assuming such additive utilities the classic folk theorems fail to account for some natural equilibria. We develop an ordinal framework for the study of repeated games, using the players' preferences alone (without the additivity assumption). Within this framework, we establish the associated folk-theorem, which generalizes the classic ones. In particular, the generalized theorem establishes the existence of equilibria unaccounted for by the classic theorems.

Nash Equilibria in Reactive Strategies

Artem Baklanov

Session: Tue16-H

In this article we study the Nash equilibrium in infinitely repeated bimatrix games where payoffs are determined by reactive strategies; players payoff functions are defined as players benefits averaged over game rounds. Reactive strategies are stochastic 1-memory

strategies such that a probability of players actions depends only on the opponents preceding move. We provide a characterization of all Nash equilibria in the class of reactive strategies. Then we derive a characterization for all symmetric stage games admitting Nash equilibria in the class of reactive strategies. Obtained results are compared with the available ones for 1-memory strategies. Extensively using examples, we illustrate new effects connected with Nash equilibria in the class of reactive strategies.

On repeated zero-sum games with incomplete information and asymptotically bounded values

Fedor Sandomirskiy

Session: Tue16-H

We consider repeated zero-sum games with incomplete information on the side of Player 2 with the total payoff given by the non-normalized sum of stage gains. In the classical examples the value V_N of such N -stage game is of the order of N or square root of N for large N . We deal with another asymptotic behavior of V_N observed for the discrete version of the financial market model introduced by De Meyer and Saley. For this game Domansky and independently De Meyer with Marino found that V_N remains bounded as N tends to infinity. This game is almost-fair, i.e., if Player 1 forgets his private information the value becomes zero. We describe a class of almost-fair games having bounded values in terms of an easy-checkable “trigger” property of the auxiliary non-revealing game.

Evolutionary Competition between Adjustment Processes in Cournot Oligopoly: Instability and Complex Dynamics

Cars Hommes, Marius Ochea and Jan Tuinstra

Session: Tue16-J

We introduce evolutionary competition between adjustment processes in the Cournot oligopoly model. Our main focus is on rational play versus a general short-memory adaptive adjustment process. We find that, although rational play has a stabilizing influence, a sufficient increase in the number of firms in the market tends to make the Cournot-Nash equilibrium unstable. Moreover, the interaction between adjustment processes naturally leads to the emergence of complicated endogenous fluctuations as the number of firms increases, even when demand and costs are linear.

Evolution of Cournot and Bertrand Firms Under A Replicator Dynamic

Hsiao-Chi Chen and Yunshyong Chow

Session: Tue16-J

This paper investigates the evolution of Cournot and Bertrand firms in a replicator dynamic. At each time period, every firm is randomly matched with a Bertrand or a Cournot

firm to play a duopoly game. The distribution of Cournot and Bertrand firms is determined by their relative average profits. When homogeneous products are produced with identical cost, we find that Bertrand and Cournot firms will co-exist in the long run with Cournot firms being the majority. By contrast, if homogeneous products are produced by different costs, then both-type firms co-exist or only Cournot firms survive in the long run. When differentiated products are produced, both-type firms co-exist, Cournot firms survive alone, or Bertrand firms survive alone in the long run. For the co-existence equilibrium, the distribution of both-type firms will depend on the sizes of market demand, firms' marginal costs, and the product differentiation levels.

The Nonparametric Approach to Evolutionary Oligopoly

Hamed Markazi Moghadam

Session: Tue16-J

This paper presents a non-Walrasian equilibrium for an evolutionary model in the asymmetric oligopoly setup where firms have different cost functions to produce a homogeneous good. Then, using revealed preference approach introduced by Carvajal, Deb, Fenske, and Quah [Econometrica 2013], I derive the testable conditions of the evolutionary oligopoly model. Therefore, without making any parametric assumption regarding to the demand curve and the cost function, this approach characterizes a set of conditions (restrictions) on observational dataset to be consistent with the non-competitive evolutionary equilibrium. An empirical application to crude oil market with main producers is presented and I compare the rejection rates of both Cournot and evolutionary hypotheses.

Sophisticatedly Stable Equilibria in the Local Public Goods Game

Pter Bayer

Session: Tue16-K

We study heterogeneous player rationality in games on networks with strategic substitutes. In the local public good game we distinguish two types of players, myopic (one-shot optimizers), and sophisticated (long-run optimizers). Starting from a static equilibrium, the game advances in two ways: by the sophisticated players' deviations to progress the game into a state where they earn higher payoffs, and by the myopic players' reactions to the deviations. We call Nash equilibria with no possible profitable deviations sophisticatedly stable. We derive conditions of stability in some networks and find that only experts and free riders equilibria can be stable. Stable equilibria also conflict with principles of stability and equality.

Efficiency in a forced contribution threshold public good game

Anna Stepanova and Edward Cartwright

Session: Tue16-K

We contrast and compare three ways of predicting efficiency in a forced contribution threshold public good game. The three alternatives are based on ordinal potential, quantal response and impulse balance theory. We report an experiment designed to test the respective predictions and find that impulse balance gives the best predictions. A simple expression detailing when enforced contributions result in high or low efficiency is provided.

Existence of Share Equilibrium in Symmetric Local Public Good Economies

Anne Van Den Nouweland and Myrna Wooders

Session: Tue16-K

Share equilibrium was introduced in van den Nouweland and Wooders (2011) as an extension of ratio equilibrium to local public good economies. In that paper, we took an axiomatic approach to motivate share equilibrium. In the current paper we consider questions related to the existence of share equilibrium and we derive a necessary and sufficient condition for the existence of share equilibrium in symmetric economies. Along the way, we develop a deeper understanding of the possible variation in share equilibrium by considering when symmetric players necessarily have the same share indices in equilibrium.

Harnessing Beliefs to Stimulate Efforts

Marco Serena

Session: Tue16-L

A contestant's effort depends on her knowledge of her rival's type. This knowledge is often limited in real-life contests. I propose a model where the principal of a contest has commitment power to verifiably disclose contestants' types. What is the optimal disclosure policy to stimulate contestants' efforts? Full disclosure spurs more (less) efforts than full concealment if the distribution of types is skewed towards high (low) types. However, the optimal disclosure policy is a particular partial disclosure, regardless of the skewness of the distribution of types; it consists in disclosing the signal which is best for the principal (i.e., all contestants are high types) and concealing the rest.

A contest success function for networks

Irem Bozbay and Alberto Vesperoni

Session: Tue16-L

This paper models conflict as a contest within a network of friendships and enmities. We assume that each player is either in a friendly or in an antagonistic relation with every other player and players compete for a fixed prize by exerting costly efforts. We

axiomatically characterize a success function which determines the share of each player given the efforts and the network of relations. This framework allows for the study of strategic incentives and friendship formation under conflict as well as the application of stability concepts of network theory to contests.

Equivalence in multi-winner contest mechanisms: An experiment

Subhasish Modak-Chowdhury, Anwesha Mukherjee and Theodore Turocy

Session: Tue16-L

Economic contests describe situations in which a group of individuals incur irretrievable expenditure of costly resources to win valuable rewards. We consider contests with more than one winning positions where any individual contestant can win at most one position. Different mechanisms have been suggested in theory for selecting the final set of winners from a larger set of contestants. However, no applied study is known of to experimentally validate those theoretical predictions so far. We consider three such mechanisms which are best-response equivalent and implement them in the laboratory using a lottery metaphor and a novel feedback. We find the data supporting the mathematical equivalence of the three mechanisms. Lastly, the observed bidding behaviour in the multi-winner contest mechanisms are compared with that from a standard single-winner Tullock contest with comparable equilibrium prediction. We find the simultaneous multi-winner contest success function to be behaviourally robust.

The sender-payoff approach to signaling and the informed-principal problem

Tymofiy Mylovanov

Session: Tue16-M

We propose a new approach to analyzing signaling games that is particularly useful if the signal space is large. Applications include informed principal problems in which a privately informed party can design any mechanism or can choose a mechanism from a restricted, but large set. Our approach has two main ingredients: sender-payoff reduced form and separation of on and off path analysis. We represent signals (mechanisms, contracts) in terms of correspondences that for each belief about the senders private information describe the set of senders equilibrium payoffs. We introduce a notion of composition to describe on-path equilibrium conditions and a notion of admissibility to describe off-path equilibrium conditions. Our main result is a criterion for a senders payoff to be admissible. We show that virtually all known equilibrium constructions in the literature on the informed-principal problem are applications of our criterion.

Multi-stage unmediated communication in a sender-receiver model

Yi Chen, Maria Goltsman, Johannes Horner and Gregory Pavlov

Session: Tue16-M

The sender, who has private information about the state of the world, and the receiver, who has to take an action, engage in a multi-stage face-to-face cheap talk. For the case of intermediate sender bias, we construct a new class of equilibria that result in higher ex ante payoffs of the players than the equilibria that are known in the literature. The information is revealed gradually in equilibrium, and at every stage there is a positive chance that the communication ends. We show that the greater the number of communication stages in equilibrium, the higher are the players' payoffs that can be achieved in equilibria of this class. We also characterize the structure of equilibria and the payoffs in the limiting case as the number of communication stages increases without bound.

Slightly Biased Communication

Francesco D'Ilme

Session: Tue16-M

This paper analyzes strategic communication between a sender and a receiver when their conflict of interest is small. In this instance, communication is smooth: the sender chooses close messages for close states of the world. Equilibrium strategies can be approximated by simple differential equations, allowing a neat visualization of how the payoff structure shapes communication. In particular, we characterize how the distribution of states influences the precision of the information transmission and which changes in the (state-dependent) bias improve communication.

A “marginalist” model of network formation

Norma Olaizola and Federico Valenciano

Session: Tue16-N

We provide a model of network-formation where the quality of a link depends on the amount invested in it and is determined by a link-formation “technology”, an increasing strictly concave function which is the only exogenous ingredient. The revenue from the investments is the information received through the network. First, assuming that the investments are made by a planner, the basic question is that of the efficient investments, either relative to a given infrastructure or in absolute terms. An “almost” complete characterization is achieved, being instrumental for this a class of core-periphery hybrid star-complete structure of which the star and complete networks are extreme cases. Second, assuming that links are the result of investments of the nodes, there is the question of stability in the network-formation game, either restricted to a given infrastructure or unrestricted. Stable complete and star networks are characterized, and examples of stable hybrid core-periphery networks provided.

Bidding for network size

Renaud Foucart and Jana Friedrichsen

Session: Tue16-N

We study two platforms that compete for users in providing additional functionalities on their networks. The stand alone values are identical for both platforms but the marginal utility from network size depends on functionality. We assume that, at the beginning of the game, both platforms have an exogenously given installed base of users. These old users incur switching costs if choosing another platform. New users have not used either platform and can choose freely. We find that, in equilibrium, platforms do not choose their functionality deterministically but randomize over two disconnected intervals. These correspond to competing for either the entire population or only new users. The value of remaining passive and not improving functionality depends on a platform's installed base. The platform with the smallest base bids more aggressively to compensate for its lower outside option and achieves a monopoly network with higher probability than its competitor.

Incentive Compatible Networks and the Delegated Networking Principle

Rui Gong, Jieshuang He and Frank Page

Session: Tue16-N

We consider a principal-agent game of network formation with asymmetric information and we address the following questions: (1) Is it possible for the principal to design a mechanism that links the reports of agents about their private information and the set of connections allowed and recommended by the principal so that players truthfully reveal their private information and follow the recommendations specified by the mechanism. (2) Is it possible for the principal to achieve the same outcome by instead choosing a profile of catalogs of allowable ways to connect and then delegating connection choices to each pair of agents. We call this approach to network formation delegated networking and we show, under relatively mild conditions on our game-theoretic model of network formation, that strategic network formation with incomplete information, implemented via a mechanism and centralized reporting is equivalent to implementation via delegated networking with monitoring.

Doing it when others do: a strategic model of procrastination

Claudia Cerrone

Session: Tue16-P

Many activities we tend to procrastinate, we prefer to do with others. In this paper, I develop a strategic model of procrastination in which present-biased people faced with an onerous task prefer to do it when someone else does. This turns their decision of

when to do the task into a procrastination game – a dynamic coordination game between present-biased players. The model characterises the conditions under which interaction mitigates or exacerbates procrastination. Interestingly, a procrastinator matched with a worse procrastinator may do her task earlier than she otherwise would, so as to avoid the increased temptation that her peer’s company would generate. Procrastinators can thus use bad company as a commitment device to mitigate their self-control problem. Principals can improve people’s welfare and reduce inefficient delay by simply matching them with each other, but who is matched with whom matters, and the efficient matching is not always stable.

Gratification and flourishing: well-being in interaction

Aviad Heifetz and Enrico Minelli

Session: Tue16-P

A long tradition of thought identifies two distinct but inter-related dimensions of well being - gratification and flourishing. Relying on insights from relational psychoanalytic theory, we devise a modeling approach based on an analogy with electric circuits, where gratification is represented by electric current and flourishing by electric power. We explore how the latter is influenced non-monotonically by challenges and their perceived values, as represented in the model by loads and resistance. Further psychoanalytic conceptualizations suggest how to extend the electric circuits metaphor for modeling mutual influence among related individuals. This extension gives rise to a definition of a social equilibrium. We prove existence, and show that there might exist ‘flourishing traps’ - social equilibria dominated by other social equilibria with enhanced flourishing for everybody and with no decrease in gratification. We discuss how ‘flourishing traps’ differ from classical coordination failures, and the implied nature of guidance for public policy.

Cognition and Rationality

Adam Brandenburger, Amanda Friedenberg, Terri Kneeland and Willemien Kets

Session: Tue16-Q

Limited reasoning about rationality is well understood to lead to important behavioral consequences. The literature has typically viewed such limited reasoning as an artifact of cognitive bounds - loosely, an inability to reason about how other players reason, etc. However, subjects may not be willing to believe their opponent is “rational, believes rationality, etc” even if the subject is capable of reasoning in this way. In this paper, we allow for the possibility that a subject’s rationality bound may be lower than her cognitive bound: so two subjects with the same cognitive bound may have different rationality bounds. We develop an identification strategy that allows us to investigate the extent to which bounds on rationality are driven by bounds on cognition. We analyze the experimental data from Kneeland (2015). Our results show that rationality bounds are tighter

than cognitive bound, especially for subjects whose cognitive bounds are not binding.

Non-Equilibrium Play in Centipede Games

Bernardo García-Pola, Nagore Iriberri and Jaromir Kovarik

Session: Tue16-Q

Centipede games represent a classic example of a strategic situation, where the unique theoretical prediction is at odds with human behavior. This study is explicitly designed to discriminate among the proposed explanations for initial responses in Centipede games. Using multiple and different Centipede games, our approach determines endogenously whether one or more explanations are empirically plausible. We find that non-equilibrium behavior is too heterogeneous to be explained by one unique model. However, most non-equilibrium choices can be fully explained by level-k thinking and quantal response equilibrium, roughly in equal proportions. Preference-based models play negligible role in explaining the non-equilibrium play.

Wimbledon Revisited

Romain Gauriot, Lionel Page and John Wooders

Session: Tue16-Q

Minimax and its generalization to mixed strategy Nash equilibrium is the cornerstone of our understanding of strategic situations that require decision makers to be unpredictable. We examine whether the behavior of professional tennis players is consistent with the minimax hypothesis, using a dataset of approximately half a million serves from over 3000 matches. The large number of matches in our dataset necessitates the development of a novel statistical test, which we show is more powerful than the tests used in prior studies. We find that win rates conform remarkably closely to theory for males, but conform far less closely for females. Both males and females exhibit serial correlation in the direction of the serve, but males exhibit less serial correlation than females, and higher-ranked males exhibit less correlation than lower-ranked males.

The Subgame Perfect Core

Parkash Chander and Myrna Wooders

Session: Tue16-R

We propose a cooperative solution concept for games in extensive form that incorporates both cooperation and subgame perfection. The new concept, which we label the subgame-perfect core, is a refinement of the core of an extensive game in the same sense as the set of subgame-perfect Nash equilibria is a refinement of the set of Nash equilibria. Also, the subgame-perfect core can be obtained as a subgame-perfect Nash equilibrium of a modified game. We establish several properties of the subgame-perfect core and demonstrate its applicability by studying three applications: the centipede game, the two-player

infinite bargaining game of alternating offers, and a dynamic game of climate change. In addition, we motivate and introduce a concept of subgame-perfect strong Nash equilibrium of an extensive game and show that it is coalition proof.

Games in partition function form with restricted cooperation

Fanni Bobák and Zsolt Udvari

Session: Tue16-R

In this paper we consider coalition formation in the presence of externalities and restricted cooperation. Previous papers in the literature define various solution concepts for games in partition function form (PFF), see Myerson (1977b), Bloch (1996) and Kóczy (2007,2009) among others. However, up to our knowledge there is no paper about PFF games with restricted cooperation. The case of restricted cooperation is the one when some coalitions cannot be formed. There are numerous examples for restricted cooperation in politics, economic theory and industrial organizations. In this paper we introduce the notion of PFF games with restricted cooperation, and the concept of the recursive core (Kóczy,2007) of PFF games with restricted cooperation, and discuss its properties. We also provide an example for a possible empirical application of our model.

Existence of a Unique Core Partition in Coalition Formation Games

Hakan Inal

Session: Tue16-R

In coalition formation games with arbitrary collection of permissible coalitions, a condition on preference profiles is sufficient for the existence of a unique core partition, strengthening uniqueness results both in Pycia (2012) and in Banerjee, Konishi, and Sonmez (2001). An algorithm is presented for finding the unique core partition when preference profiles satisfy that condition. The algorithm terminates after a finite number of iterations bounded by the number of agents.

Manipulated Electorates and Information Aggregation

Stephan Lauermaann and Mehmet Ekmekci

Session: Tue16-S

We study information aggregation with a biased election organizer who recruits voters at some cost. Voters are symmetric ex-ante and prefer policy a in state A and policy b in state B, but the organizer prefers policy a regardless of the state. Each recruited voter observes a private signal about the unknown state but does not learn the size of the electorate. In contrast to existing results for large elections, there are equilibria in which information aggregation fails: As the voter recruitment cost vanishes, the organizer can ensure that policy a is implemented independently of the state.

Information aggregation with multiple issues and continuum of types

Irem Bozbay and Hans Peters

Session: Tue16-S

We consider a simple judgment aggregation problem where a group of voters wants to make collective judgments over multiple issues. Voters share a preference for true collective judgments but hold private information in the form of types. Departing from the previous literature where a voters private information takes a binary value (true or false) for each issue, we assume that types are distributed from a state- dependent continuous distribution. We analyse efficient information aggregation and strategic voting in a Bayesian voting game setting. In contrast to the results when types take binary values for each issue, we find that with continuum of types efficient information aggregation is possible only under a strong condition which leads to the continuous analogue of the binary model.

A Generalisation of Feddersen and Pesendorfer (1998): Voting Under Ambiguity

Addison Pan

Session: Tue16-S

The well-known jury paradox – the more demanding the hurdle for conviction is, the more likely it is that a jury will convict an innocent defendant – heavily relies on Bayesian updating. However, with ambiguous information (e.g., a forensic test with accuracy of 60%, or more), standard Bayesian updating becomes invalid, challenging the existence of this paradox. By developing a novel theoretical model of voting under ambiguity, this study advances our understanding of how individuals process more realistically imprecise measures of information reliability and how this impacts on information aggregation for the group decision-making. Hence, our findings inform the institutional design of collective deliberation, for small to large group decision-making.

Claims-separable consistency and potential for claims problems

M. Josune Albizuri and J. Carlos Santos

Session: Tue16-T

In this paper we introduce an axiom, referred to as claims-separable consistency, that is satisfied by several classical division rules defined for claims problems. We determine the entire family of division rules that satisfy this new axiom. We introduce the concept of potential for claims problems and we relate it to claims-separable consistency. In addition, we use claims-separable consistency to characterize axiomatically the minimal overlap rule given by O'Neill (1982).

Weak necessary players, Myerson fairness and the concept of equality

Florian Navarro

Session: Tue16-T

This article addresses linear sharing rules on TU-games with various structures, namely communication structures and conference structures as defined by Myerson in two papers (1977, 1980). Using matrix expressions, we rewrite those sharing rules. That presentation makes it possible to identify the tight relationship between the fairness property and a weak necessary players axiom. Moreover, we show that the latter is implied by the equal treatment of equals, linking the fairness property to the notion of equality.

Efficiency and fairness in claims problems under uncertainty

Jingyi Xue

Session: Tue16-T

We study the division of limited resources among agents with uncertain needs. The division must be made before uncertainty resolves. Waste is inevitable whenever the allocated amount exceeds the realized demand. An efficient rule minimizes the expected waste induced by an allocation. An egalitarian rule minimizes the gaps of the induced individual welfare. In general, efficiency and fairness are conflicted. We propose an axiom, No Possible Improvement, which should be respected by a planner with both concerns. It asks that no other allocation yields less expected waste than the selected one, and meanwhile achieves smaller gaps of individual welfare. We characterize the family of balanced rules satisfying No Possible Improvement, Recourse Monotonicity and Consistency. The balanced rules accommodate both criteria to some extent, with the two extreme cases being exactly the efficient rule and egalitarian rule. We also characterize the subclass of rules with linear trade-off between efficiency and fairness.

Auctions with External Incentives: Experimental Evidence

Miguel Fonseca, Francesco Giovannoni and Miltiadis Makris

Session: Tue16-U

We consider auctions where bidders have external incentives and focus on the case where their valuations in the auction are positively correlated with their productivity which matters in a second stage job market. We study how this affects bidding behavior and wages in the job market and proceed to test the model's implication in an experiment where treatments differ according to which bids are disclosed. Our results broadly confirm the theoretical prediction that bidders tend to overbid, and their bidding behavior and wages are influenced by the disclosure rule. The data also suggests that the dispersion in worker wages is affected by the disclosure rule, suggesting the importance of reputational bidding.

Would Depositors pay to show that they do not withdraw? Theory and Experiment

Markus Kinaterer, Hubert Kiss and Ágnes Pintér

Session: Tue16-U

In a Diamond-Dybvig model of financial intermediation, we study how decision making changes if depositors can reveal at a cost to subsequent depositors that they keep their funds in the bank. Theoretically, without signaling, multiple equilibria exist, while under signaling, the unique equilibrium outcome is no bank run. We test the theoretical predictions in a lab experiment and find that indeed when signaling is available, bank runs are less likely to arise though, contrary to our theoretical predictions, signaling is extensively used.

Selling Money on eBay: A Field Test for Social Preferences

Olga Gorelkina and Alia Gizatulina

Session: Tue16-U

To measure the prevalence of social preferences in a competitive environment, we conduct a natural field experiment on German eBay. Acting as a seller, we offer Amazon gift cards with values from 5 to 500 euros. The randomly arriving buyers, unaware of the experiment, make us price offers according to the platforms rules. Using a novel estimation technique, we extract the underlying distribution of proposed sharing rules from the observed distribution of offers. Once we net out the effect of competition this way, we observe that the prevalence of social preferences in the field is comparable to the laboratory. We obtain three additional results: (i) the amount of money at stake has no significant effect on offers; (ii) the subjects make poor use of public information; (iii) the behaviour of East and West German subjects follows two separate patterns, likely due to the remaining cultural differences.

Asymptotic Value of Dynamic Games

Sylvain Sorin

Session: Tue18-vNeu

Long term strategic interactions in a stationary environment have usually been modeled as repeated games. At each stage of the process, the moves of the players determine the joint law of the new state and signals to the players and a stage-specific payoff. An evaluation that assigns a (for example, discounted) weight to each stage induces a total weighted payoff, hence a game, with a value that depends on the evaluation. Longer games, when the duration associated to the evaluation increases, correspond to vanishing stage weight, and the associated limit of the game values is the asymptotic value. We will describe recent advances involving new approaches and results (including cases of existence and non-existence of the limit). Another alternative approach for studying

multistage interactions considers a continuous time process that the players observe and control at discrete times, corresponding to a partition. The asymptotic approach is the analysis of the game as the mesh of the partition decreases, thus with vanishing stage duration. We will present new developments in this direction and discuss the relation with differential games or more generally games in continuous time. In both frameworks the main tool is the recursive structure and the associate operator that extend the initial Shapley formula for finite discounted stochastic games.

The Menu-Size Complexity of Revenue Approximation

Moshe Babaioff, Yannai A. Gonczarowski and Noam Nisan

Session: Wed9-A

We consider a monopolist selling n items to a single additive buyer, where the buyer's values for the items are drawn according to independent distributions $F_1, F_2, \dots, F_n$ that possibly have unbounded support. It is well known that - unlike in the single item case - the revenue-optimal auction may be complex, sometimes requiring a continuum of menu entries. It is also known that simple auctions can extract a constant fraction of the optimal revenue. Nonetheless, the question of the possibility to extract an arbitrarily high fraction of the optimal revenue via a finite menu size remained open. In this paper, we give an affirmative answer to this open question, showing that for every n and for every $\epsilon > 0$, there exists a complexity bound $C = C(n, \epsilon)$ such that auctions of menu size at most C suffice for attaining a $(1 - \epsilon)$ fraction of the optimal revenue. We prove upper and lower bounds on $C(n, \epsilon)$.

Balanced Ranking Mechanisms

Debasis Mishra and Tridib Sharma

Session: Wed9-A

In the private values single object auction model, we construct a satisfactory mechanism - a symmetric, dominant strategy incentive compatible, and budget-balanced mechanism. Our mechanism allocates the object to the highest valued agent with at least 99% probability provided there are at least 14 agents. It is also ex-post individually rational. We also show that this mechanism is optimal in a restricted class of satisfactory ranking mechanisms. Our mechanism coincides with the well-known mechanism of Green and Laont when there are no more than 8 agents, and modifies it for higher number of agents.

Auctions vs. Fixed Pricing: Competing for Budget Constrained Buyers

Cemil Selcuk

Session: Wed9-A

We investigate price mechanism selection in a setting where sellers compete for budget constrained buyers by adopting either fixed pricing or auctions (first or second price). We

show that first and second price auctions are payoff equivalent when some bidders are financially constrained, so sellers are indifferent to adopt either format. We fully characterize possible equilibria and show that if the budget is high, then sellers compete via fixed pricing, if it is low then they compete via auctions, and if it is moderate then they mix, so both mechanisms coexist. The budget constraint becomes less binding if sellers use entry fees. Interestingly an improvement of the budget—e.g. letting customers pay in installments—may lead to fewer trades and a loss of efficiency.

Buyer-Optimal Demand and Monopoly Pricing

Daniele Condorelli and Balazs Szentes

Session: Wed9-B

This paper analyzes a bilateral trade model where the buyer can choose any cumulative distribution function (CDF) supported on $[0; 1]$, which then determines her valuation. The seller, after observing the buyer's choice of the CDF but not its realization, gives a take-it-or-leave-it offer to the buyer. We characterize the unique equilibrium outcome of this game and show that in this outcome, the price and the payoffs of both the buyer and the seller are equal to $1/e$. The equilibrium CDF of the buyer generates a unit-elastic demand on $[1/e; 1]$.

Monopoly Pricing with Dual Capacity Constraints

Robert Somogyi

Session: Wed9-B

This paper studies the price-setting behavior of a monopoly facing two capacity constraints: one on the number of consumers it can serve, the other on the total amount of products it can sell. Facing two consumer groups that differ in their demands and the distribution of their willingness-to-pay, the monopoly's optimal non-linear pricing strategy consists of offering one or two price-quantity bundles. The characterization of the firm's optimal pricing as a function of its two capacities reveals a rich structure that also gives rise to some surprising results. In particular, I show that prices are non-monotonic in capacity levels. Moreover, there always exists a range of parameters in which weakening one of the capacity constraints decreases consumer surplus. In the long run, when the firm can choose how much capacity to build, prices and consumer surplus are monotonic in capacity costs.

Dynamic Demand and Sequential Monopoly: A Model of Endogenous Screening

V Bhaskar and Nikita Roketskiy

Session: Wed9-B

We analyze a model in which the consumer's flow utility depends on past and current

consumption, and the utility function is either strictly submodular or strictly supermodular. Suppliers are small, so that each interacts with the consumer only at one date, but search frictions give rise to monopoly power, and firms offer non-linear prices. Consumers have identical preferences so that differences in taste only arise due to differences in past consumption. When firms observe past consumption, they induce excessive (resp. insufficient) consumption when utility is submodular (resp. supermodular). If past consumption is unobservable to the firm, a pure strategy equilibrium fails to exist. In the two-period version of the model, we prove the existence and uniqueness of a mixed strategy equilibrium that gives rise to a distribution of period-one consumptions. Consumers are better off when past consumption is unobservable. We also present some results for the infinite horizon model.

Optimal Two-part Tariff Licensing for Incumbent Innovator in Differentiated Product Markets

Tatsuya Kitagawa, Yasushi Masuda and Masashi Umezawa

Session: Wed9-C

We investigate a two-part tariff licensing contract that enables an incumbent innovator to license the technology for a new product to a potential rival, who may alternatively develop a compatible technology for an imperfectly substitutable product. We identify the optimal two-part tariff licensing contract based on the development cost incurred by the rival, the market parameter, and the substitution coefficient.

The Market for Surprises: Selling Substitute Goods through Lotteries

Filippo Balestrieri, Sergei Izmalkov and Joao Leao

Session: Wed9-C

We solve the revenue maximization problem of a monopolist selling substitute products. We consider a Hotelling model with two horizontally differentiated goods located at the segment endpoints. Consumers are uniformly distributed and their valuations for each good are equal to base-consumption value minus distance costs. We consider different distance cost functions: linear, concave, and convex. When base-consumption value is high, the seller maximizes her expected profit by offering a menu of base and opaque goods. A continuum of type-specific opaque goods is optimal under convex costs, whereas a single half-half lottery over base goods is optimal under concave and linear costs. When base-consumption value is low, only base goods are sold. When base-consumption value is intermediate, the optimal mechanism may entail lotteries with positive probability of no delivery. Our findings can explain the emergence of opaque goods sales as the outcome of some industries search for the optimal selling scheme.

The Recommendation Effect of Niche Products - How Consumer Learning in a Hotelling Framework Leads to Differentiation

Michael Kramm and Maximilian Conze

Session: Wed9-C

The recommendation effect introduces a new rationale for product differentiation other than the usual motivation to reduce price competition. We introduce consumer learning in a version of Hotelling's model (1929) with sequential consumer purchases and a second dimension of variation, quality, about which the consumers have differential information. Due to consumer learning, firms are confronted with two offsetting effects: differentiation decreases the likelihood that a product is bought in earlier periods, but, by making inference more valuable, it also increases the likelihood that later consumers buy the differentiated good.

Mediated Audits

Martin Pollrich

Session: Wed9-D

I study optimal contracting between a principal and an agent. Via an audit the principal can verify the agent's private information after the contract was executed, but cannot contractually commit to do so. Optimal contracting requires sophisticated communication. The privately informed agent reports her information to a mediator. The mediator draws a contract at random and recommends the principal whether to audit. Using a mediator allows for finetuning information transmission. All private information is revealed to the mediator, but the principal receives only as much information as is required to persuade her to audit. Simple communication, where the agent sends a message directly to the principal is typically not optimal. I characterize optimal mediated contracts, and provide comparative statics as regards to when audits are used, which distortions are imposed, and the minimal number of contracts. Additionally, I provide a lower bound on the principal's loss of using suboptimal communication.

Costly Verification in Collective Decisions

Albin Erlanson and Andreas Kleiner

Session: Wed9-D

We study how a principal should optimally choose between implementing a new policy and keeping status quo when the information relevant for the decision is privately held by agents. Agents are strategic in revealing their information, but the principal can verify an agent's information at a given cost. We exclude monetary transfers. When is it worthwhile for the principal to incur the cost and learn an agent's information? We characterize the mechanism that maximizes the expected utility of the principal. This mechanism can be implemented as a weighted majority voting rule, where agents are given additional

weight if they provide evidence about their information. The evidence is verified whenever it is decisive for the principal's decision. Additionally, we find a general equivalence between Bayesian and ex-post incentive compatible mechanisms in this setting.

Optimal project termination with an informed agent

Erik Madsen

Session: Wed9-D

Economic decision-makers must commonly decide when to terminate temporary projects which are monitored imperfectly over time. I analyze the provision of dynamic incentives in an agent-assisted version of this problem. A firm must decide when to halt a project which yields a stochastic profit flow but eventually becomes unprofitable; the firm is aided by an agent with private information about the project's state, limited liability, and incentives for delayed project termination. I develop techniques for solving the resulting novel mechanism design problem, which features noisy verification of reports and limited transfers. The firm's optimal contract involves occasional inefficient early project termination but no late termination, a golden parachute which declines with proximity to termination, and soft deadlines exhibiting asymmetric sensitivity to news close to and far from termination.

Nontransferable utility bankruptcy games

Arantza Estevez Fernandez, Peter Borm and M. Gloria Fiestras-Janeiro

Session: Wed9-E

In this paper, we analyze bankruptcy problems with nontransferable utility (NTU) from a game theoretical perspective by redefining corresponding NTU-bankruptcy games in a tailor-made way. It is shown that NTU-bankruptcy games are both coalitional merge convex and ordinal convex. Generalizing the notions of core cover and compromise stability for transferable utility (TU) games to NTU-games, we also show that each NTU-bankruptcy game is compromise stable. Thus, NTU-bankruptcy games are shown to retain the two characterizing properties of TU-bankruptcy games: convexity and compromise stability. As a first example of a game theoretical NTU-bankruptcy rule, we analyze the NTU-adjusted proportional rule and show that this rule corresponds to the compromise value of NTU-bankruptcy games.

Divide and Choose: A strategic approach to bankruptcy problems

Jiawen Li and Yuan Ju

Session: Wed9-E

This paper proposes a simple and general strategic approach for analyzing bankruptcy problems. We construct three strategic bargaining games and show that they yield unique subgame perfect equilibrium(SPE) outcomes that coincides with the allocations given by

the three prominent solution concepts, the constrained equal awards rule, the constrained equal losses rule and the Talmud rule, respectively. Moreover, we study the variations of these games for alternative solutions for bankruptcy problems as well as surplus sharing problems. We also discuss the robustness of the result in the presence of certain incomplete information. Center to all these bargaining protocols is an extended and context-fitting divide-and-choose mechanism.

A bankrupt approach to solutions of TU Games

Genjiu Xu, Cuiying Zhu, Jun Su and Hao Sun

Session: Wed9-E

We discuss the relationship between a TU game and a bankruptcy problem, and show how the bankrupt idea can give the solutions of cooperative games a new interpretation. In cooperative games, the players aim to get greater payoffs (or save more cost). Each player has an expected payoff after they get the worth of the grand coalition through cooperation. If the sum of their expectation exceeds the worth of the grand coalition, the game generates a bankruptcy problem. If the bankruptcy rules of the generated bankruptcy problem coincide with the solutions of the original game, we give the bankrupt interpretation for the solutions of the game. Our main contribution is thus to define the generated bankruptcy problem and explore the relations between the solutions of a TU game and the bankruptcy rules of the generated bankruptcy problem.

Static versus Dynamic Deferred Acceptance in School Choice: A Laboratory Experiment

Joana Pais, Flip Klijn and Marc Vorsatz

Session: Wed9-F

In the context of school choice, we experimentally study how behaviour and outcomes are affected when, instead of submitting rankings to the proposing or the receiving deferred acceptance mechanism (DA), participants make decisions dynamically, going through the steps of each DA. Our main results show that, (a) in the proposing DA, where it is a weakly dominant strategy to act according to the true preferences, participants switch slightly less while, (b) in the receiving DA, participants truncate more in the dynamic versions of the mechanisms than in the corresponding static versions. As a consequence, for most markets we test, no significant differences exist among the two versions of the proposing DA in what stability and average payoffs are concerned, but the dynamic version of the receiving DA delivers a clear improvement over its static counterpart on both dimensions.

What you don't know can help you in school assignment

Thayer Morrill and Umut Dur

Session: Wed9-F

It is well known that it is impossible for a strategyproof mechanism to Pareto dominate the celebrated Deferred Acceptance algorithm. However, it is unknown whether a mechanism can Pareto dominate DA in equilibrium when students play weakly undominated strategies. We demonstrate that a mechanism designer can do better by learning less about students preferences when making a school assignment. Specifically, we demonstrate that running DA but limiting students to only two applications always has an equilibrium in weakly undominated pure strategies that Pareto dominates DA. We also show that no mechanism that tries to Pareto improve DA directly has this property: no mechanism that Pareto improves DA with respect to submitted preferences actually Pareto improves DA in equilibrium. Finally, we introduce a new algorithm, Application with Automatic Appeals, and demonstrate that it also dominates DA in equilibrium. Unlike the 2-school DA, the Application with Automatic Appeals is nonwasteful.

Truncated Leximin Solutions

Bram Driesen

Session: Wed9-G

This paper shows that three classic properties for bargaining solutions in an environment with a variable number of agents - Anonymity, Individual Monotonicity and Consistency - characterize a one-parameter class of Truncated Leximin solutions. Given a positive and possibly infinite α , a Truncated Leximin solution gives each agent the minimum of α and their Leximin solution payoff.

The Distribution of Optimal Strategies in Symmetric Zero-sum Games

Florian Brandl

Session: Wed9-G

Given a skew-symmetric matrix, the corresponding two-player symmetric zero-sum game is defined as follows: one player, the row player, picks a row and the other player, the column player, picks a column. The payoff of the column player is given by the corresponding matrix entry, the row player receives the negative of the column player. A randomized strategy is optimal for the column player if it guarantees an expected payoff of at least 0 independently of the strategy of the row player. We determine the probability that an optimal strategy for the column player randomizes over exactly k columns when the payoffs of the game are i.i.d. random variables that are symmetric around 0 and the game almost surely admits a unique optimal strategy. Our result has consequences for subclasses of symmetric zero-sum games and implies a result by Fisher and Reeves (1995) on tournament games.

An Ordinal Minimax Theorem

Felix Brandt, Markus Brill and Warut Suksompong

Session: Wed9-G

In the early 1950s Lloyd Shapley proposed an ordinal and set-valued solution concept for zero-sum games called weak saddle. We show that all weak saddles of a given zero-sum game are interchangeable and equivalent. As a consequence, every such game possesses a unique set-based value.

Partially-honest Nash implementation with non-connected honesty standards

Naoki Yoshihara and Michele Lombardi

Session: Wed9-H

An individual may display an honesty standard which allows her to lie a little without that being harmful to her self view as an honest person. An individual honesty standard is modeled as a subgroup of the society, including the individual herself. A partially-honest individual is an individual who strictly prefers to tell the truth prescribed by her honesty standard whenever lying has no exact effect on her material well-being. The paper studies the impact of placing honesty standard restrictions on the mechanism designer for Nash implementation problems of that society. It generates and shows that in an independent domain of preferences that condition is equivalent to Maskin-monotonicity, provided that honesty standards of society are non-connected. They are non-connected if every individual is excluded from the honesty standard of another individual.

Implementation in partial equilibrium

Michele Lombardi

Session: Wed9-H

In a partial equilibrium (PE) mechanism a sector authority (SA) aims to elicit agents' preference rankings for outcomes at hand, presuming separability of preferences, while such presumption is false in general. Therefore, its participants are required to behave as if they had separable preferences. This paper studies what can be Nash implemented if we take such misspecification of PE analysis as a given institutional constraint. The objective is to uncover the kinds of complementarity across sectors that this institutional constraint is able to accommodate. Thus, in our implementation model there are several SAs, agents are constrained to submit their rankings to each SA separately and, moreover, SAs cannot communicate with each other. When a social choice rule (SCR) can be Nash implemented by a product set of PE mechanisms, we say that it can be Nash implemented in PE. We identify necessary conditions and sufficient conditions

An Outcome Mechanism for Partially Honest Nash Implementation

Makoto Hagiwara, Hirofumi Yamamura and Takehiko Yamato

Session: Wed9-H

Dutta and Sen(2012) show that if there exists at least one partially honest agent, then no veto power is sufficient for partially honest implementation in Nash equilibria. Also, Kimya(2015) shows that if there are at least two partially honest agents, then unanimity is sufficient for partially honest implementation in Nash equilibria. While in Dutta and Sen(2012)'s mechanism and Kimya(2015)'s mechanism, each agent reports a preference profile, an outcome, and a positive integer, it is in fact unnecessary to ask agents to reveal a preference profile. We introduce an outcome mechanism in which each agent only reports an outcome and a positive integer from 1 to n . We show that the results of Dutta and Sen(2012) and Kimya(2015) are still valid by our mechanism with a smaller strategy space.

Approximation of Generalized Nash Equilibria by Means of Evolutionary Computation

Nomi Gaskó, Rodica Ioana Lung and Mihai Suciu

Session: Wed9-J

Generalized Nash Equilibrium (GNE) is an extension of the Nash equilibrium with extensive uses in real-world applications. Several numerical methods that compute this equilibrium exist, but very few computational ones capable do deal with large number of players. This paper explores the possibility of using an evolutionary algorithm for GNE approximation, based on differential evolution, and capable to compute several equilibria in a single run. Numerical experiments are used to illustrate the potential of this approach.

Evolution of Behavior in the Repeated Nash Demand Game. A Computer Simulation.

Linh Chi Nguyen

Session: Wed9-J

Bargaining is an important problem in economics literature. We simulate a population of agents adopting different strategies of the repeated Nash Demand Game and let it evolve. The result suggests that, when the game is a one-shot bargain, the 50-50 division is very stable. However, when the game is repeated (and/or the discount factor is sufficiently high), the 50-50 share is not that stable any more. Throughout the simulation, inefficient periods appear consistently. Upon closer inspection, these inefficient periods are due to aggressive strategies in the population. With this result, we would like to offer a way on a priori ground to explain why there is not always fairness in dividing a pie, and different societies may have different ways of sharing it.

A Markov state modeling approach to characterizing the punctuated equilibrium dynamics of stochastic evolutionary games

Mareen Hallier and Carsten Hartmann

Session: Wed9-J

Stochastic evolutionary games often share a dynamic property called punctuated equilibrium; this means that their sample paths exhibit long periods of stasis near one population state which are infrequently interrupted by switching events after which the sample paths stay close to a different population state, again for a long period of time. This has been described in the literature as a favorable property of stochastic evolutionary games. The methods used so far in stochastic evolutionary game theory, however, do not fully characterize these dynamics. We present an approach that aims at exposing the punctuated equilibrium dynamics by constructing Markov models on a reduced state space which approximate well this dynamic behavior. Besides having good approximation properties, the approach allows a simulation-based algorithm, which is appealing in the case of complex games.

Bayesian learning in markets with common value

Itai Arieli, Moran Koren and Rann Smorodinsky

Session: Wed9-K

Consider a Bertrand competition between firms which produce substitute goods on the one hand and many consumers with a common value on the other hand. Assume consumers receive some private signals regarding the identity of the superior product, inducing a demand uncertainty. Will such markets aggregate information? Will the superior firm necessarily prevail? We study these questions in two scenarios - one in which consumers buy simultaneously and hence can not respond to each other's actions and another where buying is done sequentially. We provide necessary and sufficient conditions on the fundamentals of the problem - the prior probabilities and signal distribution - to guarantee information aggregation and learning. We introduce a novel property over the signals, referred to as Vanishing Likelihood, which is necessary for social learning. Our results contribute to the literature of monopolistic entry deterrence on the one hand and herding on the other.

Inverse Game Theory: Learning Utilities in Succinct Games

Volodymyr Kuleshov and Okke Schrijvers

Session: Wed9-K

One of the central questions in game theory deals with predicting the behavior of an agent. Here, we study the inverse of this problem: given the agents equilibrium behavior, what are possible utilities that motivate this behavior? We consider this problem in arbitrary normal-form games in which the utilities can be represented by a small number

of parameters, such as in graphical, congestion, and network design games. In all such settings, we show how to efficiently, i.e. in polynomial time, determine utilities consistent with a given correlated equilibrium. However, inferring both utilities and structural elements (e.g., the graph within a graphical game) is in general NP-hard. From a theoretical perspective our results show that rationalizing an equilibrium is computationally easier than computing it; from a practical perspective a practitioner can use our algorithms to validate behavioral models.

Non-Monotone Observational Learning

Min Zhang

Session: Wed9-K

Whereas generating herds in the long run, rational observational learning can lead to behavior quite different from herding or imitation in the short run. This work revisits the canonical binary-state model of observational learning to investigate the possibility of non-imitative behavior generated by non-monotone learning: *ceteris paribus*, with some predecessor(s) switching to actions revealing greater confidence in one state of the world, agents become less confident in that state. We provide a necessary and sufficient condition for non-monotone learning, when agents are either uninformed or partially informed by binary private signals. In a general setting with continuous private signals, we provide a necessary condition for non-monotone learning and show that it fails only for information structures that never generate moderate public beliefs. We also provide two non-restrictive sufficient conditions for non-monotone learning under the general setting.

Strategic Manipulation in Tournament Games

Allen Io Kuan Vong

Session: Wed9-L

A model of tournament games is developed to characterize the set of tournaments where players never shirk in equilibrium. Outside of the set of such tournaments, the outcome can be a noisy indicator of players qualities, and factors such as cost of effort or heterogeneous prize spread may become irrelevant in players effort choices.

Feedback and Learning in Tournaments

Julia Wirtz

Session: Wed9-L

We study the optimal feedback policy in a dynamic tournament with strategic experimentation. In many situations performance feedback is needed for agents to evaluate the quality of their work and decide whether they need to try a new technique or work harder in order to secure a promotion. In a competitive setting the agent cares about winning the contest and his incentives are misaligned with a principal who cares about expected

output. We show that the principal can re-align incentives by restricting the feedback she gives the agent to binary recommendations. In a setting where agents both choose technology and costly effort, binary recommendations continue to be the superior policy.

Performance Pay, Sorting and Employers Choice: Are Tournaments an Attractive Payment Method?

Timo Hoffmann

Session: Wed9-L

In this paper I analyze the attractiveness of rank-order tournaments if both market sides, employers and workers, can choose between payment systems. I consider workers self-selection into payment schemes, their effort provisions and the payment system choices of managers in a real-effort laboratory experiment. Depending on the stage of the experiment, workers are either randomly tied to a manager or choose a payment scheme (a fixed wage, a piece-rate or a rank-order tournament). Without worker choice a cheap (low-prize) tournament yields larger manager profits than a piece-rate. In environments with worker choice a clear self-selection pattern emerges: Productive workers select variable payment schemes (piece-rate and tournament), most workers prefer the piece-rate. Since the low-prize tournament is not chosen by productive workers it does not yield larger profits than the piece-rate anymore. These findings demonstrate that due to worker sorting rank-order tournaments are usually not simultaneously attractive for workers and employers.

When does simple mediation improve upon cheap talk?

Maria Goltsman, Maxim Ivanov and Gregory Pavlov

Session: Wed9-M

We study communication via a neutral mediator between an informed sender and an uninformed decision maker with conflicting preferences in the framework of Crawford and Sobel (1982). We ask under what conditions introducing the mediator can provide higher ex-ante payoff to the decision maker than the most informative one-shot unmediated communication. Our model allows for players' preferences and distributions of the private information that generalize the commonly used uniform-quadratic specification. We identify intuitive sufficient conditions on the environment under which there exists a simple mediated equilibrium that strictly improves upon unmediated communication. As we show, the possibility of improving mediation depends crucially not only on the intensity of the conflict of interest between the players, but also on its sensitivity to the sender's private information.

Monotonic Cheap Talk

Shih En Lu

Session: Wed9-M

This paper studies monotonic equilibria in a multi-sender version of Crawford and Sobel's (1982) cheap talk model, i.e. equilibria where senders' strategies are weakly monotonic in the state and where the receiver's strategy is strictly monotonic in the senders' messages. Monotonic equilibria have interval form, are bounded away from full revelation, and are straightforward to compute; they are closely related to the set of coordination-free equilibria identified by Lu (2015). When senders can be ranked according to bias: (i) in monotonic equilibria, senders most biased toward larger actions are informative when the receiver's desired action is smallest, and vice versa; and (ii) monotonic equilibria are collusion-proof in a strong sense. The monotonicity of sender strategies is shown to be a weak assumption if made alone, while the strict monotonicity of the receiver's strategy is motivated by the possibility of misunderstanding.

Failure of Common Knowledge of Language in Common-Interest Communication Games

Andreas Blume

Session: Wed9-M

This paper explores the fault line that separates communication failure from success when message meaning is compromised because there is mutual but not common knowledge of which messages are available. If the size of the message space is just sufficient to convey all payoff-relevant private information, there may be communication failure at every finite knowledge order. In contrast, for any language state at which a "rich language" condition is satisfied – the sender has second-order knowledge (belief) of having access to a large set of messages – there exists an equilibrium that is language-interim optimal (optimal given available messages).

Network performance under attacks

Victor Luna, Ivan Arribas and Amparo Urbano

Session: Wed9-N

The paper is a contribution to the study of robustness in economic and social networks. Our robustness metric is based on network performance, which evaluates the system behavior and measures the flow or traffic among nodes. The paper develops a sequential model of network defense with two players, the Network Defender and the Network Attacker. The Network Defender chooses a node communication path that maximizes the information transmission inside the network by means of a Gravity model subject to node capacity constraints, and a set of network nodes to protect; protecting a node is costly. Then, the Network Attacker observes the defended network and decides whether to attack

a set of network nodes. The subgame perfect equilibrium of this game is parameterized by the defense and attack costs. We also offer two instances of complex networks: Scale free networks and Poisson networks and numerically analyze the theoretical results.

The Formation of Extractive Structures in Networks

Robert Gilles and Owen Sims

Session: Wed9-N

Critical nodes control flows in a directed network and take advantage of these positions to extract excess rents. We extend this concept to critical node sets and investigate the potential contestation of these critical node sets by other node sets. This methodology allows us to introduce a game theoretic approach to analyse the formation of such critical node sets and of new network centrality measures that are based on potential membership of these critical node sets. We introduce a non-cooperative game theoretic approach to network centrality based on the formation of certain critical node sets. We show that the Strong Nash equilibrium in a critical node set formation game identifies the maximally controlling critical node sets in any network. This provides a foundation to an algorithmic way to identify intermediation in directed networks. We develop applications to the Renaissance Florentine elite network and the networks formed by the 9/11 terrorists.

The Sorry Clause

Vatsalya Srivastava

Session: Wed9-P

When players face uncertainty in choosing actions, undesirable outcomes cannot be avoided. Accidental defections caused by uncertainty, that does not depend on the level of care, require a mechanism to reconcile the players. This paper shows the existence of a perfect sorry equilibrium in a game of imperfect public monitoring. In the sorry equilibrium, costly apology is self-imposed in case of accidental defections, making private information public and allowing cooperation to resume. Cost of the apology required to sustain this equilibrium is calculated, the efficiency characteristics of the equilibrium evaluated and outcomes compared to those from other bilateral social governance mechanisms and formal legal systems. It is argued that with the possibility of accidental defections, other social mechanisms have limitations, while formal legal systems can generate perverse incentives. Therefore, apologies can serve as a useful economic governance institution.

Swap Bonds or Stocks! A Game of Implicit Environmental Policy

H Schwerin

Session: Wed9-P

This paper develops a game of asset ownership and environmental policy. Free-rider behavior in choosing pollution abatement is a major concern of international environmental

policy design. Efficiency can be obtained, however, if each party receives less than the full share of its own profits from polluting. The remainder of the profits can be earned by other parties—in a reciprocal way. Swaps can be used to commit to share profits, hindering free-riding. The best climate policy thus may be swap contracts on asset markets.

How Game Theory Encourages Cooperation

Uri Weiss and Joseph Agassi

Session: Wed9-P

Preventing situations leading to the prisoners dilemma game or to the stag hunt game can promote cooperation. So do providing incentives and establishing expectations, specifically hopes, as these promote cooperation in the repeated prisoners dilemma game: a small improvement in players expectations may improve the result of the game dramatically. Our analysis anchors game theory in social science, as an example for a general revision that we propose, in order to make game theoretical discussions part-and-parcel of the social sciences; this should make it more critical and its models empirically testable, thus rendering game theory more useful.

Adaptive Loss Aversion and Market Experience

Luke Lindsay

Session: Wed9-Q

The paper develops a new behavioral model of trading and learning in markets called adaptive loss aversion. In the model, agents do not recognize that others have different information. Loss aversion makes them cautious about trading, which protects them from being exploited by better informed traders. The degree of loss aversion is adjusted in response to experience and carries over between games. A repeated market experiment with symmetric and asymmetric information is used to test the model. The models main predictions are supported, and it outperforms variants of quantal response equilibrium, analogy-based expectation equilibrium, cursed equilibrium and level-k.

Sophistication in Strategic One-Shot Interactions: A nonparametric approach for identifying reasoning concepts

Christian Nauerz, Frauke Meyer and Marion Collewet

Session: Wed9-Q

By means of an experiment we identify subjects way of reasoning without an econometric model and restricting assumptions. We elicit subjects probabilistic beliefs about their opponent in a series of one-shot bimatrix games without feedback. Using Seltens Measure of Predictive Success (MPS) and a parametric bootstrap we investigate if subjects follow the reasoning concepts level-k (Lk), quantal response equilibrium (QRE), or utility proportional beliefs (UPB). We find that for about 80 percent of subjects the concept with

the highest MPS also performs better than random in explaining subjects beliefs. On the other hand, only 45 percent of our subjects state beliefs as if they reason according to a fixed concept across all games. Finally, we confirm the hypothesis that subjects make choices based on their beliefs, although it is not a deterministic relationship. Subjects best-respond to their stated beliefs with a high probability if incentives are high.

On the salience-based level-k model

Irenaeus Wolff

Session: Wed9-Q

In the current literature, there is a lively debate about whether a level-k model can be based on salience to explain behaviour in games with distinctive action labels such as hide-and-seek or discoordination games. This study presents seven different experiments designed to measure salience. When based on any of these empirical salience measures, the standard level-k model does not explain hide-and-seek behaviour. Modifying the model such that players follow salience when payoffs are equal, the model fits hide-and-seek data well. However, neither the original nor the modified model account for data from a discoordination game. This holds true even when basing the level-k prediction on participants' own individual salience assessments.

New characterizations of the Owen and Banzhaf-Owen values using the intra-coalitional balanced contributions property

Silvia Lorenzo-Freire

Session: Wed9-R

In this paper, several characterizations of the Owen and Banzhaf-Owen values are provided. All the characterizations make use of a property based on the principle of balanced contributions. This property is called the intracoalitional balanced contributions property and was defined by Calvo et al.

An axiomatic characterization of the Owen-Shapley spatial power index

Hans Peters and Jos Zarzuelo

Session: Wed9-R

We present an axiomatic characterization of the Owen-Shapley spatial power index for the case where issues are elements of two-dimensional space. This characterization employs a version of the transfer condition, which enables us to unravel a spatial game into spatial games connected to unanimity games. The other axioms include two conditions concerned particularly with the spatial positions of the players, besides spatial versions of anonymity and dummy. The last condition says that dummy players can be left out with changing the power of the other players; we show that this condition can be weakened by requiring dummies to have zero power, at least if we add a condition of con-

tinuity. We also show that the axioms in our characterization(s) are logically independent.

Weakly unimodal domains, antiexchange properties, and coalitional strategy proofness of voting rules

Stefano Vannucci

Session: Wed9-S

It is shown that simple and coalitional strategy-proofness of a voting rule on the full weakly unimodal domain of a convex idempotent interval space are equivalent properties if that space satisfies interval anti-exchange, a basic property also shared by a large class of convex geometries including trees and Euclidean convex spaces. It is also established that a much weaker minimal anti-exchange property is necessary to ensure equivalence of simple and coalitional strategy-proofness in that setting. An immediate corollary to that result is that such ‘unimodal’ equivalence fails to hold both in certain median interval spaces including those induced by bounded distributive lattices that are not chains, and in certain non-median interval spaces including those induced by partial cubes that are not trees. Thus, it turns out that anti-exchange properties of the relevant interval space provide a powerful general common principle to explain the varying relationship between simple and coalitional strategy-proofness interval.

Correlated Equilibria in Voter Turnout Games

Kirill Pogorelskiy

Session: Wed9-S

Communication is fundamental to elections. This paper extends canonical voter turnout models to include any form of communication, and characterizes the resulting set of correlated equilibria. In contrast to previous research, high-turnout equilibria exist in large electorates and uncertain environments. This difference arises because communication can be used to coordinate behavior in such a way that voters find it incentive compatible to always follow their signals past the communication stage. The equilibria have expected turnout of at least twice the size of the minority for a wide range of positive voting costs, and show intuitive comparative statics on turnout: it varies with the relative sizes of different groups, and decreases with the cost of voting. This research provides a general micro foundation for group-based theories of voter mobilization, or voting driven by communication on a network.

Simple vs. sophisticated rules for weight allocation in a two-tier voting model

Nicola Maaser

Session: Wed9-S

Representatives from differently sized constituencies form an assembly which takes political decisions by a weighted voting rule and adopts the ideal point of the weighted median

amongst them. Preferences of each representative are supposed to coincide with the constituency's median voter. Analytic results by Kurz et al. (2014) for infinite chains of assemblies suggest that individual voters' a priori influence on the collective decision can be equalized by allocating voting weight proportional to the square root of constituency sizes. The paper investigates performance of this simple square root rule and sophisticated variations that are based on the Shapley value or the Penrose-Banzhaf power measure. Monte Carlo simulations indicate that power index-based rules are superior to simple rules when the number of constituencies is "small".

From the bankruptcy problem and its Concede-and-Divide solution to the assignment problem and its Fair Division solution

Christian Trudeau

Session: Wed9-T

We consider two properties for the assignment problem. The first one is inspired by the Minimal Rights First property for the bankruptcy problem: assigning to agents their minimal core allocation, adjusting the value created accordingly and sharing the value created gives the same shares as if we share the value created in the original problem. The second property considers problems in which agents have no better option than to partner up with their optimal match. Since agents have no reasons to threaten to secede with another partner, the values for other matches should not impact the shares. We show that these properties, together with stability, yield the extreme points of the core of Demange (1982) and Leonard (1983), as well as their weighted averages. Adding Symmetry, we characterize the Fair Division solution of Thompson (1981). We also provide a new method to compute the minimal core allocations.

Competitive Fair Division under linear preferences

Anna Bogomolnaia and Herve Moulin

Session: Wed9-T

Often, sets of objects must be divided without cash changing hands: inheritance among siblings, shifts among interchangeable workers, seats in overbooked classes, computing resources in peer-to-peer platforms, etc. We assume additive utilities, and that we can divide a limited number of objects, by time-sharing or randomization. The two prominent solutions are the Relative Equivalent (REG) solution, and the Nash MaxProduct, NMP (aka the Competitive Equilibrium with Equal Incomes, CEEI). With three or more participants, NMP outperforms REG: unlike the latter, NMP meets the No Envy property and all agents benefit from the addition of new objects; and NMP is often integral (does not divide any object). Moreover NMP rule induces truthful reports if preferences about objects an agent receives are verifiable ex post, so that misreporting affects only the objects lost to this agent. Together with Efficiency, Symmetry and Scale Invariance,

this Verification-proofness property in group form characterizes NMP rule.

Resource-monotonicity and Population-monotonicity in Cake-cutting

Erel Segal-Halevi and Balázs Sziklai

Session: Wed9-T

We study the monotonicity properties of solutions in the classic problem of fair cake-cutting - dividing a heterogeneous resource among agents with different preferences. Resource- and population-monotonicity relate to scenarios where the cake, or the number of participants in the division, changes. They require that the utility of all participants change in the same direction: either all of them are better-off (if there is more to share) or all are worse-off (if there is less). We show that classic fair cake-cutting protocols fail to be monotonic. We then present monotonic division rules in two utility models. When utilities are additive, several proportional and Pareto-optimal division rules satisfy one or both monotonicity axioms. In contrast, when utilities have a connectivity constraint, no proportional and Pareto-optimal rule can satisfy any monotonicity axiom. Relaxing the requirement to weak-Pareto-optimality, we show a resource-monotonic protocol for two agents and some population-monotonic rules for n agents.

A behavioral study of ‘noise’ in coordination games

Michael Maes and Heinrich Nau

Session: Wed9-U

Noise in this study, in the sense of evolutionary game theory, refers to deviations from prevailing behavioral rules. Analyzing data from a laboratory experiment on coordination in networks, we tested what kind of noise is supported by behavioral evidence. This empirical analysis complements a growing theoretical literature on how noise matters for equilibrium selection. We find that the vast majority of decisions (96%) constitute myopic best responses, but deviations continue to occur with probabilities that are sensitive to their costs, that is, less frequent when implying larger payoff losses relative to the myopic best response. In addition, deviation rates vary with patterns of realized payoffs that are related to trial-and-error behavior. While there is little evidence that deviations are clustered in time or space, there is evidence of individual heterogeneity.

Dynamic Pricing in a Labor Market: Surge Pricing and Flexible Work on the Uber Platform

Keith Chen

Session: Wed11-SP0

In many markets, new technologies allow traditional jobs to be divided into discrete tasks that are widely distributed across workers and dynamically priced given prevailing supply and demand conditions. This “sharing” or “gig” economy represents a more flexible

work system, and is most common in two-sided markets in which a firm acts as a platform to connect service providers and consumers. One prominent example of this is the ride-sharing company Uber, which connects riders and driver-partners, and dynamically prices trips using a system known as surge pricing. In this talk, I discuss the practical problems of designing such a dynamic pricing system, how that dynamic pricing coordinates workers who can now earn compensation on a flexible schedule, and more broadly how the “gig” economy is evolving and growing as a form of market organization.

Intrinsic Robustness of the Price of Anarchy

Tim Roughgarden

Session: Wed11-SP0

The price of anarchy is a measure of the inefficiency of selfish behavior that has been successfully analyzed in many applications, including network routing, resource allocation, auctions, and even models of basketball. It is defined as the worst-case ratio between the welfare of a Nash equilibrium and that of an optimal (first-best) solution. Seemingly, a bound on the price of anarchy is meaningful only if players successfully reach some Nash equilibrium. The main result of this paper is that for many of the classes of games in which the price of anarchy has been studied, results are “intrinsically robust”: a bound on the worst-case price of anarchy for pure Nash equilibria *necessarily* implies the exact same worst-case bound for much larger sets of outcomes, including mixed Nash equilibria, correlated equilibria, and sequences of outcomes generated by natural experimentation strategies (such as successive best responses or simultaneous regret-minimization). We also discuss subsequent developments, such as generalizations to incomplete-information games with applications to mechanism design.

Neural circuitry of strategic thinking

Colin Camerer

Session: Wed11-SP1

Many studies across species have explored the nature and neural basis of strategic thinking (often called “mentalizing” in psychology and other sciences). This talk summarizes what is known, with an emphasis on cognitive hierarchy models in which agents can think strategically at more or fewer levels of depth.

Game theory and evolution

Avi Shmida

Session: Wed11-SP1

TBA

Multi-Donor Organ Exchange

Utku Ünver

Session: Wed11-SP2

Owing to the worldwide shortage of deceased donor organs for transplantation, living donations became a significant source of transplant organs. However, not all willing donors can donate to their intended recipients because of medical incompatibilities. These incompatibilities can be overcome by an exchange of donors between patients. Such exchanges have become widespread in the last decade for kidneys with the introduction of optimization and market design techniques to kidney exchange. A small but growing number of liver exchanges has also been conducted. Over the last two decades a number of transplantation procedures emerged where organs from multiple living donors are transplanted to a single patient. Prominent examples include dual-graft liver transplantation, lobar lung transplantation, and simultaneous liver-kidney transplantation. Exchange, however, is neither practiced nor introduced in this context. We introduce multi-donor organ exchange as a novel transplantation modality, provide a model for its analysis, and introduce optimal exchange mechanisms under various logistical constraints. Our simulations suggest that living-donor transplants can be significantly increased through multi-donor organ exchanges. Joint work with Haluk Ergin and Tayfun Sonmez.

Information Acquisition under Persuasive Precedent versus Binding Precedent

Hülya Eraslan

Session: Wed11-SP2

We analyze a dynamic model of judicial decision making. A court regulates a set of activities by allowing or banning them. In each period a new case arises and the appointed judge has to decide whether the case should be allowed or banned. The judge is uncertain about the correct ruling until she conducts a costly investigation. We compare two institutions: persuasive precedent and binding precedent. Under persuasive precedent, the judge is not required to follow previous rulings but can use the information acquired in an investigation made in a previous period. Under binding precedent, however, the judge must follow previous rulings when they apply. We analyze both a three-period model and an infinite-horizon model. In both models, we find that the incentive to acquire information for the judge is stronger in earlier periods when there are few precedents under binding precedent than under persuasive precedent, but as more precedents are established over time, the incentive to acquire information becomes weaker under binding precedent than under persuasive precedent. Joint work with Ying Chen at Johns Hopkins University.

Law as a Convention: Remarks on a Game-Theoretical Insight into Legal Ontology

Wojciech Zaluski

Session: Wed11-SP3

The overarching goal of the presentation is to analyze the (arguably) main game-theoretic (or rather: inspired by game theory) insight into the nature of law, namely that the law (legal rules) can be plausibly regarded as a convention. The presentation is divided into four parts. The first part provides an overview of the various accounts of the concept of convention which were proposed both within game theory and philosophy. It also highlights the complex relations between these accounts. The second part is devoted to the problem of which of these accounts best illuminate the nature of law (legal rules) and what assumptions regarding the law they presuppose. The third part deals with the limits to understanding law (legal rules) as a convention. In the last part a certain paradox regarding the conventional nature of law is formulated. The paradox can be roughly stated as follows. Conceiving law as convention seems to imply what may be called a 'strategic' conception of legal validity, according to which legal norms are valid only if they are generally, or almost generally, followed and/or regarded as valid in a society (which implies that an agent does not have a prima facie duty to obey a legal norm if the other agents with whom she interacts or may interact do not follow and/or do not regard as valid this norm). The paradox arises from the fact that conceiving law as a convention is typical for the adherents of legal positivism which, arguably, implies a non-strategic account of validity, according to which a norm is valid if it has been enacted in accordance with a proper procedure (and thereby it is irrelevant for its validity whether it is generally, or almost generally, followed and/or regarded as valid).

Equilibrium Bidding Strategies in Combinatorial Procurement Auctions with Diseconomies of Scale

Gian-Marco Kokott, Martin Bichler and Per Paulsen

Session: Wed14-A

Equilibrium bidding strategies in combinatorial auctions are not well understood. Ex-post split-award auctions are a wide-spread form of combinatorial procurement auctions, in which the demand for some quantity to be procured is split into two or more shares. We focus on markets with $n \geq 2$ bidders and diseconomies of scale, which is practically relevant and strategically challenging, since bidders have to coordinate on the efficient outcome. We show that the first-price sealed-bid and the Dutch ex-post split-award auction are not strategically equivalent. The sealed-bid format exhibits a coordination problem for bidders, whereas the Dutch has a unique and efficient equilibrium. Hence, it is possible to characterize conditions, for which a buyer should strictly prefer the Dutch over the first-price sealed-bid auction. We also provide a welfare analysis and compare purchas-

ing costs of both first-price auctions to the Vickrey-Clarke-Groves and descending auction.

Nash Equilibria of Sealed-Bid Combinatorial Auctions

Marissa Beck and Marion Ott

Session: Wed14-A

We characterize the complete set of pure-strategy Nash equilibria of a class of sealed-bid combinatorial auctions. The class contains any auction that assigns bundles to maximize the sum of bids and chooses payments between the reported social opportunity cost for the bundle won and the bid amount. We rank equilibria of prevalent auctions in this class, finding that the equilibria of the pay-as-bid (PAB) auction are a subset of the equilibria of bidder-optimal core-selecting (BOCS) auctions, which are in turn a subset of the equilibria of the Vickrey auction. Characterizing the equilibrium outcomes, we find that any assignment and payments that generate individually rational payoffs can result from some equilibrium of the Vickrey and BOCS auctions, whereas possible outcomes of the PAB auction are more limited. We consider extensions of the auction games to address the seller's incentives, the impact of budget constraints, and the implementation of the tie-breaking rule.

Competing Combinatorial Auctions

Thomas Kittsteiner, Marion Ott and Richard Steinberg

Session: Wed14-A

We investigate if and how revenue-maximizing auctioneers restrict combinatorial bidding in the presence of auctioneer competition. Two sellers offer the same set of two heterogeneous items to six bidders. Each bidder desires either one of the two items or the package of the two items. First, each seller decides on which packages to allow bidders to submit bids in a VCG mechanism. Then, each bidder selects which one of the two sellers' auctions to participate in. We find that sellers will not both offer an unrestricted VCG mechanism, i.e., a combinatorial auction. Rather they will segment the market via their respective choice of allowable package bids: One seller will attract bidders who desire a single item; the other seller will attract bidders who desire both items.

Competition in store complexity takes us halfway between Diamond and Bertrand

Saara Hamalainen

Session: Wed14-B

We consider a new, dynamic price search model with fixed or random deadlines to study in detail how consumers search within and across stores during a single search spell. To endogenize the intensity of competition, we allow firms to adjust freely the level of frictions in their online stores. Interestingly, this pins down uniquely the numbers of informed

and uninformed consumers. We show that there exist two inefficient equilibria, both with a prominent firm and a non-prominent firm, where these numbers are exactly the same. The outcome is thereby precisely halfway between Diamond equilibrium and Bertrand equilibrium.

Strategic Incentives for Innovations and Market Competition

Evangelia Chalioti and Konstantinos Serfes

Session: Wed14-B

We combine agency theory with product market competition to study the strategic properties of rivals' contract decisions for cost-reducing innovations and the relationship between risk and incentives. We show that a change in risk may trigger asymmetric responses of rivals in the same market: lower risk may induce some firms to strengthen, while other firms to weaken the incentives provided to their agents. This result holds regardless of the mode of competition in the product market, Cournot or Bertrand, as long as the rivals' R&D decisions are strategic substitutes. Our model generates new empirical implications and can provide an explanation for the lack of strong empirical support in the literature for a negative relationship between risk and incentives. It also has policy implications about the effect of risk on the incentives to innovate.

Inducing Herding with Capacity Constraints

Alexei Parakhonyak and Nick Vikander

Session: Wed14-C

This paper shows that a firm may benefit from restricting its capacity, in order to trigger herding behaviour from consumers in situations where such behavior is otherwise unlikely. We consider a setting with social learning, where consumers observe sales from previous cohorts and update beliefs about product quality before making their purchase decision. Imposing a capacity constraint effectively results in coarser available information: following a sell-out, consumers cannot infer the exact level of demand, but instead attach positive probability to all levels of demand that exceed capacity. The resulting discrete jump in beliefs about quality following a sell-out benefits the firm. However, the capacity constraint also hurts the firm by directly limiting potential sales. We show that, under certain condition, the informational concern prevails and it is optimal for a firm restrict its capacity.

Information Use and Acquisition in Price-Setting Oligopolies

Chris Wallace and David Myatt

Session: Wed14-C

Price-setting multi-product suppliers have access to multiple sources of information about demand conditions, where the publicity of each source corresponds to the cross-industry

correlation of signals received from it. A signal's influence on suppliers' prices is increasing in its publicity as well as in its precision. The emphasis on relatively public information is stronger for smaller suppliers who control narrower product portfolios. When information is endogenously acquired, suppliers listen to only a subset of information sources. This subset is smaller when products are less differentiated and when the industry is less concentrated. Smaller suppliers focus attention on fewer information sources. The inefficiencies arising from information acquisition and use are identified. The associated externalities depend upon the extent of product differentiation, the concentration of the industry, and the degree of decreasing returns to scale.

Quick or Persistent? On the Feedback Effects between First and Second Mover Advantages in a Stochastic Investment Game

Jan-Henrik Steg and Jacco Thijssen

Session: Wed14-C

We analyse a dynamic model of investment under uncertainty in a duopoly where firms have an option to switch from one market to another. We construct a subgame perfect equilibrium in Markovian mixed strategies and show that both preemption and attrition can occur along typical equilibrium paths. This changes the nature of stopping problems to be solved, compared to existing strategic real option models. Equilibrium outcomes differ qualitatively from those of the models deterministic version. Competition endogenously determines the firms exposure to the two markets risk factors, one of which is indeed eliminated by the mixed strategies in equilibrium.

Perfect Bayesian Equilibria in Reputation Games with Nested Information Structure

Nuh Aygun Dalkiran and Serdar Yuksel

Session: Wed14-D

We analyze reputation games where a strategic long-lived player acts in a repeated game against a collection of short-lived Bayesian players. The running assumption is that the information at the short-lived players is nested in that of the long-lived player in a causal fashion. Under this setup, we show that the set of perfect Bayesian equilibria coincide with a properly defined Markov perfect equilibria. Hence, a dynamic programming formulation is obtained for the computation of optimal strategies for the strategic long-lived player in any perfect Bayesian equilibrium. Furthermore, by using measure concentration techniques, we obtain a lower payoff bound on the value of reputation. Our findings contribute to the reputations literature by obtaining structural and computational results on the equilibrium behavior in finite-horizon, infinite horizon and undiscounted settings, as well as continuity results in the prior probabilities, and refined upper and lower bounds on the value of reputations.

Bounded Memory, Reputation, and Impatience

Benjamin Sperisen

Session: Wed14-D

Reputation models typically assume players have full memory, yet in many applications this does not hold. This paper studies incomplete information games where players observe only finitely many recent periods, deriving a recursive characterization of the equilibrium payoff set that captures both stationary and previously unexplored non-stationary equilibria, as well as tools for studying purifiable (i.e. robust to payoff perturbations) equilibria. These tools are applied to a product choice game. For 1-period memory, I obtain the exact minimum and maximum purifiable equilibrium payoffs for almost all discount factors and prior beliefs on an “honest” firm type. For long memory, I characterize the minimum purifiable (non-stationary) equilibrium payoff and unique stationary payoff. In both cases, incomplete information and non-stationary behavior qualitatively change the equilibrium payoff set. These results hold for fixed discount factors independent of prior beliefs, and so do not require extreme patience.

Reputation Building under Uncertain Monitoring

Joyee Deb and Yuhta Ishii

Session: Wed14-D

We study a canonical model of reputation between a long-run player and a sequence of short-run opponents, in which the long-run player is privately informed about uncertain state, which determines the monitoring structure in the reputation game. The long-run player plays a stage-game repeatedly against a sequence of short run opponents. We present necessary and sufficient conditions (on the monitoring structure and type space) to obtain reputation building in this setting. Specifically, in contrast to the previous literature, with only stationary commitment types, reputation building is generally not possible and highly sensitive to the inclusion of other commitment types. However with the inclusion of appropriate dynamic commitment types, reputation building can again be sustained while maintaining robustness to the inclusion of other arbitrary types.

Perception Games and Privacy

Ronen Gradwohl and Rann Smorodinsky

Session: Wed14-E

Players (people, firms, states, etc.) have privacy concerns that may affect their choice of actions in strategic settings. We use a variant of signaling games to model this effect and study its relation to pooling behavior, misrepresentation of information, and inefficiency.

Privacy Preserving Market Design

Mariann Ollar, Marzena Rostek and Ji Hee Yoon

Session: Wed14-E

Preserving privacy is a concern in auctions and exchanges. To examine the role of privacy in markets, this paper suggests an alternative to differential privacy (Dwork (2006)) that accommodates settings in which outcomes of a mechanism respond to incentives. We formulate a class of mechanism design problems based on the uniform-price market clearing to study the joint design of bid schedules (contingent variables); transparency of auction outcomes (observables); and the timing of market clearing. A design preserves privacy if the publicly observable outcome is not informative about the participants' private information. We show that this privacy requirement can be necessary for the viability of the market – if violated, equilibrium may not exist. However, there need not be a trade-off between privacy preservation and welfare. In particular, we derive constructive solutions to show that privacy-preserving designs can be efficient.

Self-selection in School Choice

Li Chen and Juan Pereyra

Session: Wed14-F

We study self-selection in centralized school choice, a strategic behavior that takes place when students submit preferences before knowing their priorities at schools. A student self-selects if she decides not to apply to some schools despite being desirable. We give a theoretical explanation for this behavior: if a student believes her chances of being assigned to some schools are zero, she may not rank them even when the mechanism is strategy-proof. Using data from Mexico City high school match, we find evidence that self-selection exists, and has negative consequences for low income students as a result of their strategic mistakes.

School Choice under Partial Fairness

Umut Dur, Ozgur Yilmaz and Arda Gitmez

Session: Wed14-F

School districts have been considering to allow violations of priorities at certain schools to improve students' welfare. Inspired by this, we generalize the school choice problem by allowing such violations. We characterize set of constrained efficient outcomes for school choice problem in this setting. We introduce a class of algorithms, Student Exchange under Partial Fairness (SEPF), which guarantees to find constrained efficient matching. Moreover, any constrained efficient matching Pareto dominating the Student Optimal Stable Matching can be obtained via a member of this class. A similar approach to improve students' welfare is to ask students' consent for violation of their priorities (Kesten(2010)). The idea is that each student weakly benefits from this weakening of

stability. Clearly, this welfare gain depends on students' having incentives to consent. We identify the unique rule, Top Priority Rule, within this class, giving each student incentives to consent. Uniqueness result implies it is equivalent to Kesten's EADAM.

Monotonic epsilon-equilibria in strongly symmetric games

Shiran Rachmilevitch

Session: Wed14-G

epsilon-equilibrium allows for worse actions to be played with higher probability than better actions. I introduce a refinement that addresses this shortcoming: an epsilon-equilibrium is monotonic if each player assigns (weakly) higher probabilities to better actions. This concept is logically independent of strong epsilon-equilibrium. I study these refinements of epsilon-equilibrium in games with countably many players and finitely many pure strategies, and prove the existence of monotonic epsilon-equilibrium in a special class of such games—strongly symmetric games. The proof is constructive and it implies, in particular, the existence of symmetric epsilon-equilibrium in strongly symmetric games. This result fails to hold in the larger class of weakly symmetric games.

Subgame-perfect epsilon-equilibria in perfect information games with sigma-discrete discontinuities

János Flesch and Arkadi Predtetchinski

Session: Wed14-G

Multi-player perfect information games are known to admit a subgame-perfect epsilon-equilibrium, for every $\epsilon > 0$, under the condition that every player's payoff function is bounded and continuous on the whole set of plays. In this paper, we address the question on which subsets of plays the condition of payoff continuity can be dropped without losing existence. Our main result is that if payoff continuity only fails on a sigma-discrete set (a countable union of discrete sets) of plays, then a subgame-perfect epsilon-equilibrium, for every $\epsilon > 0$, still exists. For a partial converse, given any subset of plays that is not sigma-discrete, we construct a game in which the payoff functions are continuous outside this set but the game admits no subgame-perfect epsilon-equilibrium for small $\epsilon > 0$.

A game highlighting the difference between countably and finitely additive strategies

János Flesch, Dries Vermeulen and Anna Zseleva

Session: Wed14-G

We examine a type of zero-sum games that highlights the differences between modeling strategies as countably-additive measures and modeling them as finitely-additive measures. The solutions of these games are essentially different for these two classes of strategies, and when using countably-additive strategies, the solutions depend heavily on

set theoretic axioms.

Bounded Depths of Rationality and Implementation with Complete Information

Rene Saran

Session: Wed14-H

We move towards a more robust theory of individual behavior in mechanism design by allowing hierarchies of players with varying but bounded “depths of rationality”. Specifically, we study (full) implementation with complete information when players are at least rational and at most k -rational. In “independent domain of preferences” (IDP) environments, we obtain a revelation principle: A social choice function (SCF) is implementable if and only if it is implementable by its associated direct mechanism. Two conditions characterize such SCFs: Strategy-proofness and “strong non-bossiness”. For non-IDP environments, we provide simple necessary and sufficient conditions as well as characterization of implementable SCFs. We also present results for the case when rationality is at least mutual knowledge. There is a significant gap between implementation when rationality is at least mutual knowledge compared to when it is not. However, it does not make a significant difference whether rationality is mutual knowledge or common knowledge.

Pure Strategy Nash Implementation with Finite Mechanisms

Ville Korpela

Session: Wed14-H

Canonical mechanisms have unattractive features because they have to cover every instances of the implementation problem. This is unavoidable but at the same time it leaves open whether these features can be avoided in all specific cases or even most of them. We focus on one such feature: The infinity of the message space. It has been known since Jackson [A crash course in implementation theory, Soc Choice Welfare 18 (2001) 655-708.] that allowing only finite message spaces is a constraint. What is not known, however, is how bad this constraint is. Not surprisingly it all depends on what is known about the utility representations. What is surprising, though, is that allowing only finite message spaces does not severely limit implementability. In economic environments the constraints are particularly weak.

On Non-Cooperative Foundation and Implementation of the Nash Solution in Subgame Perfect Equilibrium via Rubinstein’s Game

Papatya Duman and Walter Trockel

Session: Wed14-H

The alternating offers game (Rubinstein (1982)) used by Binmore (1980) and Binmore

et al.(1986) to provide via its unique subgame perfect equilibrium an approximate non-cooperative support for the Nash bargaining solution(NBS) of associated cooperative two-person bargaining games. These results strengthened the prominent role of NBS in cooperative axiomatic bargaining theory and its application, and often interpreted as a mechanism theoretical implementation of the Nash solution. We provide exact non-cooperative foundations via weakly subgame perfect equilibria of a game, then via subgame perfect equilibria of a modification of our game. They provide a general rule how to transform approximate support results into exact ones. We discuss the relation of the support results, including ours, with mechanism theoretic implementation in weakly-subgame perfect equilibrium of the Nash solution. We come to the conclusion that a sound interpretation as an implementation can hardly be found except in rare cases of extremely-restricted-domains of players' preferences.

Positive feedback in coordination games: stochastic evolutionary dynamics and the logit choice rule

Sung-Ha Hwang and Luc Rey-Bellet

Session: Wed14-J

We show that under the logit dynamics, positive feedback among agents (also called bandwagon property) induces evolutionary paths along which agents tend to repeat the same actions consecutively so as to take full advantage of the feedback effects. In particular, for paths escaping the domain of attraction of a given equilibrium—called a convention—positive feedback implies that along the minimum cost escaping paths, agents always switch away from the status quo convention strategy. In addition, the relative strengths of positive feedback effects impose a particular ordering on alternative strategies to which transitions occur in the minimum cost path. Using these two effects, we demonstrate that the optimal paths involve only the same repeated mistakes by agents. From our results on the exit problem, we then characterize stochastically stable states under the logit choice rule for a class of non-potential games with an arbitrary number of strategies.

Observations on Cooperation

Yuval Heller and Erik Mohlin

Session: Wed14-J

We study environments in which agents are randomly matched to play the Prisoner's Dilemma, and each player observes a few of the partner's past actions against other opponents. We depart from the existing literature in two key aspects: (1) we allow few agents in the population to be commitment types, and (2) we do not assume a time zero in which the entire community start interacting. We show that the presence of few committed agents destabilizes the existing mechanisms to sustain cooperation, and we present a novel mechanism (which is essentially unique) that sustains stable cooperation

in many environments.

Diverse Behavior Patterns in a Symmetric Society with Voluntary Partnerships

Takako Fujiwara-Greve and Masahiro Okuno-Fujiwara

Session: Wed14-J

In voluntarily separable repeated Prisoner's Dilemma, many neutrally stable distributions as defined in Fujiwara-Greve and Okuno-Fujiwara (2009) are vulnerable to "secret-handshake" mutants. In particular, the fundamentally asymmetric equilibrium of co-operators and myopic defectors, which was shown to be often more efficient than any trust-building equilibrium, is not neutrally stable. However, evolutionary stability is restored when mutation is sufficiently diverse to include exploiters of secret-handshake mutants. In a large society, diverse mutation occurs naturally. The boundary distributions of the sufficiently diverse mutant distributions correspond to payoff-equivalent equilibria to the original equilibrium, because they internalize the incumbent strategy distribution at points when partnerships end. Therefore, diverse actions at many turning points of long-term partnerships are not a non-convergence event but an equilibrium phenomenon.

Altruistic Observational Learning

Christoph March and Anthony Ziegelmeyer

Session: Wed14-K

We report two information cascade game experiments that directly test the impact of altruism on observational learning. Participants play the cascade game in two parallel sequences, the observed and the unobserved sequence. Only the actions of the observed entail informational benefits to subsequent participants. We find that observed contradict their private information significantly less often than unobserved when the monetary incentives to follow others are moderately weak. Unobserved are slightly reluctant to contradict their private information only when the monetary incentives to follow others are the weakest. Once the monetary incentives to follow others are strong enough observed contradict their private information to the same extent as unobserved. Long laboratory cascades accumulate substantial public information which in turn often increases the earnings of participants. In Experiment 2, participants are offered better opportunities to learn about the strategies played by observed which amplifies the impact of altruism on observational learning.

The Interplay of Cultural Aversion and Assortativity for the Emergence of Cooperation

Ennio Bilancini, Leonardo Boncinelli and Jiabin Wu

Session: Wed14-K

This paper investigates the emergence of cooperation in a heterogeneous population. The population is divided into two cultural groups. Agents in the population are randomly matched in pairs to engage in a prisoner dilemma. The matching process is assortative, that is, cooperators are more likely to be matched with cooperators, defectors are more likely to be matched with defectors. When two agents of different cultures are matched, they suffer a cost due to their cultural differences. We call such a cost cultural aversion. We find that when cultural aversion is sufficiently strong, perfect correlation between culture and behavior emerges: all agents from one cultural group cooperate, while all agents from the other cultural group defect.

First-Mover Advantage in Round-Robin Tournaments

Alex Krumer, Reut Megidish and Aner Sela

Session: Wed14-L

We study round-robin tournaments with either three or four symmetric players whose values of winning are common knowledge. In the round-robin tournament with three players we characterize the sub-game perfect equilibrium and show that each player maximizes his expected payoff and his probability to win if he competes in the first and the last stages of the tournament. In the round-robin tournament with four players we characterize the sub-game perfect equilibrium and show that a player who plays in the first match of each of the first two rounds has a first-mover advantage as reflected by a significantly higher winning probability as well as a significantly higher expected payoff than his opponents.

Tournament Game with Incumbent

Elham Nikram and Dieter Balkenborg

Session: Wed14-L

In this study we investigate the extension of Hotelling-Downs model to the case where the preferences of the voters do not have to be single-peaked. Where the classical results show that the equilibrium point is unique, we show that the result is robust under small perturbations. However, the structure of the model and the equilibrium change when the perturbations are not small. We provide examples and define a criteria which describe the structure of the equilibrium points when the tie situation has been resolved by perturbation.

Bayesian persuasion by a privately informed sender

Jonas Hedlund

Session: Wed14-M

This paper introduces private sender information in a game of Bayesian persuasion with monotonic sender preferences. I derive properties of increasing differences related to the precision of signals and use these to characterize the set of equilibria selected by the D1 criterion. These equilibria are either separating, i.e., the sender's choice of signal reveals his private information to the receiver, or fully disclosing, i.e., the outcome of the sender's chosen signal fully reveals the payoff-relevant state. If full disclosure is optimal for all sender types, then the equilibrium is fully disclosing. Otherwise, the equilibrium is fully separating and incentive compatibility requires the sender to use signals that are strictly more informative than the ones that would be used under symmetric information. Therefore, when full disclosure is suboptimal the sender incurs a cost in comparison to the symmetric information case, while the receiver obtains better information and extracts an "ignorance rent."

Bayesian Persuasion by Stress Test Disclosure

Wolfgang Gick and Thilo Pausch

Session: Wed14-M

We develop a multi-receiver framework of Bayesian persuasion to show that banking supervisors disclosure of macroprudential stress tests can be designed in a way that increases welfare. We show that through an optimal disclosure mechanism macroprudential authorities are able to provide valuable information to actors in the financial system, thereby increasing their decision-making quality and ensuring the well-functioning of financial markets. Even if the optimal mechanism exposes macroprudential authorities to uncertainty which would not exist without informative disclosure of macro stress tests, we show that authorities are able to exploit uncertainty in a way beneficial to financial market actors. In the light of Basel III, our theory may help explaining the rising importance of macro stress tests and how they should be designed.

Bayesian Persuasion under Partial Commitment

Daehong Min

Session: Wed14-M

This paper studies a variation of the Bayesian persuasion model in which the sender's commitment to a signaling device binds with probability less than one. The receiver knows the commitment probability but cannot tell whether the commitment is binding or not. We first show that the sender is weakly better off as the commitment probability increases. Then, we study the model in a specific environment: the uniform-quadratic case. In the uniform-quadratic case, we show that for any level of the sender's bias (even

when the bias is arbitrarily high), both players are strictly better off as they move from the no-commitment through the partial-commitment to the full-commitment case. To establish the strict welfare improvement from the no-commitment to the partial-commitment case, it suffices to consider only three types of signaling devices. Interestingly, one of them can achieve the best outcome in Blume et al. (2007) and Goltman et al. (2009).

Generalizations of the General Lotto and Colonel Blotto Games

Dan Kovenock and Brian Roberson

Session: Wed14-N

In this paper, we generalize the General Lotto game (budget constraints satisfied in expectation) and the Colonel Blotto game (budget constraints hold with probability one) to allow for battlefield valuations that are heterogeneous across battlefields and asymmetric across players, and for the players to have asymmetric resource constraints. We completely characterize Nash equilibrium in the generalized version of the General Lotto game and find that there exist sets of non-pathological parameter configurations of positive Lebesgue measure with multiple payoff nonequivalent equilibria. Across equilibria each player achieves a higher payoff when he more aggressively attacks battlefields in which he has lower relative valuations. Hence, the best defense is a good offense. We then show how this characterization can be applied to identify equilibria in the Colonel Blotto version of the game.

Sequential Attacker-Defender Game with Redeployment: A Conic Approach

Sarah Yini Gao, Chung-Piaw Teo and Huan Zheng

Session: Wed14-N

The classical Colonel Blotto game is the earliest game to model conflicts in multiple battlefields. In this paper, we extend the Colonel Blotto game to a sequential attacker-defender game where defender can redeploy its resources after observing the attacker's deployment. Our goal is to understand the value of this redeployment option in such games, and understand its impact on both player's strategy. In general, finding an equilibrium strategy in this game is challenging. We obtained an equivalent reformulation of the game using a conic program. By analyzing this equivalent reformulation, we can obtain many interesting properties of the game. We further explore how the redeployment network structure affects the game, showing that a sparse redeployment network structure can already capture the value of redeployment for the defender, and thus he does not need to establish full or dense flexible redeployment network structure to achieve high level of performance.

How Jeremy Bentham would defend against coordinated attacks

Christoph Schottmueller and Ole Jann

Session: Wed14-N

We analyze the problem of a single player who is threatened by a coordinated attack. For example, consider a central bank defending a currency peg, a government facing a revolution or a prison warden trying to prevent a riot. The defending player would like to deter his opponents from attacking by using their coordination problem against them and thus exerting as little resources as possible. Bentham (1787) proposed the panopticon, an innovative prison concept, as an ideal solution to this problem. We consider different information structures in a stylized model of a prison. We show that Bentham's intuition was correct and that the panopticon often performs best, especially if there are many prisoners. This provides recommendations for the more general problem of defense against coordinated attacks as well as insights into the applications of Bentham's ideas across the social sciences.

Value Creation vs. Appropriation, and the Evolution of Property Rights

Bharat Goel and Arijit Sen

Session: Wed14-P

Weak property rights encourage rival value appropriation vis-a-vis own value creation. But value destruction due to appropriative conflicts can encourage collective action towards improving property rights. We consider two countries (communities), initially situated in anarchy, differentially-endowed in initial resources, and populated by a sequence of generations. In every generation, the countries' myopic citizens agree on 'nudges' to the inherited property rights regime by mutual consent, and then decide on value creation vs. appropriation. When initial resource inequality is low and /or past consumption is the major force behind resource growth, perfect property rights can emerge in the long-run. But high initial resource inequality and/or the dominance of past productive investments in determining future resource growth perpetuates anarchy.

Levelling the playing field in jury selection

Martin Van der Linden

Session: Wed14-P

Different procedures are used to implement the challenge of prospective jurors by the parties to a trial. Judges and legislators typically care for procedures which limit the parties' ability to strategize against one another. This paper compares some of the most commonly used procedures in terms of the room they leave for strategizing. No procedure in a wide class that includes all procedures used in practice is completely immune to strategizing. The rationality threshold of a procedure (i.e. the number of rounds of iterated elimination of strategies which are never best responses needed to reach an

equilibrium) can however be used to measure procedures degree of strategic involvement. Based on this measure, so-called struck procedures leave less room for strategizing than so-called strike and replace procedures. Sequential procedures also tend to have a lower rationality threshold than simultaneous ones.

Legislative Bargaining with Heterogeneous Disagreement Values: Theory and Experiments

Luis Miller, Maria Montero and Christoph Vanberg

Session: Wed14-P

We study a legislative bargaining game in which failure to agree in a given round may result in a breakdown of negotiations. In that case, each player receives an exogenous ‘disagreement value’. We characterize the set of stationary subgame perfect equilibria under all q -majority rules. Under unanimity rule, equilibrium payoffs are strictly increasing in disagreement values. Under all less-than-unanimity rules, expected payoffs are either decreasing or first increasing and then decreasing in disagreement values. We conduct experiments involving three players using majority and unanimity rule, finding support for these predictions.

Uncertain Rationality, Depth of Reasoning and Robustness in Games with Incomplete Information

Fabrizio Germano, Jonathan Weinstein and Peio Zuazo-Garin

Session: Wed14-Q

Predictions under common knowledge of payoffs may differ from those under arbitrarily, but finitely, many orders of mutual knowledge; Rubinstein’s email game is a seminal example. Weinstein and Yildiz (2007) showed that the discontinuity in the example generalizes: for types with multiple rationalizable actions, there exist similar types with unique rationalizable action. Call this the “WY-discontinuity.” We study the robustness of the WY-discontinuity to weakenings of common belief in rationality (CBR). We weaken ICR to ICR- λ , being λ a sequence whose k th component is the probability players attach to k th-order belief in rationality. The WY-discontinuity is found robust for constant λ , and non-robust for λ converging to 0. I.e., when CBR breaks down almost completely at high orders, the intuitive continuity of behavior with respect to perturbations of belief hierarchies is restored. ICR- λ formalizes some well-known behavioral concepts (level- k and cognitive hierarchy models) in the language of classical game theory.

How Many Levels Do Players Reason? An Observational Challenge and Solution

Adam Brandenburger, Alex Danieli and Amanda Friedenberg

Session: Wed14-Q

How can a researcher identify the number of levels of reasoning undertaken by players in a game? We focus on the case where the researcher cannot observe players' beliefs. Instead, the researcher has access to data which serve as a signal of the players' strategies. In the case of simultaneous-move games, standard results relate levels of reasoning to rounds of elimination of dominated strategies and, thereby, allow the researcher to partition the data to answer this question. However, in extensive-form games, levels of reasoning cannot be directly related to elimination of conditionally dominated strategies. The main theorem of this paper shows how to solve the researcher's inference problem in extensive-form games.

A characterization of the Myerson value

Ayşe M. Derya

Session: Wed14-R

We provide a characterization of the Myerson value with two axioms. Our first axiom considers a situation where there is a change of the value function at a network g and at each network containing g . It requires that at such a situation, this change must be divided equally between all the players in g that has at least one link at g . Our second axiom is a condition on the value function where the value of each network is zero. It requires that if the value is zero at each of the possible networks, then each player must get zero payoff at each network. By changing our first axiom slightly, we also give a characterization for the position value. A natural comparison of the two value operators arises by our results. Our characterizations are similar to Chun's characterization of the Shapley value. We compare our results with Chun's result.

The Shapley value for directed graph games

Anna Khmelnitskaya, Ozer Selcuk and Dolf Talman

Session: Wed14-R

In classical cooperative game theory it is assumed that any coalition of players may form. However, in many practical situations the set of feasible coalitions is limited by some social, economical, hierarchical, or technical structure. In this paper we assume that restrictions on cooperation are given by an arbitrary directed graph (digraph) on the player set, the directed links of which prescribe the subordination among the players. We introduce the Shapley value for digraph games that are TU games with limited cooperation determined by a digraph. It is defined as the average of the marginal contribution vectors corresponding to all permutations which do not violate the induced subordination of players. We study properties of this solution and its core stability. For digraph games

with the digraphs being directed cycles an axiomatization of the solution is obtained.

The Shapley Value in the Knaster Gain Game

Federica Briata, Andrea Dall'Aglia, Marco Dall'Aglia and Vito Fragnelli

Session: Wed14-R

In Briata, Dall'Aglia and Fragnelli (2012), the authors introduce a cooperative game with transferable utility for allocating the gain of a collusion among completely risk-averse agents involved in a fair division procedure introduced by Knaster (1946). In this paper we analyze the features of the Shapley value (Shapley, 1953) of the game, and propose a simple algorithm for computing it efficiently.

Where Power Resides: Evidence from the Chairman's Paradox

Alexander K. Wagner and Dura-Georg Granic

Session: Wed14-S

We investigate the effects of voting power in a committee in which one member (the chairman) holds, on top of a regular vote, also the power to break ties. In contrast to the equilibrium prediction under strategic voting, known as the Chairmans Paradox, experimental data reveals that the tie-breaking power of the chairman is large and real. The chairman is able to induce her preferred outcome much more often than predicted, but only partially because of exercising tie-breaking power directly. The advantage of the chairman is largely determined by the limited strategic sophistication of committee members and the chairmans salient position in the committee.

Alternative characterizations of the plurality rule

Z. Emel Ozturk

Session: Wed14-S

We consider a collective choice problem. A society needs to select a subset of a set of feasible alternatives over which each individual has a strict preference. We provide three axiomatic characterizations of a specific election method, plurality rule, which selects the alternative(s) most preferred by the largest number of individuals. Our first characterization strengthens the characterization result by Ching [Ching, S. (1996). A simple characterization of plurality rule. *Journal of Economic Theory*, 71(1):298-302] by replacing independence of dominated candidates by the weaker axiom called cloning-consistency. Our second result replaces the efficiency axiom of Yeh [Yeh, C.-H. (2008). An efficiency characterization of plurality rule in collective choice problems. *Economic Theory*, 34(3):575-583] by a weaker version of independence of irrelevant alternatives. Additionally, we provide a third, independent characterization using a weakened version of cloning-consistency.

Characterization of the Minimal Norm Solution with Incomplete Information

Xu Lang

Session: Wed14-S

We provide a characterization of the probability-weighted minimal norm solution for Bayesian social choice problems. This solution prescribes the incentive feasible utility allocation that minimizes a probability-weighted norm to an interim reference point. The solution is uniquely determined by four axioms: weak extension independence, interim Pareto optimality, symmetry for a class of transferable utility problems and interim symmetry by rescaling. We discuss the solutions duality property and some illustrations.

Performance, Curiosity, and Gender: She Just Wants To Know

Carlos Alós-Ferrer, Jaume Garcia-Segarra and Alexander Ritschel

Session: Wed14-U

We conducted two experiments showing that self-image concerns trump inequality aversion and help overcome fear of competition. We focused on performance curiosity, that is, the desire to know ones own performance. Participants chose between an equal allocation and a performance-based, competitive one within a small group after generating surplus in a real-effort task. In the experimental treatment, avoiding competition by choosing an equal allocation came at the cost of not knowing the own performance, which led to a substantial increase of performance-based choices in comparison with the control treatment. The effect was especially pronounced for women, and the analysis reveals that the origin of this gender effect is a difference in expectations regarding performance.

Cooperation among behaviorally heterogeneous players in social dilemma with stay or leave decisions

Xiaochuan Huang, Takehito Masuda, Yoshitaka Okano and Tatsuyoshi Saijo

Session: Wed14-U

Given the substantial evidence of behavioral heterogeneity in social dilemma experiments, in this study we consider how to achieve cooperation in n-player prisoners dilemma situations where each player has one behavioral type, either selfish or conditionally cooperative. We introduce a two-stage game form called the stay-leave mechanism, where each cooperator has the chance to revise his choice when players choices are not unanimous. For homogeneous behavioral type cases, theory predicts that the unique outcome is cooperative under the stay-leave mechanism. For heterogeneous behavioral type cases, selfish types tend to exploit conditionally cooperative types as the latter increases. The average cooperation rate in the stay-leave mechanism experiment is 86.6% across 15 periods, which increases to 96.0% after period 5. We also provide evidence that selfish and conditionally cooperative types coexist throughout the sessions. Our results corroborate the importance of incorporating behavioral heterogeneity into institutional design.

Thats impossible: An Experiment on Participation Constraints

Sander Renes and Timo Hoffmann

Session: Wed14-U

Before a group can take a decision, its members must agree on a mechanism to aggregate individual preferences. In this paper we present a first experimental test of the effect of participation constraints in such group choice situations. While efficient mechanisms are desirable, Myerson and Satterthwaite (1983) show that participation constraints can prevent their implementation. We experimentally show this effect in the context of social choice mechanisms for the provision of an indivisible public good. We find strong indications that individual preferences for choice rules are sensitive to individual expected payoffs. This highlights the importance of considering participation constraints when designing choice institutions. We contrast the empirical performance of the theoretically optimal mechanism (AGV) with the common Simple Majority voting mechanism (SM). Both do not achieve their theoretical efficiency. The SM is more robust to changes in the environment, but the AGV is more efficient in most treatments.

Trading Votes for Votes - A Decentralized Matching Algorithm

Thomas Palfrey

Session: Wed16-Morg

Vote-trading is common practice in committees and group decision-making. Yet we know very little about its properties. Inspired by the similarity between the logic of sequential rounds of pairwise vote-trading and matching algorithms, we explore three central questions that have parallels in the matching literature: (1) Does a stable allocation of votes always exist? (2) Is it reachable through a decentralized algorithm? (3) What welfare properties does it possess? We prove that a stable allocation exists and is always reached in a finite number of trades, for any number of voters and issues, for any separable preferences, and for any rule on how trades are prioritized. Its welfare properties however are guaranteed to be desirable only under specific conditions. A laboratory experiment confirms that stability has predictive power on the vote allocation achieved via sequential pairwise trades, but lends only weak support to the dynamic algorithm itself. Joint work with Alessandra Casella.

(Almost) Efficient Mechanisms for Bilateral Trading

Liad Blumrosen and Shahar Dobzinski

Session: Thu9-A

We study the simplest form of two-sided markets: one seller, one buyer and a single item for sale. It is well known that there is no fully-efficient mechanism for this problem that maintains a balanced budget. We characterize the quality of the most efficient mecha-

nisms that are budget balanced, and design simple and robust mechanisms with these properties. We also show that even minimal use of statistical data can yield good results. Finally, we demonstrate how a mechanism for this simple bilateral-trade problem can be used as a “black-box” for constructing mechanisms in more general environments.

The imitation game: A simple rule to prevent discrimination in procurement

Nicolas Fugger, Vitali Gretschko, Helene Mass and Achim Wambach

Session: Thu9-A

Procurement regulation aimed at curbing discrimination in auctions requires that all bidders are treated equally. However, Deb and Pai (2013) show that such regulation poses virtually no restriction on the ability to discriminate. We propose a simple rule - imitation perfection - that restricts discrimination in a meaningful way. With homogeneous bidders, imitation perfection implies that in every equilibrium conditional on their valuation all bidders earn the same surplus. There exist revenue and social-surplus-optimal auctions that are consistent with imitation perfection. With heterogeneous bidders, imitation perfection is incompatible with revenue and social-surplus optimization. Thus, there exists a trade-off between non-discrimination and optimality.

Effects of Seller’s Information Disclosure in Equity Auctions Requiring Post-Auction Investment

Takeharu Sogo

Session: Thu9-A

We consider a moral hazard issue inherent in the equity auctions of assets such as oil & gas leases and corporate takeovers. After the auction, the winning bidder decides whether or not to make follow-up investments in the acquired asset and makes the equity payment out of the revenue from it according to the auction outcome. Before the auction, the seller holds private information about the possible returns on that investment and must decide whether to disclose it. Disclosing her private information causes moral hazard in different degrees to bidders with different productivities. In contrast to the seminal linkage principle by Milgrom and Weber (1982), expected seller revenues may be higher when she does not disclose her private information than when she commits to publicly announcing it regardless of whether it is good or bad.

Preemptive Investment under Uncertainty

Jan-Henrik Steg

Session: Thu9-B

This paper provides a general characterization of subgame-perfect equilibria for a strategic timing problem, where two firms have the (real) option to invest irreversibly in some market. Profit streams are uncertain and depend on the market structure. The analysis

of the problem emphasizes its dynamic nature and exploits only its economic structure. In particular, the determination of equilibria with preemption is reduced to solving a single class of constrained stopping problems. The general results are applied to typical state-space models from the literature, to point out common deficits in equilibrium arguments and to suggest alternative equilibria that are Pareto improvements.

Conjectures and Equilibrium in Dynamic Differentiated Duopoly Games

Shinji Kobayashi and Koji Takenaka

Session: Thu9-B

This paper examines conjectures, open-loop equilibrium and Markov perfect equilibrium in dynamic differentiated duopoly games. We explore relationships between open-loop equilibrium and Markov perfect equilibrium in both a model of quantity adjustment and that of price adjustment. Open-loop equilibrium in a quantity adjustment model corresponds to static Cournot equilibrium when time goes to infinity. Open-loop equilibrium in a price adjustment model corresponds to static Bertrand equilibrium when time goes to infinity. Conjectural variations for both the dynamic model of quantity adjustment and that of price adjustment are identified. We also show that Markov perfect equilibrium in a quantity adjustment model is more competitive than static Cournot equilibrium.

Dynamic oligopoly with sticky prices - off-steady-state analysis

Agnieszka Wiszniewska-Matyszek, Marek Bodnar and Fryderyk Mirota

Session: Thu9-B

In this paper we analyse a dynamic game modelling Cournot oligopoly with sticky prices. We calculate Nash equilibria: feedback and open loop, and compare resulting trajectories of price and production. Although our paper is not the first such model of oligopoly, it appears to be the first paper in which non-stationary open loop Nash equilibria were rigorously calculated. Therefore, our analysis allows us to study and compare closed loop and open loop Nash equilibria which are not constant. We prove that feedback equilibrium production from some time instant on, is strictly greater than the open loop equilibrium production, with reverse inequality for prices. We also analyse behaviour of equilibrium price and production as functions of parameters of the model and we obtain, among others, that the feedback equilibrium steady states do not converge to static Cournot equilibrium as the speed of adjustment tends to infinity, unlike the open loop equilibrium.

Pooling hawks and doves: Interim-efficient labor contracts for other-regarding agents.

Thomas Daske

Session: Thu9-C

Behavioral contract theory typically argues that agents who differ in their intrinsic motivations to collaborate or to compete would be screened by principals, or self-sort in labor market competition. This view is in contrast with the empirical observation that workers' perceived support from coworkers is a key factor for labor turnover. The present study considers a principal-multiple agents model with independent observable efforts. Agents are privately informed about their more or less pronounced altruistic (spiteful) preferences. It is shown that the interim-efficient labor contract is a pooling contract that ex interim Pareto-dominates any allocation that could be achieved under complete information. Hence, all parties involved prefer the composition of social types at work to be random. The distributive effects of interim-efficient contracting are closely related to the hawk-dove game, with the principal taking the role of nature. Interim-efficient contracting implies relative or team performance pay in a payoff-equivalent way.

Screening Through Coordination

Nemanja Antic and Kai Steverson

Session: Thu9-C

A principal decides whether or not to take an action on each of a number of agents without the use of transfers. Each agent desires the action to be taken and has private information (his type) about the principal's payoff from taking the action on him. The principal's payoff exhibits complementarities across agents, which the principal leverages by coordinating the agents. Coordination involves taking the action on agents with high (low) types more often when the other agents also have high (low) types. Due to complementarities, coordination optimally accepts failure when the consequences are small in order to ensure success when the gain is high. We also find that, in a variety of environments, the action is taken more often for an ex-ante inferior agent, a phenomenon we call favoritism. One possible application of our setting is a firm downsizing a division and deciding which employees to keep.

An Economic Theory of Statistical Testing

Aleksey Tetenov

Session: Thu9-C

This paper models the use of statistical hypothesis testing in regulatory approval. A privately informed agent proposes an innovation. Its approval is beneficial to the proponent, but potentially detrimental to the regulator. The proponent can conduct a costly clinical trial to persuade the regulator. I show that the regulator can screen out all ex-ante

undesirable proponents by committing to approval based on a simple statistical test. Its level is the ratio of the trial cost to the proponents benefit from approval. In application to new drug approval, this level is around 15% for the average Phase III clinical trial.

Promoting a Reputation for Quality

Daniel Hauser

Session: Thu9-D

I consider a model in which a firm invests in both product quality and a costly signaling technology, and the firm's reputation is the market's belief that its quality is high. Signaling influences the rate at which consumers receive information about quality: the firm can either promote, which increases the arrival rate of signals, or censor, which decreases the arrival rate of signals. I study how the firm's incentives to build quality and signal depend on its reputation. The firm's ability to control information dramatically changes incentives. Promotion and investment in quality are complements: the firm has stronger incentives to build quality when the promotion level is high. Costly promotion can reduce the firm's incentive to build quality; this effect persists even as the cost of building quality approaches zero. Censorship and investment in quality are substitutes. The ability to censor can destroy a firm's incentives to invest in quality.

Reputation and the value of information in a trust game

Emilia Oljemark

Session: Thu9-D

I analyze a twice-repeated trust game in which an Investor chooses in each period whether to invest or not in a project carried out by an Entrepreneur who may not be reliable. The value of the project is fixed through time and is either common knowledge, or private knowledge of the Entrepreneur. The Investor learns about the reliability of the Entrepreneur by observing whether he repays investments or not. If the project is valuable enough, an unreliable Entrepreneur invests in reputation in order to obtain financing also in the second round. There is shown to always exist parameter environments under which ex-ante welfare is maximized for each player if the Entrepreneur is privately informed about the value of his project.

Reputation Concerns and Information Aggregation

Emiliano Catonini and Sergey Stepanov

Session: Thu9-D

We analyze how reputation concerns of a decision-maker affect her ability to extract information from reputation-concerned advisors. Contrary to most of the literature, we show that the decision-maker's concerns for her reputation as an expert can improve information aggregation. When the decision-maker's reputation concerns are very low,

she is tempted to ask for advice regardless of her private information, which undermines advisors' truth-telling incentives. Very high reputation concerns destroy the incentives to seek advice. The optimal strength of the reputation concerns maximizes advice-asking without undermining advisors' incentives. Prior uncertainty about the state of nature calls for a more reputation-concerned decision-maker, unless the uncertainty becomes too high, in which case the reputation concerns become (almost) irrelevant. The expected competence of advisors has a similar effect. A higher number of advisors generally results in higher optimal reputation concerns of the decision-maker.

Efficiency and strategy-proofness in object assignment problems with multi-demand preferences

Tomoya Kazumura and Shigehiro Serizawa

Session: Thu9-E

We consider the problem of allocating sets of objects to agents and collecting payments. Each agent has a preferences over the set of pairs consisting of a set of objects and a payment. Preferences can be non-quasi-linear. Non-quasi-linear preferences describe environments where the wealth effect is non-negligible. We investigate the existence of efficient and strategy-proof rules. A preference relation is unit-demand if given a payment level, for each set of objects, the most preferred one in the set is at least as good as the set itself; it is multi-demand if given a payment level, when an agent receives an object, receiving some additional object(s) makes him better off. We show that if a domain contains all the unit-demand preferences and at least one multi-demand preference relation, and if there are more agents than objects, no rule satisfies efficiency, strategy-proofness, individual rationality, and no subsidy for losers on the domain.

Same Sex Marriage, The Great Equalizer

Alexei Parakhonyak and Sergey Popov

Session: Thu9-E

We demonstrate the abundance of asymmetric equilibria in a standard marriage market model, when agents must only engage in heterosexual marriage: agents of different gender are not guaranteed to have the same payoff even under equal opportunities, even if all other factors, such as own type or the distribution of partner types, are same across genders. Then we allow for same-sex marriage, and we demonstrate that under equal opportunities, only symmetric equilibria survive.

Core and competitive equilibria in one-seller assignment markets with multi-item demands

Francisco Robles Jimnez and Marina Nunez

Session: Thu9-E

We consider an assignment market with one seller who owns several indivisible heterogeneous goods and many buyers each willing to buy up to a given capacity. In this market, the core contains the allocation in which every buyer gets his marginal contribution to the grand coalition. We characterize the minimum and the maximum competitive equilibrium prices to determine when the buyers- optimal and the seller-optimal core allocations are competitive. In addition, we characterize in terms of the valuation matrix the coincidence between the core and the set of competitive equilibrium payoff vectors.

Governance in university

Anna Panova

Session: Thu9-F

The decision making mechanism at university is one of important factors affecting university's performance. We look for appropriate mechanisms in the case when clear criteria for effectiveness are missing and at the same time one can rely on professors' knowledge. We study the situation when the university's founder has to delegate decision making power and choose among several types of governance. The first type of governance is sharing governance, in this case the decision is made on the basis of majority voting. The second type is autocratic governance without rotation. The third type is autocratic governance with rotation, and finally we have governance when the decisions are made by a committee. If the founder cannot assess the preferences of professors and choose professors with specific characteristics, sharing governance gives the best results. The second best chose is to delegate the decision to a committee.

How do universities differentiate themselves?

Mike Peacey and Gervas Huxley

Session: Thu9-F

In this paper we ask how do colleges differentiate themselves, and what is the impact of this differentiation on the structure and efficiency of higher education markets. We propose a model that draws on both the horizontal and vertical differentiation literature. The benefit to Students attending college depends on their ability and the academic standard of the college. The extent of the mismatch between a student's ability and the college they attend is analogous to a transport cost. However, because higher ability students are willing to pay more than lower ability students, colleges are also vertically differentiated. We also explain why the cost of travel function must be non-monotonic in match distance. We present a number of welfare results that help explain some features

of higher education markets. We also highlight similarities and differences between the results of our hybrid model and those of Hotelling and Thisse.

The Design of Teacher Assignment: Theory and Evidence

Julien Combe, Olivier Tercieux and Camille Terrier

Session: Thu9-F

This paper studies reassignment problems in matching markets where there exists some initial matching. In this context, a natural Individual Rationality (IR) constraint emerges : agents must obtain a weakly better match than their initial one. In the standard college admission problem, it is well known that the standard Deferred Acceptance mechanism is the unique Pareto-efficient (for both sides), fair and strategy-proof mechanism. In the reassignment problem however, it is known that this mechanism fails to be IR. Both in the literature and in practice (e.g. to assign teachers in France) a simple modification of this mechanism has been proposed to ensure IR and keep strategy-proofness. However, we show that this modification is not Pareto-Efficient. We then show that there is a unique IR, Pareto-efficient and strategy-proof mechanism. Then using data on the assignment of teachers in France, we show that the gains of this new mechanism are important.

A characterization of the sets of equilibrium payoffs of finite games

Guillaume Vigeral and Yannick Viossat

Session: Thu9-G

It is well known that the set of mixed equilibrium payoffs of any finite n -player game is a nonempty semialgebraic and compact subset of R^n . We show that for $n > 2$ the converse is true: any nonempty semialgebraic and compact subset of R^n is the set of equilibrium payoffs of some finite n -player game. The proof is constructive. We also show that this implies that some problems concerning finite games are undecidable.

The structure of Nash equilibria in Poisson games

Claudia Meroni and Carlos Pimienta

Session: Thu9-G

In finite games, the graph of the Nash equilibrium correspondence is a semialgebraic set (i.e. it is defined by finitely many polynomial inequalities). This fact implies many game theoretical results about the structure of equilibria. We show that many of these results can be readily exported to Poisson games even if the expected utility functions are not polynomials. We do this proving that, in Poisson games, the graph of the Nash equilibrium correspondence is a globally subanalytic set. Many of the properties of semialgebraic sets follow from a set of axioms that the collection of globally subanalytic sets also satisfy. Hence, we easily show that every Poisson game has finitely many connected components and that at least one of them contains a stable set of equilibria. By the same reasoning,

we also show how generic determinacy results in finite games can be extended to Poisson games.

Necessary and Sufficient Conditions for Existence of Maximal Elements and Coalitional Equilibria under Discontinuous Preferences

Rida Laraki

Session: Thu9-G

We extend Sonnenschein's and Tian's theorems for existence of a maximal element of a discontinuous preference to more general discontinuous preferences when the space of outcomes are not necessarily Hausdorff or convex. We apply our condition to obtain necessary and sufficient ordinal conditions for existence of coalitional equilibria in discontinuous games. Our approach allows to unify several Nash equilibrium existence results and most notably those of Reny, Bay-Tian-Zhou, and Barelli-Meneghel.

Scoring Rules and Implementation in Iteratively Undominated Strategies

Christian Basteck

Session: Thu9-H

We characterize voting procedures according to the solution that they implement when voters cast ballots strategically, applying iteratively undominated strategies. In elections with three candidates, the Borda Rule is the unique positional scoring rule that satisfies unanimity (U) (elects a candidate whenever it is unanimously preferred) and is majoritarian after eliminating a worst candidate (MEW)(with a unanimously disliked candidate, the majority-preferred among the other two is elected). In the larger class of direct mechanism scoring rules, Approval Voting is characterized by a single axiom it is majoritarian after eliminating a Pareto dominated candidate (MEPD)(with a Pareto-dominated candidate, the majority-preferred among the other two is elected). However, it fails a desirable monotonicity property: a candidate that is elected for some preference profile, may lose the election once she gains further in popularity. In contrast, the Borda Rule is the unique direct mechanism scoring rule that satisfies U, MEW and monotonicity.

Efficient Coalition-Proof Full Implementation

Mikhail Safronov

Session: Thu9-H

D'Apresmont Gerard-Varet (AGV) mechanism implements efficient social choice in a budget-balanced manner, however it is susceptible to a joint misreport by a coalition of agents, and it may have inefficient equilibria. This paper extends AGV mechanism by putting more structure on its monetary transfers, making all equilibria efficient and coalition-proof. In the resulting direct mechanism each agent is paid the Shapley value generated from the expected externalities his report imposes on others. This makes each

group of agents to be paid in total the expected externality their report imposes on others, and makes it Bayesian incentive compatible to report truthfully. Moreover, any agent can guarantee to receive his ex ante efficient payoff if he always reports truthfully, making all equilibria efficient. It is generically impossible to make truthful report a dominant strategy for all coalitions.

Metastability of Asymptotically Well-Behaved Potential Games

Diodato Ferraioli and Carmine Ventre

Session: Thu9-J

Convergence rate and stability of a solution concept are classically measured in terms of “eventually” and “forever”, respectively. In the wake of recent computational criticisms to this approach, we study whether these time frames can be updated to have states computed “quickly” and stable for “long enough”. Logit dynamics allows irrationality in players’ behavior, and may take time exponential in the number of players n to converge to a stable state (i.e., a certain distribution over pure strategy profiles). We prove that any potential game, for which the behavior of the logit dynamics is not chaotic as n increases, admits distributions stable for a super-polynomial number of steps in n no matter the players’ irrationality, and the starting profile of the dynamics. The convergence rate to these *metastable distributions* is polynomial in n when the players are not too rational. Our proofs build upon a number of involved technical contributions.

Meta-stability of attractive evolutionary equilibria

Reinoud Joosten and Berend Roorda

Session: Thu9-J

We present attractiveness, a refinement criterion on the defining mathematical properties of three evolutionary equilibrium concepts, i.e., the evolutionarily stable strategy, the evolutionarily stable equilibrium and the truly evolutionarily stable state. We call an evolutionary equilibrium meta-stable if it is dynamically, structurally as well as conceptually stable for a non-singleton class of dynamics. We show that any attractive evolutionary equilibrium is (a) dynamically stable, i.e., if the system at equilibrium is slightly disturbed, it will return to equilibrium, (b) structurally stable, i.e., preserves defining properties for small perturbations of the underlying structure of the system, (c) conceptually stable, i.e., equivalent to at least one other attractive evolutionary equilibrium, for non-singleton classes of dynamics. We also show that each strict saturated (Nash) equilibrium is meta-stable for a vast class of evolutionary dynamics.

Large Deviations and Stochastic Stability

William Sandholm and Mathias Staudigl

Session: Thu9-J

We establish a sample path large deviation principle for sequences of Markov chains arising in game theory and other applications. As the state spaces of these Markov chains are discrete grids in the simplex, our analysis must account for the fact that the processes run on a set with a boundary. A key step in the analysis establishes joint continuity properties of the state-dependent Cramer transform, the running cost appearing in the large deviation principle rate function.

Informative Milestones in Experimentation

Christoph Wolf

Session: Thu9-K

I study the optimal contract offered by a principal funding a financially constrained agent to work on a multistage project. The project requires all stages to be completed to yield benefits. Exerting effort in early stages is informative but not conclusive about the feasibility of future stages. The optimal contract features milestones to be achieved before a deadline. If the project is ultimately successful, the agent is rewarded with a share of the benefits that depends on performance in all stages. The timing of successes in early stages influences the beliefs in later stages and the deadlines and shares. Later successes imply more pessimism about the project's quality. The effect of learning does not necessarily induce deadlines and shares to be monotone in success time. First, later successes induce more pessimism about the project. Second, more pessimism makes incentive provision harder. For late successes the second effect outweighs the first.

Strategy Revision Opportunities and Collusion

Matthew Embrey, Friederike Mengel and Ronald Peeters

Session: Thu9-K

This paper studies whether and how strategy revision opportunities affect levels of collusion in indefinitely repeated two-player games. Consistent with standard theory, we find that such opportunities do not affect strategy choices, or collusion levels, if the game is of strategic substitutes. In contrast, there is a strong and positive effect for games of strategic complements. Revision opportunities lead to more collusion. The latter cannot be explained by renegotiation or standard risk-dominance considerations, but is consistent with a notion of fear of miscoordination based on minmax regret.

A Fairness Condition for Unfair Contests: Multi-Dimensional Favoritism with Asymmetric Players

Xiaoyu Cheng, Jie Zheng and Jaimie Lien

Session: Thu9-L

We study optimal contest design when two asymmetric players compete in a complete-information all-pay-auction contest with multi-dimensional favoritism. The favoritism can take the form of a player being given a head-start advantage (“additive bias”), or an effectiveness advantage which enhances each unit of effort (“multiplicative bias”) expended by a player. We solve for the optimal contest for a designer who would like to achieve each of the following objectives: maximizing the total effort, maximizing the total score, maximizing the highest effort by a single player, and maximizing the winners effort. We find that a “fairness condition” is necessary under each of the four objectives of the designer, which is also robust to non-linear forms of favoritism. Our findings contribute to a better understanding of the optimal unfair contests, and generalize some of the results in the previous literature with just one-dimensional unfairness.

Intermediaries versus Trolls in Contests for Patents

Charlne Cosandier

Session: Thu9-L

This paper examines the emergence of nonpracticing entities in the market for patents. While patent trolls monetize their patents through the threat of litigation against alleged infringers, intermediaries instead intend to protect their affiliated firms by buying patents that would otherwise fall in trolls hands. We develop a model of patent acquisition through an auction incorporating both trolls and intermediaries. We find that firms can never win the auction when individually competing against the troll, while the sellers revenue sharply increases in response to the trolls participation in the auction. We then introduce an intermediary in the model. Since the patent is collectively financed through voluntary contributions, firms tend to free ride on other contributors. While the intermediaries probability to outbid the troll in the auction is positive, the collective action issue inherent to his funding mechanism greatly hampers his performance in the auction and undermines the sellers revenue.

Relational Communication with Transfers

Anton Kolotilin and Hongyi Li

Session: Thu9-M

We enrich the Crawford and Sobel (1982) model of strategic communication between an informed sender and an uninformed receiver by adding repeated interactions and voluntary transfer payments. Transfers play two roles here: they incentivise decision-making and signal information. Although full separation can be frictionlessly attained in equilib-

rium, partial or complete pooling is optimal if preferences are sufficiently divergent. In this case, extreme information is optimally pooled to discipline the receivers decision-making by reducing her reneging temptation. As an extension, we consider a partially-informed receiver. As the receiver becomes more informed, welfare strictly decreases because self-enforcing agreements become harder to sustain.

Communication Games with Optional Verification

Simon Schopohl

Session: Thu9-M

We consider a Sender-Receiver Game in which the Sender can send either a costless cheap-talk message or a costly verifiable message. While the Sender has private information about the state of the world, the Receiver chooses an action, which yields to a specific utility for both players. Since the preferences about the actions may differ, depending on the state of the world, the Receiver may or may not trust the messages if they are not verified. In a discrete setting we show under which conditions full revelation is possible and also describe the players optimal behaviour if full revelation is impossible. We also state necessary and sufficient conditions for fully revealing equilibria in a continuous model. In both models we distinguish between equilibria where just one type of message is sent and where the Sender chooses the type of message depending on the state of the world.

Equilibrium Selection in Persuasion Games with Binary Actions

Shintaro Miura

Session: Thu9-M

This paper studies equilibrium selection in persuasion games where the receiver's actions are binary, and discusses how to justify the most informative equilibrium as a reasonable consequence. In general, there exist multiple equilibria in this environment even if the sender's private information is fully certifiable, and the convention of focusing on the most informative equilibrium is followed without formal justification. However, we show that the existing selection criteria in the literature on strategic communication hardly justifies such a convention; in particular, these criteria might select the least informative equilibrium. We then suggest the notion of certifiable dominance, and show that the most informative equilibrium is uniquely selected by a perfect Bayesian equilibrium constructed using certifiably undominated strategies. This criterion could also uniquely select the most informative equilibrium when the sender's private information is partially certifiable.

Local coordination and global congestion in random networks

Ivan Arribas and Amparo Urbano

Session: Thu9-N

This paper analyzes the impact of local and global interactions on individuals action choices. Players are located in a network and interact with each other with perfect knowledge of their neighborhood and probabilistic knowledge of the complete network topology. Each player chooses an action, from some finite set, which imposes an externality on their neighbors as well as an externality on the complete network. Players deal with two opposing forces: they obtain utility from sharing their choices with their neighbors (positive local externality) but suffer disutility from sharing the same choice with all members of the network (negative global externality). We find the conditions for the existence of all symmetric Bayesian Nash equilibria and translate them to a characterization in terms of the main properties of the network topology. The balance between local satisfaction and global dissatisfaction (congestion) partially explains the equilibrium outcome.

Optimal Mechanisms for Robust Coordination in Congestion Games

Philip Brown and Jason Marden

Session: Thu9-N

We study the application of taxes to a network-routing game, and we assume that the tax-designer knows neither the network topology nor the tax-sensitivities and demands of the agents. We show that it is possible to design taxes that guarantee that selfish network flows are arbitrarily close to optimal flows, despite the fact that agents tax-sensitivities are unknown to us. These taxes enforce optimal behavior in any routing game without a priori knowledge of the specific game parameters. In general, these taxes may be very high; accordingly, for affine-cost parallel-network routing games, we explicitly derive the optimal bounded tolls and the best-possible performance guarantee as a function of a toll upper-bound. Finally, we restrict attention to very simple fixed-toll methodologies and show that they are incapable of providing strong performance guarantees if the designer lacks good information about either the network topology or the user sensitivities.

Inspection Game with Partial Inspections

Elham Nikram and Dieter Balkenborg

Session: Thu9-P

In this study we investigate a version of the Inspection Game first introduced by Dresher (1962), where the inspector may use a mixture of partial and full inspections. With a partial or incomplete inspection, a violation may only be found with a probability significantly less than one. We investigate the behaviour of players in the equilibrium and describe some of its qualitative features. We show that as long as the opportunity for a full inspection exists, the inspector never starts his sequential inspections with a partial

inspection. As the game has been modelled as a zero sum game, by investigating the value of the game we have an efficient tool to compare the efficiency of the full and partial inspections.

Proportional use of force in counter-terrorism

Artyom Jelnov

Session: Thu9-P

This paper studies a concept of proportional use of force in a counter-terrorism action. The terrorist organization decides whether to attack or not to attack the state, while the state decides about his counter-terrorist measure. The state is supposed not to use a 'non-proportional' force, namely, the counter-terrorist measure taken by the state should be sufficient to remove a threat imposed by terrorists, but not higher than that. The level of force required against the terrorist organization is a private information of the organization. The model predicts under which conditions terrorists will not attack the state, and under which conditions with a positive probability the attack will take place, the state will react with a tough counter-terrorist measure and the state may be accused for non-proportional use of violence.

Computing Possible and Necessary Equilibrium Actions (and Bipartisan Set Winners)

Markus Brill, Rupert Freeman and Vincent Conitzer

Session: Thu9-Q

In many multiagent environments, a designer has some, but limited control over the game being played. In this paper, we formalize this by considering incompletely specified games, in which some entries of the payoff matrices can be chosen from a specified set. We show that it is NP-hard for the designer to make these choices optimally, even in zero-sum games. In fact, it is already intractable to decide whether a given action is (potentially or necessarily) played in equilibrium. We also consider incompletely specified symmetric games in which all completions are required to be symmetric. Here, hardness holds even in weak tournament games and in tournament games. The latter result settles the complexity of the possible and necessary winner problems for a social-choice-theoretic solution concept known as the bipartisan set. We finally give a mixed-integer linear programming formulation for weak tournament games and evaluate it experimentally

Exclusion Method for Finding Nash Equilibrium in Multi-Player Games

Kimmo Berg and Tuomas Sandholm

Session: Thu9-Q

We present a complete method with the best-known upper bound for computing an epsilon-Nash equilibrium in multiplayer games. The main components of our tree-search-

based method are a node-selection strategy, an exclusion oracle, and a subdivision scheme. The node-selection strategy determines the next region to be explored. The exclusion oracle provides a provably correct sufficient condition for there not to exist an equilibrium in the region. The subdivision scheme determines how the region is split if it cannot be excluded. Unlike well-known incomplete methods, our method does not need to proceed locally, which avoids it getting stuck in a local minimum that may be far from any actual equilibrium. The run time of our algorithm grows rapidly with game size; this suggests a hybrid scheme where one of the relatively fast prior incomplete algorithms is run, and if it fails to find an equilibrium, then our method is used.

On the relationship between Shapley and configuration values

Xun-Feng Hu and Deng-Feng Li

Session: Thu9-R

In this paper, we propose two kinds of analytic relationships between the Shapley value and the configuration value. Firstly, by introducing an appropriate probability distribution on the coalition configuration set, we prove that the Shapley value coincides with the expectation of the configuration values. Then, as a corollary, we establish that the Shapley value equals the average of the configuration values over each set of the same kind of coalition configurations. The equivalence of these two results is ensured by proving that the corollary implies the first result. Finally, we show that similar analytic relationships also hold between the Shapley value and the dual configuration value, while they do not hold between the Banzhaf-Coleman index and the generalized Banzhaf-Coleman index.

Backward induction foundations of the Shapley value

Ben Mcquillin and Robert Sugden

Session: Thu9-R

We present a noncooperative game model of coalitional bargaining, closely based on that of Gul (1989) but solvable by backward induction. In this game, Gul's condition of 'value additivity' does not suffice to ensure the presence of a subgame perfect Nash equilibrium that supports the Shapley value, but a related condition - 'no positive value externalities' - does. Multiple equilibria can arise only in the event of ties, and with a mild restriction on tie-break rules these equilibria all support the Shapley value.

Decomposition of solutions and the Shapley value

Andr Casajus and Frank Huettner

Session: Thu9-R

We suggest a foundation of the Shapley value via the decomposition of solutions for cooperative games with transferable utility. A decomposer of a solution is another solution that splits the former into a direct part and an indirect part. While the direct part (the

decomposer) measures a player's contribution in a game as such, the indirect part indicates how she affects the other players' direct contributions by leaving the game. The Shapley value turns out to be unique decomposable decomposer of the naive solution, which assigns to any player the difference between the worth of the grand coalition and its worth after this player left the game.

Income Inequality and Political Polarization

Yiming Liu

Session: Thu9-S

In last four decades, party polarization and income inequality have been rising in tandem. In this paper we try to build a link between them. We consider a Spatial model of redistribution with heterogeneity in voters' wealth. Two ex ante identical candidates for a public office compete by proposing redistributive taxes. Voters also care about candidates' valence, which is determined by individual contributions. Voters contribute to their preferred candidates to persuade other voters who initially prefer the other candidate. Rich voters have the strongest preferences for tax rates and are more likely to contribute. In equilibrium, policy polarization (divergence) depends on income inequality. With low enough inequality, median voter theorem holds; otherwise, there exist polarized equilibria in which one party chooses a policy that appeals to a large share of poor voters, while another party will select a policy that is preferred by a smaller group of rich voters.

Polarization and Pandering in a Spatial Model of Common-Value Elections

Joseph McMurray

Session: Thu9-S

This paper analyzes candidate incentives in a spatial model of common-value elections - in essence synthesizing the very different but canonical approaches of Condorcet and Downs. Office motivation can push candidates toward the political center, but the welfare consequences of this are opposite those of standard private-value models. Moreover, in large elections, a candidate who believes that truth is on her side sees no need to moderate, and may thus remain highly polarized even if she is highly office motivated.

The Optimal Degree of Centralization

Charles Zheng

Session: Thu9-S

This paper considers the normative foundation of government based on a Hobbesian anarchy where one region may pillage the other. A center that takes enough power from the regions and helps the victim to fight the aggressor can deter warfare thereby incentivizing productive efforts of the regions, but with less power the regions become less productive. This paper characterizes the social-surplus maximizing allocation of power, which

depending on the parameters can be fully decentralized to the regions or centralized to some degree. The paper proves that, when the marginal product of power and the supermodularity between power and efforts are sufficiently small, every fully decentralized system generates less social surplus at equilibrium than some centralized one. In a numerical example, every fully decentralized system generates less social surplus than even the total centralization, with regions completely powerless and the center maximizing the tax revenues extracted from them.

Benchmarking

Christopher Chambers and Alan Miller

Session: Thu9-T

We introduce a theory of ranking sets of accomplishments in the presence of objectively incomparable marginal contributions (apples and oranges). Our theory recommends benchmarking, a method under which an individual is deemed more accomplished than another if and only if she has achieved more benchmarks, or important accomplishments. We show that benchmark rules are characterized by four axioms: transitivity, monotonicity, incomparability of marginal gains, and incomparability of marginal losses. The latter two properties are local, and hence we endogenously derive a concept of a global, objective good, which we call a benchmark.

sophisticated sincerity with incomplete information

Benny Moldovanu and Andreas Kleiner

Session: Thu9-T

We study binary, sequential voting procedures in settings where several privately informed agents have single-peaked preferences on a finite set of alternatives. We identify two intuitive conditions on binary voting trees, convexity of divisions and monotonicity of qualified majorities, ensuring that sincere voting at each stage forms an ex-post perfect equilibrium in the associated extensive form game with incomplete information. We illustrate our findings with several case studies.

Revealed Relative Utilitarianism

Tilman Borgers and Yan Min Choo

Session: Thu9-T

We consider the aggregation of agents von Neumann-Morgensterns utility functions into a societal von Neumann-Morgenstern utility function. We start from Harsanyi's (1955) axiomatization of utilitarianism, and ask when a social preference order that satisfies Harsanyi's axiom uniquely reveals society's marginal rates of substitution between the probabilities of any two agents most preferred alternatives. We then introduce three axioms for these revealed marginal rates of substitution. Our main result is that the only

welfare function satisfying these three axioms is the relative utilitarian welfare function. This welfare function, that was introduced in Dhillon (1998) and Dhillon and Mertens (1999), normalizes agents utility functions so that the lowest utility is 0 and the highest is 1, and then adds up the utility functions. The three axioms that we introduce are related to axioms that Dhillon and Mertens used, but our axioms allow a simpler and more transparent derivation of the main result.

Causal Responsibility in Games

Florian Engl

Session: Thu9-U

I study the attribution of responsibility to agents for the implementation of an event, when the event's implementation depends on the interaction of multiple agents and/or chance. In particular, I develop a notion of causal responsibility, which is based on a counterfactual-reasoning approach, incorporate the notion into a framework of responsibility preferences, study its implication for the allocation of punishment and reward in a game-theoretic environment, and test the predictions of the theory with existing experimental evidence. Responsibility preferences imply that, in addition to their preferences over monetary payoffs, agents have a taste to reward (punish) other agents for the implementation of what they judge as good (bad) events, to the extent that those agents are causally responsible for the event.

An Experimental Test of Belief Free Strategies in a Repeated Game with Stochastic Private Monitoring

Paul Healy, Ritesh Jain and Ryan Oprea

Session: Thu9-U

We study the prevalence of belief free strategies in repeated games with stochastic private monitoring. In these games players receive noisy private signals of their opponent's action each period, and with some probability each period they also view the entire history of play without noise. The opponent is not informed when the noiseless history is revealed, so the game is one of private monitoring. In an experiment we ask subjects to choose their next period's action after observing the noisy signal. The subject then discovers whether they learn the entire (noiseless) history of play. If they do, they have the opportunity to revise their next-period action. Subjects using belief-free strategies will not revise their next-period action after observing the entire history.

Good News and Bad News are Still News: Experimental Evidence on Belief Updating

Alexander Coutts

Session: Thu9-U

Bayesian updating remains the benchmark for dynamic modeling under uncertainty. Recent theory and evidence suggests individuals process information in a biased manner when it relates to personal characteristics or future life outcomes. Specifically, updating has been found to be asymmetric, with good news receiving more weight than bad news. I put this theory and evidence to the test, by examining information processing across multiple domains with varying stake conditions. I do not find that good news is over-weighted relative to bad news, but in fact, I find the opposite asymmetry. However the same updating patterns are present in domains that have no scope for the type of psychological bias discussed in the literature. As in previous research, I also find gender differences in updating behavior, however these differences are similarly present across domains. Despite deviations from the mechanics of Bayes' rule, posterior beliefs are well approximated by Bayesian posteriors.

An implementation of the Vickrey outcome for buyers-submodular one-seller markets

Francisco Robles

Session: Thu11-A

A market with only one seller and many buyers is considered. The seller owns several indivisible heterogeneous objects on sale and each buyer can acquire many objects. Buyers have submodular valuation functions over the set of all packages of objects. The aim of this paper is to analyze the following mechanism. Simultaneously, each buyer requests a package by announcing how much he would pay for it. After all buyers' requests, the seller decides the final assignment of packages and the prices. If a buyer gets a package of objects, it must be his request or an allocation at least as good as his request. The subgame perfect equilibrium outcomes of the mechanism correspond to the Vickrey outcome (see Vickrey, 1961) of the market.

Partnership Dissolution, Auctions and Differences between Willingness to Pay and Willingness to Accept

Alexander Heczko

Session: Thu11-A

We extend the partnership dissolution model by Cramton et al. (CGK, 1987) and allow for differences in willingness to accept (WTA) and willingness to pay (WTP). We determine a necessary and sufficient condition for the existence of an individually rational, ex post efficient, budget balanced and incentive compatible dissolution mechanism for the

prominent 50-50 ownership case. In contrast to CGK no partnership can be dissolved ex-post efficiently if a partners difference between WTA and WTP is within a certain range. Consequently, partners might not be willing to participate in the widely analyzed $k+1$ -price auction. For $k=1/2$ we study a $k+1$ -price auction with voluntary participation and compare its performance with a $k+1$ -price auction which allows separate bids for different shares. Only for small differences in WTA and WTP the first outperforms the second in terms of efficiency and ex ante expected utilities.

Revenue-capped efficient auctions

Nozomu Muto, Yasuhiro Shirata and Takuro Yamashita

Session: Thu11-A

This paper studies an auction that maximizes the expected social surplus under an upper-bound constraint for the seller's expected revenue (revenue cap). Such a constrained-efficient auction may arise, for example, when the auction designer is "pro-buyer", i.e., he maximizes the weighted sum of the buyers' and the seller's payoffs in auctions, where the weight for the buyers is larger than that for the seller. We characterize the constrained-efficient auction mechanisms, and obtain their important properties under reasonable assumptions. First, the seller sets no reserve price, and sells the good for sure. Second, with a nontrivial revenue cap, "bunching" is necessary (i.e., failure of the pointwise maximization approach). Finally, with a sufficiently severe revenue cap, bunching occurs (at least) "at the top" (i.e., failure of "no distortion at the top"), which is implemented by a bid cap.

Concealments of Problems: An Incentive of Avoiding the Responsibility

Tomoya Tajika

Session: Thu11-B

We study workers' incentives for reporting problems within a firm, by considering an OLG organization consisting of an apprentice and a manager. The apprentice is responsible for detecting and reporting a problem, and the manager is responsible for solving the reported problem. An unsolved problem may cause accidents, in which case, the blame is placed on the manager if the problem has been reported in the past. The apprentice has an incentive to conceal a problem since if he reports it but the manager's ability is too low for the problem, the responsibility is transferred to the apprentice since he becomes a manager in the next period. We show that concealment is more likely when the problem gets larger over time. We also show that if the blame to the manager for ignoring a problem gets large, concealment may get worse.

Strategic Corporate Social Responsibility

Lisa Planer-Friedrich and Marco Sahm

Session: Thu11-B

We examine the strategic use of Corporate Social Responsibility (CSR) in oligopolistic markets. In our two-stage model, the level of CSR determines the weight that a firm puts on consumer surplus in its objective function before it decides upon supply. First, we consider symmetric Cournot competition and show that the endogenous level of CSR is positive for any given number of active firms. However, positive CSR levels imply smaller equilibrium profits. Second, we find that an incumbent monopolist may profitably use CSR as an entry deterrent. Both results indicate that CSR may increase market concentration and possibly be anticompetitive. We identify circumstances in which CSR mitigates the problem of excessive entry and increases total welfare but decreases consumer surplus.

Responsibility-based allocation of cartel damages

Stefan Napel and Dominik Welter

Session: Thu11-B

In 2014, the EU passed a directive on antitrust damages actions which facilitates the compensation of cartel victims. Anti-trust infringers are liable jointly and severally: a victim can sue any cartel member and this firm must pay compensation on behalf of all. The sued cartel member can later seek redress from its former collaborators. The directive requires that individual compensation contributions reflect relative responsibility but leaves open how to quantify this. We propose to invoke the Shapley value for assessing cartel members' contributions to equilibrium price increases. We provide first structural results and address two practical questions: are there useful bounds on fair damage shares? Does any simple heuristic, like equating responsibility with market shares, approximate the Shapley allocation better than others?

Occurrence of deception in the presence of a regulator with reputation concerns

Ayca Ozdogan

Session: Thu11-D

This paper studies deception by an agent in the presence of a regulator, who is supposed to detect deviations from rightful behavior through costly monitoring. The goal is to understand occurrence of deceptions when the regulator has reputation concern for being diligent. We find that when the regulator faces a sequence of myopic agents, reputation helps the regulator to prevent the undesirable behavior of the agents and to achieve the first best payoff: Her payoff at any Nash equilibria converges to the maximum as the discount factor approaches to one for any prior belief about the regulator's type. And,

there is a unique Markov equilibrium with a continuous and nondecreasing value function at which the reputation for being diligent persists whenever it reaches to a threshold level with the associated value function attaining its highest value. These results are likely to differ when the regulator faces the same long-lived agent.

A network-based rating system and its resistance to bribery

Umberto Grandi and Paolo Turrini

Session: Thu11-D

We study a rating system in which a set of individuals (e.g., the customers of a restaurant) evaluate a given service (e.g, the restaurant), with their aggregated opinion determining the probability of all individuals to use the service and thus its generated revenue. We explicitly model the influence relation by a social network, with individuals being influenced by the evaluation of their trusted peers. On top of that we allow a malicious service provider (e.g., the restaurant owner) to bribe some individuals, i.e., to invest a part of his or her expected income to modify their opinion, therefore influencing his or her final gain. We analyse the effect of bribing strategies under various constraints, and we show under what conditions the system is bribery-proof, i.e., no bribing strategy yields a strictly positive expected gain to the service provider.

Multi-sided assignment games on m-partite graphs

Ata Atay and Marina Nunez

Session: Thu11-E

We consider a multi-sided assignment game with the following characteristics: (a) the agents are organized in m sectors that are connected by a graph G^* associated with a weighted m -partite graph G on the set of agents, (b) a basic coalition is formed by agents from different sectors that are connected by G^* and (c) the worth of a basic coalition is the addition of the worths of all its pairs that belong to connected sectors. We provide a sufficient condition on the weights to guarantee balancedness of the related multi-sided assignment game. Moreover, when the graph G^* is a tree, we prove the game is strongly balanced and the core is described by means of the cores of the underlying two-sided assignment games associated with the edges of G . If the tree G^* is a star, then the core can be characterized by means of the competitive prices.

d-dimensional Stable Matching with Cyclic Preferences

Johannes Hofbauer

Session: Thu11-E

Gale and Shapley [D. Gale and L. S. Shapley. College admissions and the stability of marriage. The American Mathematical Monthly, 69(1):915, 1962] have shown that in marriage markets, where men and women have preferences over potential partners of the

other gender, a stable matching always exists. In this paper, we study a more general framework with d different genders due to Knuth [D. E. Knuth. *Mariages stables*. Les Presses de l'Universit  de Montral, 1976]. The genders are ordered in a directed cycle and agents only have preferences over agents of the subsequent gender. Agents are then matched into families, which contain exactly one agent of each gender. We show that there always exists a stable matching if there are at most $d+1$ agents per gender, thereby generalizing and extending previous results. The proof is constructive and computationally efficient.

Hard to get: The scarcity of women and the competition for high-income men in Chinese cities

David Ong, Yu Yang and Junsen Zhang

Session: Thu11-E

We test for the competitive consequences of women's preference for men who have higher incomes than themselves. We show that the key characteristic of this reference dependent preference (RDP) is to escalate the competition women face as their incomes increase by reducing the pool of men they desire while simultaneously expanding the pool of other women who desire those men. Consequently, high-income women can be made worse off when high-income men are even richer or more plentiful, because either increases the returns to poorer women in competing for those men. We exploit variations in local sex ratios and men's incomes across major cities in China to test for changes in the online dating search intensity, marriage probability, and household bargaining power of women. As predicted, the search intensity, singles probability, and share of housework of only the high-income women increase with the incomes and availability of men.

Scale-invariant citation indices

William Zwick and Josep Freixas

Session: Thu11-F

Citation indices measure and rank publication records of scholars. Some well known indices reward records that balance impact I with productivity P ; many publications with few citations will score poorly, as will a small number of heavily cited papers. Often implicit, however, is a single optimal trade-off ratio r of productivity to impact – think of r as a fixed scale factor relating the unit size on the I axis to that on the P axis. Scholars, or entire disciplines, may be assigned higher index values if their publication records fit better with r ; this can scramble the relative ordering of scholars within a discipline, in an undesirable way. We propose four scale-invariant indices modeled loosely on John Nash's bargaining solution. These preserve some degree of impact-productivity balance, while adjusting r to best fit the publication record of each scholar. We mention the advantages, and discuss axioms that capture scale-invariance.

Co-authorship and the Measurement of Individual Productivity

Karol Szwagrzak and Rafael Treibich

Session: Thu11-F

We propose a new index of individual scientific productivity that formally accounts for coauthorship. In contrast to existing measures, our index, CoScore, reflects the complete coauthorship network, not only the publication record of the author being ranked. CoScore uses the varying levels of success of all academic partnerships to infer, simultaneously, an author's productivity and her credit for each of her papers. Crucially, the productivities of all authors are determined endogenously via the solution of a fixed point problem. We illustrate CoScore for a large database of papers in economics.

How to score multiple-choice tests: an axiomatic approach

Andy Zapechelnyuk

Session: Thu11-F

This note axiomatically justifies a simple scoring rule for multiple-choice tests. The rule permits choosing any number, k , of available options and grants $1/k$ -th of the maximum score if one of the chosen options is correct, and zero otherwise. This rule satisfies a few desirable properties: simplicity of implementation, non-negative scores, discouragement of random guessing, and rewards for partial answers. This is a novel rule that has not been discussed or empirically tested in the literature.

Adjacent non-manipulability and strategy-proofness in voting domains: equivalence results

Sonal Yadav, Arunava Sen, Souvik Roy and Huaxia Zeng

Session: Thu11-G

A plausible incentive compatibility requirement based on behavioral considerations, is that agents only consider manipulations that are “close” to their true preference. In a finite voting environment, this is interpreted as preference orderings that are at a Kemeny distance of one from the true preference ordering. A social choice function (SCF) is adjacent manipulation (AM) proof, if it is immune to such manipulations. A domain satisfies equivalence if every AM-proof SCF defined on this domain, is also strategy-proof. Sato (2013) provides a necessary condition and a separate, stronger sufficient condition for equivalence. We extend Sato's results in several directions. We identify a condition which is necessary for equivalence; in conjunction with Sato's necessary condition, it is sufficient for equivalence for SCF's satisfying unanimity. We also provide an additional, stronger sufficient condition for equivalence without unanimity. We show that every unanimous and AM-proof SCF is also group strategy-proof provided equivalence holds.

Bribeproof mechanisms for two-values domains

Matúš Mihalák, Paolo Penna and Peter Widmayer

Session: Thu11-G

Schummer (Journal of Economic Theory, 2000) introduced the concept of bribeproof mechanism, which, in a context where monetary transfer between agents is possible, requires that manipulations through bribes are ruled out. Unfortunately, in many domains, the only bribeproof mechanisms are the trivial ones which return a fixed outcome. This work presents one of the few constructions of non-trivial bribeproof mechanisms for the quasi-linear environments. Though the suggested construction applies to rather restricted domains, the results obtained are tight: For several natural problems, the method yields the only possible bribeproof mechanism and no such mechanism is possible on more general domains.

Strategy-proofness and double implementation with minimax and maximax strategies

Tsuyoshi Adachi

Session: Thu11-H

This study proposes a double implementation of two solution concepts derived from minimax and maximax strategies and examines its relationship with strategy-proofness (or dominant strategy implementation). Although the combination of the two solution concepts is strictly weaker than a dominant strategy, their double implementation implies strategy-proofness when the preference domain satisfies a richness condition; consequently, their double implementation is almost equivalent to a dominant strategy implementation. Our richness condition is weaker than the condition of Sato (2013) for adjacent strategy-proofness to be equivalent to strategy-proofness, and is satisfied by the general domains based on convexity, including standard economic environments and single-peaked preferences allowing weak orders.

Robustness of Subgame Perfect Implementation

Peter Eccles and Nora Wegner

Session: Thu11-H

In this paper we consider the robustness of subgame-perfect implementation in situations when the preferences of players are almost perfectly known. More precisely we consider a class of information perturbations where in each state of the world players know their own preferences with certainty and receive almost perfectly informative signals about the preferences of other players. We show that implementations using two-stage sequential move mechanisms are always robust under this class of restricted perturbations, while those using more stages are often not.

An evolutionary approach to social choice problems with q-quota rules

Akira Okada and Ryoji Sawa

Session: Thu11-J

This paper considers a dynamic process of n-person social choice problems under q-majority where a status-quo policy is challenged by an opposing policy drawn randomly in each period. The opposing policy becomes the next status-quo if it receives at least q votes. We characterize stochastically stable policies under a boundedly rational choice rule of voters. Under the best response rule with mutations, a Condorcet winner is stochastically stable for all q-quota rules, and uniquely so if q is greater than the minmax quota. Under the logit choice rule, the Borda winner is stochastically stable under the unanimity rule. Our evolutionary approach provides a dynamic foundation of the mini-max policies in multidimensional choice problems with Euclidean preferences.

Opinion Formation with Imperfect Agents as an Evolutionary Process

Matjaz Steinbacher and Mitja Steinbacher

Session: Thu11-J

We study the evolutionary dynamics of a discrete-time continuous-opinion model under bounded confidence in a complete network with random meetings when different types of agents are present, i.e. regular, stubborn and insincere. We find the following. Even though the decision-making succumbs to the contraction principle, the opinion dynamics converges to multiple opinion clusters if regular agents are present with insufficient threshold levels. Further, we identify the conditions under which the process with stubborn agents generates long-run consensus, permanent disagreement or permanent fluctuation in opinions. Even a small deviation towards the inconsistent behavior by a small fraction of agents may turn the society into a persistent fluctuation in opinions. The size of a quorum reduces the effects of insincere counterparts. Simulations generated some non-linearities in the process of opinion formation, giving us some additional insights into the relationship between agents' tolerance and the level of extremism in a society.

The Evolution of Conventions under Condition-Dependent Mistakes

Ennio Bilancini and Leonardo Boncinelli

Session: Thu11-J

In this paper we study the long run convention emerging from stag-hunt interactions when errors occur at a rate that is inversely related to the payoff previously earned, i.e., condition-dependent mistakes. We find that, if interactions are sufficiently stable over time, then the payoff-dominant convention emerges in the long run. Instead, if interactions are volatile, then the safer convention emerges even if it is not risk-dominant. We contrast the results under condition-dependent mistakes with results under alternative error models: error rates that are constant over states, i.e., uniform mistakes, and error

rates that depend on expected losses, i.e., payoff-dependent mistakes.

The Advantage of Sex and Selfish Alleles

Katharina Schüller and Frank Thuijsman

Session: Thu11-K

Research on the advantage of sexual over asexual reproduction is widely spread. Many hypotheses try to explain effects that compensate the disadvantages of the (expensive) sexual way of reproduction. In our work, we focus on the differences in the genetics of the species with respect to their reproduction method. Based on theoretical work by Edhan et al. [2015], we developed a software tool that tracks the growth of species depending on the chosen way of reproduction. In order to verify the theoretical results, we are able to adjust lots of initial settings like for example the available genotype space or the survival chance of arising genotypes. Besides examining the effects in genotype space, we also examine what happens in allele space. We use our software to investigate various scenarios like mutations or spatial structures that are difficult to examine theoretically.

Sex With No Regrets: How Sexual Reproduction Uses a No Regret Learning Algorithm for Evolutionary Advantage

Omer Edhan, Ziv Hellman and Dana Sherill-Rofe

Session: Thu11-K

'Why sex' has long been a puzzle. The randomness of sexual recombination, which potentially lowers fitness, contradicts expectations of monotonic fitness landscape climbing. We show that sex implements a machine learning no-regret algorithm that is a goal-directed walk through genotype space. The algorithm reliably works even though each generation is a tiny sample of the vast genotype space. Simulations indicate this gives sex an evolutionary advantage, even in stable, unchanging environments. Asexual populations rapidly reach a fitness plateau, but the learning aspect of the no-regret algorithm most often eventually boosts the fitness of sexual populations past the maximal viability of corresponding asexual populations. The randomness of sexual recombination, rather than a hindrance, is a crucial component of the learning by sampling no-regret algorithm.

Deep Learning for Human Strategic Modeling

Jason Hartford, James Wright and Kevin Leyton-Brown

Session: Thu11-K

Predicting the behavior of human participants in strategic settings is an important problem in many domains. Most existing work either assumes that participants are perfectly rational, or attempts to directly model each participant's cognitive processes based on insights from cognitive psychology and experimental economics. In this work, we present an alternative, a deep learning approach that automatically performs cognitive modeling

without relying on such expert knowledge. We introduce a novel architecture that allows a single network to generalize across different input and output dimensions by using matrix units rather than scalar units, and show that its performance reaches that of the previous state of the art, which relies on expert-constructed features.

Extortion can outperform generosity in the iterated Prisoner's Dilemma

Bin Xu, Yanran Zhou, Jaimie Lien, Jie Zheng and Zhijian Wang

Session: Thu11-L

The zero-determinant (ZD) strategies, raised by Press and Dyson, can enforce a linear relationship between a pair of players' scores in the iterated Prisoner's Dilemma. In particular, the Extortionate ZD strategies can enforce and exploit cooperation and provide a player with a score advantage, and consequently, higher scores than those from either mutual cooperation or Generous ZD strategies. In a set of laboratory experiments, we demonstrate that both the Generous and the Extortionate ZD strategies indeed enforce a unilateral control of the reward. When the experimental setting is sufficiently long and the computerized nature of the opponent is known to human subjects, the Extortionate strategy outperforms the Generous strategy. Human subjects' cooperation rates when playing against Extortionate and Generous ZD strategy are similar after learning has occurred. We observe that more than half of the Extortionate strategists finally obtain an average score higher than that from mutual cooperation.

Accuracy and Retaliation in Repeated Games with Imperfect Private Monitoring: Experiments and Theory

Hitoshi Matsushima, Yutaka Kayaba and Tomohisa Toyama

Session: Thu11-L

This paper experimentally examines repeated prisoners dilemma with random termination, where monitoring is imperfect and private. Our estimation of individual strategies indicates that a significant proportion of our subjects follow generous tit-for-tat strategies. However, their retaliation policies are systematically inconsistent with the standard-theoretical predictions implied by the generous tit-for-tat equilibria. Contrary to the theory, our subjects tend to retaliate more in the high accuracy treatment than in the low accuracy treatment. They also tend to retaliate more than the standard theory predicts in the high accuracy treatment, while they tend to retaliate lesser in the low accuracy treatment. In order to describe our experimental results as equilibrium behavior, we demonstrate an alternative theory from the behavioral viewpoint, which permits players to be motivated by not only pure self-interest but also navet and reciprocity.

Persuasion and Transparency

Ronen Gradwohl and Timothy Feddersen

Session: Thu11-M

An advisory committee with common values and asymmetric information provides a recommendation to a decision maker facing a binary choice. We investigate the effect of a transparency requirement—making committee members' actions observable—on the committee's ability to influence the decision maker. We show that unless the preferences of the committee and decision maker are very close, requiring transparency is harmful, as it destroys the committee's ability to provide any useful information. In contrast, if committee members are able to verifiably reveal their signals then transparency can be beneficial.

The Optimal Timing of Persuasion

Jacopo Bizzotto, Jesper Rüdiger and Adrien Vigier

Session: Thu11-M

We study the effect of the arrival of exogenous news in dynamic games of Bayesian persuasion. A receiver chooses what action to take, and when to act. If Receiver waits, exogenous news may be observed. A sender chooses a first information structure that generates a signal before the news and, if Receiver waits, a second signal structure after the news. Receiver observes the signal structures, as well as the corresponding signal realized. We show that, in the sense of Blackwell, information provided by Sender before the news is non-monotonic in the quantity of exogenous news. For very small and very large quantities of exogenous news, Sender provides enough information for Receiver to act before the news with probability one. By contrast, for intermediate quantities of exogenous news, Sender curbs the information she provides, in a way that minimizes the chances of Receiver acting early against Sender's interest.

Optimal price caps in congested networks

Tobias Harks, Marc Schröder and Dries Vermeulen

Session: Thu11-N

We study the efficiency of price cap regulation in a competitive market with congestion externalities. Each link in a network is owned by a profit-maximizing firm that sets a price for travel. The subgame perfect equilibrium of the associated game is called oligopoly equilibrium in Acemoglu and Ozdaglar (2007). The latency costs of an oligopoly equilibrium can be arbitrarily worse than the optimal latency costs. Therefore we consider competition regulation in the form of a price cap. On the one hand, setting a price cap of zero corresponds to a Wardrop equilibrium. On the other hand, setting a price cap of infinity corresponds to an oligopoly equilibrium. We characterize a tight bound of $8/7$ between the latency costs at the optimal price cap and the optimal latency costs, when there are two links with affine latency functions. In general, this ratio is unbounded due

to the non-existence of oligopoly equilibria.

The curse of sequentiality in routing games

Jasper de Jong, Bart De Keijzer, Marc Uetz and Jose Correa

Session: Thu11-N

In “The curse of simultaneity”, Paes Leme et al. show that there are interesting classes of games for which sequential decision making and subgame perfect equilibria avoid worst case Nash equilibria, resulting in substantial improvements for the price of anarchy. This is called the sequential price of anarchy. A handful of papers have lately analyzed it for various problems, yet one of the most interesting open problems was to pin down its value for linear atomic routing games, where the price of anarchy equals $5/2$. The main contribution of this paper is the surprising result that the sequential price of anarchy is unbounded even for linear symmetric routing games, thereby showing that sequentiality can be arbitrarily worse than simultaneity for this class of games. Additionally, we prove price of anarchy bounds and, that in these games, even with two players, computing the outcome of a subgame perfect equilibrium is NP-hard.

Second-best Probability Weighting

Florian Herold and Nick Netzer

Session: Thu11-P

Non-linear probability weighting is an integral part of descriptive theories of choice under risk such as prospect theory. But why do these objective errors in information processing exist? Should we try to help individuals overcome their mistake of overweighting small and underweighting large probabilities? In this paper, we argue that probability weighting can be seen as a compensation for preexisting biases in evaluating payoffs. In particular, inverse S-shaped probability weighting in prospect theory is a flipside of S-shaped payoff valuation. Probability distortions may thus have survived as a second-best solution to a fitness maximization problem, and it can be counter-productive to correct them while keeping the value function unchanged.

Subjective expected utility representations for Savage preferences on topological spaces

Marcus Pivato and Vassili Vergopoulos

Session: Thu11-P

In many situations of decision-making under uncertainty, the set of possible states of the world and the set of possible outcomes each have a topological structure, and the only feasible acts are those where the outcome varies continuously with the state. Indeed, in some situations, the only feasible acts are differentiable functions. Savages (1954) axioms do not apply to such a restricted domain of acts. Nevertheless, we axiomatically charac-

terize a Subjective Expected Utility (SEU) representation of ex ante preferences in this environment. Our SEU representation involves a unique Borel probability measure on the state space, and an essentially unique, continuous utility function on the outcome space.

Non-cooperative games with prospect theory players and dominated strategies

Lars Metzger and Marc Rieger

Session: Thu11-P

We investigate a framework for non-cooperative games in normal form where players have behavioral preferences following Prospect Theory (PT) or Cumulative Prospect Theory (CPT). On theoretical grounds CPT is usually considered to be the superior model, since it normally does not violate first order stochastic dominance in lottery choices. We find, however, that CPT when applied to games may select purely dominated strategies, while PT does not. For both models we also characterize the cases where mixed dominated strategies are preserved and where violations may occur.

Utilitarian Nash Equilibrium for Games with Incomplete Preferences

Youssef Askoura and Antoine Billot

Session: Thu11-Q

We consider a framework where each player has incomplete preferences and is viewed as a multiutility decision-maker. We define a decision rule as a probability distribution over each player's set of infinitely many utilities and prove first that, in a basic model of incomplete information with linear utilities, the decision rule corresponds to the utilitarian aggregation one. Consequently, we establish a generalization of Harsanyi's (1955) famous possibility result for infinitely many individuals (Theorems 1-2). Finally, we prove the existence of a Nash equilibrium for normal form games with incomplete information where players are multiutility decision-makers and conform with the utilitarian decision rule (Theorem 3).

Simultaneous Abstraction and Equilibrium Finding in Games

Noam Brown and Tuomas Sandholm

Session: Thu11-Q

A key challenge in solving extensive-form games is dealing with large, or even infinite, action spaces. In games of imperfect information, the leading approach is to find an equilibrium in an abstraction that includes only a few actions at each decision point. However, it is difficult to know which actions the abstraction should include without first solving the game, and it is infeasible to solve the game without first abstracting. We introduce an algorithm that combines abstraction with equilibrium finding by enabling actions to be added to the abstraction at run time. It can quickly add actions while provably not

having to restart equilibrium finding. It enables anytime convergence to a Nash equilibrium of the full game. Experimentally it outperforms fixed abstractions at every stage: early on it improves as quickly as equilibrium finding in coarse abstractions, and later converges to a better solution than equilibrium finding in fine-grained abstractions.

A Smooth Path-Following Method for Determining Perfect Equilibria

Yin Chen and Chuangyin Dang

Session: Thu11-Q

Perfect equilibrium (or trembling-hand perfect equilibrium) is a refinement of Nash equilibrium for finite n-person games. For any extensive-form game with perfect recall, the literature shows that a perfect equilibrium of its agent normal-form representation is also a perfect equilibrium of the extensive-form game itself, which always results in a sequential equilibrium. To effectively determine such a perfect equilibrium, this paper develops a smooth path-following method. The method closely approximates Nash equilibria of perturbed games by incorporating a logarithmic barrier term into each player's payoff function with an appropriate combination. It is proved that there exists a smooth path which starts from a totally mixed strategy profile and ends at a perfect equilibrium. A predictor-corrector method is adopted for numerically following the path. Numerical results further confirm the effectiveness of the method.

Reflections on the First Man vs. Machine No-Limit Texas Hold 'em Competition

Sam Ganzfried

Session: Thu11-R

The first ever human vs. computer no-limit Texas hold 'em competition took place from April 24 to May 8, 2015 at River's Casino in Pittsburgh, PA. In this article I present my thoughts on the competition design, agent architecture, and lessons learned.

Making the Rules of Sports Fairer

Steven Brams and Mehmet Ismail

Session: Thu11-R

The rules of many sports are not fair—they do not ensure that equally skilled competitors have the same probability of winning. As an example, the penalty shootout in soccer, wherein a coin toss determines which team kicks first on all five penalty kicks, gives a substantial advantage to the first-kicking team, both in theory and practice. We show that a so-called Catch-Up Rule for determining the order of kicking would not only make the shootout fairer but also is essentially strategyproof. By contrast, the so-called Standard Rule now used for the tiebreaker in tennis is fair. We briefly consider several other sports, all of which involve scoring a sufficient number of points to win, and show how they could

benefit from certain rule changes, which would be straightforward to implement.

Reciprocal Accountability with Multidimensional Policies

Mario Gilli and Li Yuan

Session: Thu11-S

Any political leader must be judged by her supporters and this is a constraint that is more or less binding depending on the authoritarian system. The literature on autocracies has not analyzed the fact that policies have multiple dimensions and that people observe the effects of some policy dimensions with noises. Our objective is to study the effects of these differences in public perception on the dictator's accountability. The crucial innovation is the two dimensional policy. Our model produces three clear results: the region of the selectorate's de facto power such that reciprocal accountability works shrinks as opacity increases, counter intuitively both the probability of full efficient and full inefficient policies decrease as opacity increases, finally, and mostly interesting, the expected probability of a coup might have a non monotone behavior wrt opacity, so that at intermediate level an increment in opacity might actually increase the likelihood of a coup.

A Reform Dilemma in Polarized Democracies

Hans Gersbach and Oriol Tejada

Session: Thu11-S

We study the feasibility and efficiency of policy reforms in polarized democracies. We develop an election model where (i) reforms are costly and these costs increase with the extent of policy change, and (ii) politicians differ in their ability to carry out reforms efficiently. We identify a so-called Reform Dilemma, which manifests itself in two variants. First, from a static perspective, low-reform-ability politicians may be elected, who impose high costs on citizens for each reform step. Second, from a dynamic perspective, incumbents may choose socially undesirable policies to align the social need for reform with their own reform ability, thereby increasing re-election chances or securing re-election outright. In general, both manifestations of the Reform Dilemma are more pronounced when political parties' positions are polarized. Furthermore, the Reform Dilemma is independent of the exact point in time when the abilities of candidates reveal themselves and become common knowledge.

Media Competition and the Source of Disagreement

Jacopo Perego and Sevgi Yuksel

Session: Thu11-S

We identify a novel channel through which increased competition among information providers decreases the efficiency of electoral outcomes. A number of profit-maximizing firms compete to sell information to a group of Bayesian agents about how two political

candidates compare on several issues. Voters can disagree on which issues are important to them (agenda) and on how each issue in their agenda should be addressed (slant). We show that competition forces firms to differentiate the type of information they produce. In particular, differentiation leads to higher provision of information on issues where there is higher disagreement in the electorate. Although voters become individually better informed, the share of votes going to the socially optimal candidate decreases. We also show that this inefficiency is magnified if there is higher polarization in the underlying preferences of the society.

Feasible elimination procedures in social choice: an axiomatic characterization

Bezalel Peleg and Hans Peters

Session: Thu11-T

Feasible elimination procedures (Peleg, 1978) play a central role in constructing social choice functions which have the following property: in the associated game form, for any preference profile there exists a strong Nash equilibrium resulting in the sincere outcome. In this paper we provide an axiomatic characterization of the social choice correspondence resulting from applying feasible elimination procedures. The axioms are anonymity, Maskin monotonicity, and independent blocking.

Strategic Manipulation of Social Welfare Functions via Strict Preference Extensions

Onur Dogan and Jean Lain

Session: Thu11-T

This paper investigates the robustness of aggregation rules to strategic manipulation. Preferences over alternatives are extended to preferences over orders, called hyper-preferences. An individual manipulates an aggregation rule at some profile if misrepresenting one's preference induces a social ordering that is preferred to the current one according to the hyper-preference generated by said preference. We provide a set of necessary and sufficient conditions on aggregation rules so that there exist hyper-preferences for which no individual can manipulate the outcome. Moreover, we introduce a constraint for domains of hyper-preferences that allow for non-trivial and non-manipulable aggregation rules. Later on, we shift our focus to hyper-preferences which satisfy the betweenness criterion. We provide a complete study of strategy-proofness for pairwise unanimous and anonymous aggregation rules defined for 3 alternatives. Finally, we show that when there are at least 3 alternatives, pairwise unanimity, anonymity, reverse orders independence and strategy-proofness are mutually incompatible.

Plurality Voting versus Proportional Representation in the Citizen-Candidate Model: An Experiment

Aaron Kamm

Session: Thu11-U

This paper implements the citizen-candidate paradigm in a laboratory experiment to investigate candidate behavior under different electoral rules and for varying costs of running for office. Comparing the candidates observed entry decisions under plurality voting and proportional representation (PR) I find support for the theoretical predictions. Entry rates are significantly higher under PR when such a treatment effect is expected but not in the absence of a predicted difference. This suggests that the increase in entry found under PR is not due to a heuristic but a response to the change in incentives. Furthermore, I find that as theoretically predicted higher costs of running for office lead to fewer entrants that are more centrist. Additionally, I replicate the well-known finding of over-entry compared to the Nash equilibrium predictions.

Condorcet Jury Theorem and Cognitive Hierarchies: Theory and Experiments

Yukio Koriyama and Ali Ihsan Ozkes

Session: Thu11-U

This paper introduces an endogenous cognitive hierarchy model in which players are assumed to best-reply holding heterogeneous beliefs on the other players' cognitive levels. Contrary to the previous models, players are allowed to consider presence of opponents at their own cognitive level. This extension is shown to eradicate the incompatibility of standard cognitive hierarchy models in the games where the best-reply function is an expansion mapping. We employ the model to explain asymptotic voting behavior in information aggregation problems of the Condorcet Jury Theorem. Behavioral assumption of the strategic thinking turns out to be a crucial factor in whether the asymptotic efficiency is obtained or not. We conducted laboratory experiments and obtained evidences that the endogenous cognitive hierarchy model provides significant improvements upon standard cognitive hierarchy models and symmetric Bayesian Nash equilibrium in explaining observed behavior of voters.

Expected-Norm Consistency: An Experimental Study of Trust and Trustworthiness

Miguel Costa-Gomes, Yuan Ju and Jiawen Li

Session: Thu11-U

In this experiment, subjects play both roles of a modified version of the trust game (Berg et al. 1995) and state their beliefs about their opponents behavior in both roles. We investigate how peoples trust and trustworthiness are connected to their beliefs about

their opponents. Our results confirm that most people carry out their actions based on their beliefs of what the others would do in their positions. Moreover, subjects behavior as trustees are significantly influenced by their experience and feedback of playing the trustors role. The experience of playing the trustees role, even without feedback information, helps the trustors make a better prediction of the trustees behavior. People are not as consistent in the trustee role.

EC'16

Abstracts

Learning good mechanisms

Jamie Morgenstern, Vasilis Syrgkanis

Session: EC-Tut-AGTDS

The first component of the tutorial will focus on "standard" sample complexity questions within mechanism design. We will first overview what is known about the sample complexity of revenue maximization, in both single-parameter and multiparameter settings. Many of these practical results show that low-dimensional classes of mechanisms can be learned with fewer samples, giving theoretical justification for trading off the number of parameters for revenue optimality when designing a mechanism. There are a wide variety of theoretical open problems, both in the small and large sample regimes, studying the optimal bicriterial guarantees for a variety of auction design problems. Most of these results hinge on a variety of assumptions about the distributions from which buyers are drawn. Practical work studying whether these assumptions are satisfied in real-world datasets can guide future theory and practice of designing mechanisms which generalize well from training to test.

Econometric theory

Jamie Morgenstern, Vasilis Syrgkanis

Session: EC-Tut-AGTDS

The second part of the tutorial will review recent progress in econometric theory for game theoretic settings. We will address questions such as, i) how to perform parametric inference from observed strategic interactions, ii) how does the structure of a game or mechanism affect the statistical properties of the resulting inference methods, iii) how to perform A/B testing in strategic market environments. A large part of this section will also cover techniques from the economics literature and present the state of the art from the econometrics community when addressing inference problems in game theoretic settings. This will help in two respects: i) to build upon existing results, ii) to understand how the computer science and algorithmic perspective can influence or inform existing results and questions already addressed by the econometric community.

Gambit and SageMath

Theodore Turocy

Session: EC-Tut-GTsoftware1

The main software package for computing in finite games is Gambit (<http://www.gambit-project.org>). It provides representations of finite games in extensive or strategic form, and implementations of many algorithms for analysing the set of Nash equilibria. Gambit is released under the open-source GNU General Public License. It is fully-cross platform, with Linux/Unix, Mac OS X, and Microsoft Windows implementations supported. We will begin with an introduction to the Gambit library. The core library is written in

C++, and each implementation of a method for computing the equilibria of games is contained in an independent module. These methods are also exposed as standalone command-line tools for interaction via shell scripts or calling from other tools without requiring linkage to the C++ libraries. There is a set of Python bindings to the Gambit library and analysis algorithms. In particular, Gambit is now included in SageMath (<http://www.sagemath.org>), an Open Source system for doing computational mathematics. We will illustrate the use of Gambit in Python and SageMath through a series of short examples. These will include examples of how the set of equilibria changes as a function of payoff parameters of the game.

Game Theory Explorer

Rahul Savani, Bernhard von Stengel

Session: EC-Tut-GTsoftware2

Game Theory Explorer (GTE, <http://www.gametheoryexplorer.org>) is a browser-based graphical interface for investigating games that does not require a download and local installation of the full Gambit packages. We present how the program is used, and the ideas behind its main algorithms. We report on experiences with the architecture of the software and its development as an open-source project.

Algorithms

Theodore Turocy

Session: EC-Tut-GTsoftware2

The second part of the tutorial on Gambit will present examples that illustrate the possibilities for computation in games at a scale suitable for research projects and real applications, including: The estimation of quantal response equilibrium (QRE), and its use in estimating payoff parameters using data from laboratory experiments; The analysis of Colonel-Blotto like games, such as the apex game model of political lobbying appearing in Montero et al (2016, Economic Theory); Optimal patrol strategies for real-world security applications, including metro systems and water-based transport; Modeling the “position auction” for online advertising allocation using action graph games.

The Bidder Exclusion Effect

Dominic Coey, Bradley Larsen, Kane Sweeney

Session: EC-AGTDS-Sun1330

No abstract given

Testing Choice Theories

Jan Christoph Schlegel

Session: EC-AGTDS-Sun1330

No abstract given

Non-revelation Mechanism Design

Jason Hartline, Samuel Taggart

Session: EC-AGTDS-Sun1330

No abstract given

ERA: A Framework for Economic Resource Allocation for the Cloud

Noam Nisan

Session: EC-Cloud-Sun1330

No abstract given

Cloud Pricing: The Spot Market Strikes Back

Ludwig Dierks, Sven Seuken

Session: EC-Cloud-Sun1330

No abstract given

On-Demand or Spot? Selling the Cloud to Risk-Averse Customers

Darrell Hoy, Nicole Immorlica, Brendan Lucier

Session: EC-Cloud-Sun1330

No abstract given

Pretium: Dynamic Pricing and Traffic Engineering for Timely Inter-Datacenter Transfers

Virajith Jalaparti, Ivan Bliznets, Srikanth Kandula, Brendan Lucier, Ishai Menache

Session: EC-Cloud-Sun1330

No abstract given

Approximately Efficient Cost Sharing via Double Auctions

Felix Fischer, Ian Kash, Peter Key, Junxing Wang

Session: EC-Cloud-Sun1330

No abstract given

Inference and Auction Design in Online Advertising

Denis Nekipelov

Session: EC-AGTDS-Sun1530

Many large online advertising platforms in the last decade have switched from the “traditional” approach to selling advertising through negotiated contracts to completely automated systems. These automated systems are generally powered by auctions that allocate and price the advertising slots contemporaneously on the basis of the bids submitted by the bidders. Such automated auction systems in the context of the fast paced Internet environment pose new challenges. First of all, these systems need to understand how to predict the behavior of advertisers and users exposed to the ads. Second, the advertising industry has to respond to the changes in technology and adapt to new user devices and new forms of ads. Finally, the design of advertising platforms and automated tools that facilitate placement of bids by advertisers require fast and, importantly, robust methods for evaluation its performance (such as the reach to the user audience and return on investment). These challenges can be addressed by using the data from the advertising platform to inform its design and help structure bidding strategies of advertisers. Econometric analysis of data can allow both the robust evaluation of user satisfaction and profits of advertisers generated by the platform, as well as optimize the informed platform. I will provide an overview of approaches to econometric inference in online advertising platforms by emphasizing their significant difference from most previously studied auction markets. When the bids of the platform constitute the Nash equilibrium, one can recover the unobserved values per click of the advertisers and then use those values to make predictions of the advertisers’ response to the system design changes. Given aggregated measure of performance of the new platform design (such as revenue of the platform or utilities of advertisers) the inference in equilibrium settings can be performed to directly produce the prediction from the observed bids. I will also illustrate approaches to econometric analysis of advertising auctions when the bids are not in equilibrium. In that case it becomes impossible to pin-point values per click for the advertisers. Instead, one can recover ranges for values and average regret of advertisers are compatible with the data. Finally, I discuss the transition of existing approaches to face new technological challenges that are generated by the increased complexity of user behavior and different monetization structure on more segmented online verticals.

When are Welfare Guarantees Robust?

Tim Roughgarden, Jan Vondrak

Session: EC-AGTDS-Sun1530

No abstract given

How to Manipulate Truthful Prior Dependent Mechanisms

Pingzhong Tang and Yulong Zeng

Session: EC-AGTDS-Sun1530

No abstract given

A General Statistical Framework for Designing Strategy-proof Assignment

Mechanisms *Harikrishna Narasimhan and David C. Parkes* Session: EC-AGTDS-Sun1530

No abstract given

Robust Automated Mechanism Design *Michael Albert, Vincent Conitzer and Peter*

Stone Session: EC-AGTDS-Sun1530

No abstract given

Maximizing Revenue with Limited Correlation: The Cost of Ex-Post Incentive Compatibility *Michael Albert, Vincent Conitzer and Giuseppe Lopomo* Session:

EC-AGTDS-Sun1530

No abstract given

Congestion Games with Mixed Objectives

Matthias Feldotto, Lennart Leder, Alexander Skopalik, John Conley, Simon Wilkie

Session: EC-Cloud-Sun1605

No abstract given

Dynamic Games for Market Dominance in the Cloud

John Conley

Session: EC-Cloud-Sun1605

No abstract given

The Price of Privacy in the Cloud, or The Economic Consequences of Mr. Snowden

Simon Wilkie

Session: EC-Cloud-Sun1605

No abstract given

Competition and Efficiency in Large Markets for Innovation: The Case of Mobile Applications on iTunes and Google Play

Yongdong Liu, Denis Nekipelov, Minjung Park

Session: EC-AGTDS-Mon830

No abstract given

An Experimental Evaluation of Regret-Based Econometrics

Noam Nisan, Gali Noti

Session: EC-AGTDS-Mon830

No abstract given

Fairness in Learning: Classic and Contextual Bandits

Matthew Joseph, Michael Kearns, Jamie Morgenstern, Aaron Roth

Session: EC-AGTDS-Mon830

No abstract given

Incentivizing Evaluation via Limited Access to Ground Truth: Peer-Prediction Makes Things Worse

Xi Alice Gao, James R. Wright, Kevin Leyton-Brown

Session: EC-AGTDS-Mon830

No abstract given

Foundations of Elicitation

Rafael Frongillo, Bo Waggoner

Session: EC-Tut-ElicML1

Elicitation is the study of contracts to exchange information for money. For example, how can you incentivize an agent to truthfully report a probability distribution for a future event? We'll cover the beautiful theory of proper scoring rules, based on properties of convex functions and Bregman divergences, their applications in algorithmic game theory, and connections to mechanism design. We will then give the basics of property elicitation, where one is interested in a statistic (e.g. the mean, variance, mode) of an agent's belief.

Connections to Machine Learning

Rafael Frongillo, Bo Waggoner

Session: EC-Tut-ElicML2

How does the loss function determine the model selected by regression? We'll place this question in the context of elicitation, where loss functions correspond to scoring rules. The convexity-based paradigm from Part 1 applies here, and in particular we will explore property elicitation in this context. We'll conclude with more advanced topics such as elicitation complexity, which asks the number of parameters needed to elicit a given statistic, and survey open problems in the field.

Mini-talks

Various Speakers

Session: EC-AdAuc-Mon14

Online Budgeted Allocation with General Budgets, by Nathaniel Kell and Debmalya Panigrahi

The Seasonality of Paid Search Effectiveness from a Long Running Field Test, by Quinn Ye, Saarthik Malik, Ji Chen, and Haijun Zhu

Truthful Outcomes from Non-Truthful Position Auctions, by Paul Duetting, Felix Fischer, and David Parkes

Where to Sell: Simulating Auctions from Learning Data, by Hamid Nazerzadeh, Renato Paes Lemes, Afshin Rostamizadeh, and Umar Syed

The Strange Case of Privacy in Equilibrium Models, by Rachel Cummings, Katrina Ligett, Mallesh Pai, and Aaron Roth

Criteo Bidding Strategy

Patrick De Pas

Session: EC-AdAuc-Mon14

Criteo buys display ads on behalf of advertisers with the goal of maximizing post-click sales on advertisers' websites. This talk discusses the design of Criteo's "future-proof" bidding strategy and the resulting incentives for advertisers.

Computer Poker

Sam Ganzfried, Marc Lanctot

Session: EC-Tut-Poker

Poker has been studied academically since the founding of game theory and in fact may have even been the inspiration for the field: the only motivating problem described in John Nash's PhD thesis, which defined and proved existence of the central solution concept, was actually a three-player poker game. Such interest has not waned over time. Last year when a computer program competed against the strongest human two-player no-limit Texas hold 'em players in the inaugural Brains vs. Artificial Intelligence competition, thousands of poker fans followed with excitement. Earlier that year another monumental breakthrough was attained, as the two-player limit variation of Texas hold 'em was "essentially weakly solved" (i.e., an ϵ -Nash equilibrium was computed for such a small ϵ to be statistically indistinguishable from zero in a human lifetime of played games). Poker, and particularly Texas hold 'em, is tremendously popular for humans, and online poker is a multi-billion dollar industry. The tutorial will cover practical and theoretical aspects of all of the components of the strongest poker agents, including detailed description of the architecture of recent competition champions. This includes algorithms for game abstraction, equilibrium computation, action translation, post-processing, endgame

solving, and opponent exploitation. While some of these approaches are heuristic, many of them have interesting theoretical aspects and open questions.

Design and Implementation of Combinatorial Prediction Markets

Sébastien Lahaie, Miroslav Dudík

Session: EC-Tut-Predict

No abstract given

Optimal Dynamic Mechanisms with Ex-Post IR via Bank Accounts

Vahab Mirrokni, Renato Paes Lemes, Pingzhong Tang, Song Zuo

Session: EC-AdAuc-Mon16

No abstract given

Fast Convergence of Common Learning Algorithms in Games

Dylan Foster, Zhiyuan Li, Thodoris Lykouris, Karthik Sridharan, Éva Tardos

Session: EC-AdAuc-Mon16

No abstract given

Inventive Compatibility of VCG under Miscalibration

Dominic Coey, Seungwon Jeong

Session: EC-AdAuc-Mon16

No abstract given

Game Abstractions for Counterfactual Predictions in Online Markets

Mark Hou, Eric Sodomka, Nicolas Stier-Moses

Session: EC-AdAuc-Mon16

No abstract given

Ironing in the Dark

Tim Roughgarden, Okke Schrijvers

Session: EC-1a

This paper presents the first polynomial-time algorithm for position and matroid auction environments that learns, from samples from an unknown distribution, an auction with expected revenue arbitrarily close to the maximum possible. In contrast to most previous work, our results do not assume that the unknown distribution is regular, and require only that the distribution does not have an extremely heavy tail (a necessary assumption for any non-trivial results). Our performance guarantee is with respect to the strongest possible benchmark, the Myerson-optimal auction. Learning a near-optimal auction for an irregular distribution is technically challenging because it requires learning the appro-

priate “ironed intervals”, a delicate global property of the distribution.

A/B Testing of Auctions

Shuchi Chawla, Jason Hartline, Denis Nekipelov

Session: EC-1a

No abstract given

The FedEx Problem

Amos Fiat, Kira Goldner, Anna Karlin, Elias Koutsoupias

Session: EC-1a

Consider the pricing problem faced by FedEx. Each customer has a package to ship, a deadline d by which he needs his package to arrive, and a value v for a guarantee that the package will arrive by his deadline. FedEx can (and does) offer a number of different shipping options in order to extract more revenue from their customers. In this paper, we solve the optimal (revenue-maximizing) auction problem for the single-agent version of this problem. Our paper adds to the relatively short list of multi-parameter settings for which a closed-form solution is known.

Descending Price Optimally Coordinates Search

Robert Kleinberg, Bo Waggoner, Glen Weyl

Session: EC-1a

Investigating potential purchases, such as a start-up company to acquire, is often a substantial investment under uncertainty. Standard market designs, such as simultaneous or ascending price auctions, compound this with additional uncertainty about the eventual price a bidder will have to pay in order to win. As a result they tend to confuse the process of search by leading to both wasteful information acquisition on goods that have already found a good purchaser and discouraging needed investigations of objects, potentially eliminating all gains from trade. Fully efficient procedures that avoid these problems, such as dynamic Vickrey-Clarke-Groves processes, are extremely complex and fragile. By contrast, we show that the Dutch auction preserves all of its properties from a standard setting without information costs because it guarantees, at the time of information acquisition, a price at which the good can be purchased.

Position-Indexed Formulations for Kidney Exchange

John Dickerson, David Manlove, Benjamin Plaut, Tuomas Sandholm, James Trimble

Session: EC-1b

A kidney exchange is an organized barter market where patients in need of a kidney swap willing but incompatible donors. Determining an optimal set of exchanges is theoretically and empirically hard. Traditionally, exchanges took place in cycles, with each partici-

pating patient-donor pair both giving and receiving a kidney. The recent introduction of chains, where a donor without a paired patient triggers a sequence of donations without requiring a kidney in return, increased the efficacy of fielded kidney exchanges - while also dramatically raising the empirical computational hardness of clearing the market in practice. While chains can be quite long, unbounded-length chains are not desirable: planned donations can fail before transplant for a variety of reasons, and the failure of a single donation causes the rest of that chain to fail, so parallel shorter chains are better in practice. In this paper, we address the tractable clearing of kidney exchanges with short cycles and chains that are long but bounded. This corresponds to the practice at most modern fielded kidney exchanges. We introduce three new integer programming formulations, two of which are compact. Furthermore, one of these models has a linear programming relaxation that is exactly as tight as the previous tightest formulation (which was not compact) for instances in which each donor has a paired patient. On real data from the UNOS nationwide exchange in the United States and the NLDKSS nationwide exchange in the United Kingdom, as well as on generated realistic large-scale data, we show that our new models are competitive with all existing solvers – in many cases outperforming all other solvers by orders of magnitude. Finally, we note that our position-indexed chain-edge formulation can be modified in a straightforward way to take post-match edge failure into account, under the restriction that edges have equal probabilities of failure. Post-match edge failure is a primary source of inefficiency in presently-fielded kidney exchanges. We show how to implement such failure-aware matching in our model, and also extend the state-of-the-art general branch-and-price-based non-compact formulation for the failure-aware problem to run its pricing problem in polynomial time.

The Stochastic Matching Problem with (Very) Few Queries

Sepehr Assadi, Sanjeev Khanna, Yang Li

Session: EC-1b

Motivated by an application in kidney exchange, we study the following stochastic matching problem: we are given a graph $G = (V, E)$ (not necessarily bipartite), where each edge in E is realized with some constant probability $p > 0$ and the goal is to find a maximum matching in the realized graph. An algorithm in this setting is allowed to make queries to edges in E in order to determine whether or not they are realized. We design an adaptive algorithm for this problem that, for any graph G , computes a $(1 - \epsilon)$ -approximate maximum matching in the realized graph G_p with high probability, while making $O(\log(1/\epsilon p)/\epsilon p)$ queries per vertex, where the edges to query are chosen adaptively in $O(\log(1/\epsilon p)/\epsilon p)$ rounds. We further present a non-adaptive algorithm that makes $O(\log(1/\epsilon p)/\epsilon p)$ queries per vertex and computes a $(1/2 - \epsilon)$ -approximate maximum matching in G_p with high probability. Both our adaptive and non-adaptive algorithms achieve the same approximation factor as the previous best algorithms of Blum et al. (EC

2015) for this problem, while requiring exponentially smaller number of per-vertex queries (and rounds of adaptive queries for the adaptive algorithm). Our results settle an open problem raised by Blum et al. by achieving only a polynomial dependency on both ϵ and p . Moreover, the approximation guarantee of our algorithms is instance-wise as opposed to only being competitive in expectation as is the case for Blum et al. This is of particular relevance to the key application of stochastic matching in kidney exchange. We obtain our results via two main techniques, namely matching-covers and vertex sparsification that may be of independent interest.

Cadet-Branch Matching in a Quasi-Linear Labor Market

Ravi Jagadeesan

Session: EC-1b

Sönmez [2013] and Sönmez and Switzer [2013] used matching theory with unilaterally substitutable preferences [Hatfield and Kojima, 2010] to propose mechanisms to match cadets to military branches. Unilaterally substitutable priorities in general exhibit complementarities. In this paper, I construct the same mechanisms in matching markets with substitutable priorities. My results show that cadet-branch matching does not require weakened substitutes conditions. The cadet-branch matching market with substitutable branch priorities constructed in this paper can be often regarded as a labor market in the model of Kelso and Crawford [1982]. The length of a contract is interpreted as the inverse of a salary, and the branches' priorities can be taken to be quasi-linear. Therefore, the substitutable branch priorities are appealing from a theoretical perspective. My results complement the original constructions of the proposed cadet-branch matching mechanisms. Sönmez and Switzer [2013] showed that the currently-implemented USMA priority structure is compatible with fairness, strategy-proofness, and respect for improvements. My approach to the construction of the proposed mechanisms relies on deviation of the branch priorities from the exact currently-implemented priorities, but this modification does not affect the proposed matching mechanisms. Together, my results and those of Sönmez and Switzer [2013] show that cadet-branch matching can be performed in Kelso-Crawford economies so that the deferred acceptance mechanisms, but not the branch priorities in the economies, are consistent with the currently-implemented USMA priorities.

Virtual Demand and Stable Mechanisms

Jan Christoph Schlegel

Session: EC-1b

We study conditions for the existence of stable, strategy-proof mechanisms in a many-to-one matching model with discrete salary space (the discrete Kelso-Crawford model). Workers and firms want to match many-to-one and agree on the terms of their match.

Firms demand different sets of workers at different salaries. Workers have preferences over different firm-salary combinations. Workers' preferences are monotone in salaries. We show that for this model, a descending auction mechanism is the only candidate for a stable mechanism that is strategy-proof for workers. Moreover, we identify a maximal domain of demand functions for firms, such that the mechanism is stable and strategy-proof. For each demand function in our domain, we can construct a related demand function that we call a virtual demand function. Replacing demand functions by virtual demand functions will not change the outcome of our mechanism. Known conditions (gross substitutability and the law of aggregate demand) can be applied to the virtual demand profile to check whether the mechanism is stable and strategy-proof. Our result gives a sense in which gross substitutability and the law of aggregate demand are necessary for the existence of a stable and strategy-proof mechanism. In the special case where demand functions are generated by quasi-linear profit functions, demand functions and virtual demand functions agree. Thus for this case, our domain reduces to the domain of demand functions under which workers are gross substitutes.

Deferred Acceptance with Compensation Chains

Piotr Dworczak

Session: EC-Best

I introduce a class of algorithms called Deferred Acceptance with Compensation Chains (DACC). DACC algorithms generalize the DA algorithms by Gale and Shapley (1962) by allowing both sides of the market to make offers. The main result is a characterization of the set of stable matchings: a matching is stable if and only if it is the outcome of a DACC algorithm.

Which Is the Fairest (Rent Division) of Them All?

Kobi Gal, Moshe Mash, Ariel Procaccia, Yair Zick

Session: EC-Best

What is a fair way to assign rooms to several housemates, and divide the rent between them? This is not just a theoretical question: many people have used the Spliddit website to obtain envy-free solutions to rent division instances. But envy freeness, in and of itself, is insufficient to guarantee outcomes that people view as intuitive and acceptable. We therefore focus on solutions that optimize a criterion of social justice, subject to the envy freeness constraint, in order to pinpoint the “fairest” solutions. We develop a general algorithmic framework that enables the computation of such solutions in polynomial time. We then study the relations between natural optimization objectives, and identify the maximin solution, which maximizes the minimum utility subject to envy freeness, as the most attractive. We demonstrate, in theory and using experiments on real data from Spliddit, that the maximin solution gives rise to significant gains in terms of our opti-

mization objectives. Finally, a user study with Spliddit users as subjects demonstrates that people find the maximin solution to be significantly fairer than arbitrary envy-free solutions; this user study is unprecedented in that it asks people about their real-world rent division instances. Based on these results, the maximin solution has been deployed on Spliddit since April 2015.

SIGecom Doctoral Dissertation Award presentation

Inbal Talgam-Cohen

Session: EC-Best

No abstract given

The Revelation Principle for Mechanism Design with Reporting Costs

Andrew Kephart, Vincent Conitzer

Session: EC-2a

The revelation principle is a key tool in mechanism design. It allows the designer to restrict attention to the class of truthful mechanisms, greatly facilitating analysis. This is also borne out in an algorithmic sense, allowing certain computational problems in mechanism design to be solved in polynomial time. Unfortunately, when not every type can misreport every other type (the partial verification model), or, more generally, misreporting can be costly, the revelation principle can fail to hold. This also leads to NP-hardness results. The primary contribution of this paper consists of characterizations of conditions under which the revelation principle still holds when misreporting can be costly. (These are generalizations of conditions given earlier for the partial verification case [Green and Laffont 1986; Yu 2011].) We also study associated computational problems.

Optimal Auctions for Negatively Correlated Items

Zihe Wang, Pingzhong Tang

Session: EC-2a

We consider the problem of designing revenue-optimal auctions for selling two items and bidders' valuations are independent among bidders but negatively correlated among items. Abstractly, this setting can be thought of as an instance with single-dimensional type space but multi-dimensional allocation space. Such setting has been extensively studied in the literature, but all under the assumption that the items are positively correlated. Under the positive correlation assumption, the optimal allocation rules are simple, avoiding difficulties brought by ensuring Bayesian incentive compatibility (BIC) under multi-dimensional feasibility constraints and by ensuring interim individual rationality (IIR) given the possibility that the lowest utility point may no longer be at the boundary of the type domain. However, the nice properties no longer hold when there is negative correlation among items. In this paper, we obtain the closed-form optimal auction for this

setting, by directly addressing the two difficulties above. In particular, the first difficulty is that when pointwise maximizing virtual surplus under multi-dimensional feasibility (i.e., the Border feasibility), (1) neither the optimal interim allocation is trivially monotone in the virtual value, (2) nor the virtual value is monotone in the bidder's type. As a result, the optimal interim allocations resulting from virtual surplus maximization no longer guarantee BIC. To address (1), we prove a generalization of Border's theorem and show that optimal interim allocation is indeed monotone in the virtual value. To address (2), we adapt Myerson's ironing procedure to this setting by redefining the (ironed) virtual value as a function of the lowest utility point. The second difficulty, perhaps a more challenging one, is that the lowest utility type in general is no longer at the endpoints of the type interval. To address this difficulty, we show by construction that there exist an allocation rule and an induced lowest utility type such that they form a solution of the virtual surplus maximization and in the meanwhile guarantees IIR. In the single bidder case, the optimal auction consists of a randomized bundle menu and a deterministic bundle menu; while in the multiple bidder case, the optimal auction is a randomization between two extreme mechanisms. The optimal solutions of our setting can be implemented by a Bayesian IC and IR auction, however, perhaps surprisingly, the revenue of this auction cannot be achieved by any (dominant-strategy) DIC and IR auction. In other words, we have witnessed the first instance where a Bayesian IC auction yields strictly more revenue than any IC auction, resolving an important conjecture concerning whether there exists a quasi-linear setting where the optimal revenues differ under the two different solution concepts.

Strategic Ironing in Pay-as-Bid Auctions: Equilibrium Existence with Private Information

Kyle Woodward

Session: EC-2a

It is known that pay-as-bid auctions admit pure-strategy equilibria when bidders have private information, as long as the space of available strategies is discrete; except in parameterized settings, there is no tractable method for computing these equilibria. Continuous approximations frequently prove useful when equilibria are difficult to compute in underlying discretized models, however the presence of payoff discontinuities in pay-as-bid auctions implies that current equilibrium existence results cannot be directly applied to the natural continuous approximation of the pay-as-bid auction. I establish the existence of pure-strategy Bayesian-Nash equilibria in divisible-good pay-as-bid auctions with private information. Existence in the divisible-good model follows from examining a particular limit of strategies in discretized models, taken as the discretization becomes infinitesimal. The techniques employed in demonstrating that properly-defined limiting strategies are mutual best responses may be useful to establishing the existence

of pure-strategy equilibria in other models which do not meet the assumptions of the current equilibrium existence literature. That the proof of existence relies on a semi-constructive argument from equilibria in discretized auctions implies that equilibrium in the divisible-good model can approximate equilibrium in nearby multi-unit auctions, hence the divisible-good model may be a reasonable approximation of real-world multi-unit auctions. I further show that equilibrium strategies must exhibit strategic ironing, a phenomenon in which the bidding incentives for an infinitesimal quantity are linked to the bidding incentives for nearby quantities. Strategic ironing implies that incentives in the discriminatory divisible-good auction differ from those in the classical single-unit first-price auction in ways which have not previously been recognized. While equilibrium first-order conditions give the impression that divisible-good auctions may be solved by a system of differential equations, strategic ironing implies that the optimal bid for any particular quantity may depend on non-local constraints, and has negative implications for the tractability of equilibrium strategies.

Pay-as-Bid: Selling Divisible Goods

Marek Pycia, Kyle Woodward

Session: EC-2a

Pay-as-bid auctions are frequently implemented when a single seller allocates multiple units of a homogeneous good, and are commonly used to sell treasury securities, allocate electricity generation, and distribute emissions credits. In this auction format, bidders submit demand curves to a seller who uses these stated demands to compute market-clearing quantities, then allocates each bidder her associated quantity while charging the entire area under her stated demand curve. Except in parameterized settings, little has been known about equilibrium strategies in pay-as-bid auctions. We model pay-as-bid auctions using random supply and a perfectly-divisible good. In a setting where bidders are perfectly symmetric, we prove the uniqueness of pure-strategy Bayesian-Nash equilibria and give a tight sufficient condition for the existence of this unique equilibrium. Equilibrium uniqueness does not depend on any restrictive assumptions on the form of bids: equilibrium bid functions are unique in the space of all bounded, decreasing functions on the domain of available quantities. We show that this equilibrium has a surprisingly convenient and tractable analytical form: the bid for any quantity is a weighted average of the marginal values for all larger quantities. Leveraging this representation of bids, we show that deterministic supply revenue-dominates all distributions of random supply; hence if the seller can affect the distribution of supply, it should sell the classical monopolist's quantity. We show that, with optimal supply, if the seller is also permitted to set a reserve price, the pay-as-bid auction and the uniform-price auction - the other common format for allocating multiple homogeneous units - are revenue-equivalent; without the ability to set a reserve price, the pay-as-bid auction weakly revenue-dominates

all equilibria of the uniform-price auction. The equivalence of optimally-parameterized auctions may provide insight into the empirical ambiguity surrounding which mechanism generates better outcomes.

When Should an Expert Make a Prediction?

Amir Ban, Yishay Mansour, Yossi Azar, Rachel Cummings, David Pennock, Jennifer Wortman Vaughan

Session: EC-2b

We consider a setting where in a known future time, a certain continuous random variable will be realized. There is a public prediction that gradually converges to its realized value, and an expert that has access to a more accurate prediction. Our goal is to study when should the expert reveal his information, assuming that his reward is based on a logarithmic market scoring rule (i.e., his reward is proportional to the gain in log-likelihood of the realized value). Our contributions are: (1) we characterize the expert's optimal policy and show that it is threshold based. (2) we analyze the expert's asymptotic expected optimal reward and show a tight connection to the Law of the Iterated Logarithm, and (3) we give an efficient dynamic programming algorithm to compute the optimal policy.

Arbitrage-Free Combinatorial Market Making via Integer Programming

Christian Kroer, Miroslav Dudik, Sébastien Lahaie, Sivaraman Balakrishnan

Session: EC-2b

We present a new combinatorial market maker that operates arbitrage-free combinatorial prediction markets specified by integer programs. Although the problem of arbitrage-free pricing, while maintaining a bound on the subsidy provided by the market maker, is #P-hard in the worst case, we posit that the typical case might be amenable to modern integer programming (IP) solvers. At the crux of our method is the Frank-Wolfe (conditional gradient) algorithm which is used to implement a Bregman projection aligned with the market maker's cost function, using an IP solver as an oracle. We demonstrate the tractability and improved accuracy of our approach on real-world prediction market data from combinatorial bets placed on the 2010 NCAA Men's Division I Basketball Tournament, where the outcome space is of size 2^63 . To our knowledge, this is the first implementation and empirical evaluation of an arbitrage-free combinatorial prediction market on this scale.

Informed Truthfulness in Multi-Task Peer Prediction

Victor Shnayder, Arpit Agarwal, Rafael Frongillo, David Parkes

Session: EC-2b

The problem of peer prediction is to elicit information from agents in settings without any objective ground truth against which to score reports. Peer prediction mechanisms

seek to exploit correlations between signals to align incentives with truthful reports. A long-standing concern has been the possibility of uninformative equilibria. For binary signals, a multi-task mechanism achieves strong truthfulness, so that the truthful equilibrium strictly maximizes payoff. We characterize conditions on the signal distribution for which this mechanism remains strongly-truthful with non-binary signals, also providing a greatly simplified proof. We introduce the Correlated Agreement (CA) mechanism, which handles multiple signals and provides informed truthfulness: no strategy profile provides more payoff in equilibrium than truthful reporting, and the truthful equilibrium is strictly better than any uninformed strategy (where an agent avoids the effort of obtaining a signal). The CA mechanism is maximally strongly truthful, in that no mechanism in a broad class of mechanisms is strongly truthful on a larger family of signal distributions. We also give a detail-free version of the mechanism that removes any knowledge requirements on the part of the designer, using reports on many tasks to learn statistics while retaining epsilon-informed truthfulness.

Optimal Commitments in Asymmetric Auctions with Incomplete Information

Pingzhong Tang, Zihe Wang,, Xiaoquan (Michael) Zhang

Session: EC-3a

We solve the Bayesian sequential equilibrium of a general class of single-item first-price or all-pay auctions of incomplete information. Our main contribution is a general methodology for solving the optimal commitment problem, in closed form, for asymmetric continuous-type distributions. Our approach consists of a number of innovations. We propose a modeling concept called equal-bid function to build a bridge between two players' strategies. Another concept called equal-utility curve transforms any commitment strategy into a weakly better continuous and everywhere directional-differentiable strategy. The optimal commitment functions in these auctions reveal some important insights. When the player with commitment power (the leader) has low valuation, he bids passively. This is a credible way to alleviate competition and to enable collusion. We demonstrate, via concrete examples, that this is a credible way to threaten the follower so that the leader can secure a higher utility.

Sequential Mechanisms with Ex-post Participation Guarantees

Itai Ashlagi, Costis Daskalakis, Nima Haghpanah

Session: EC-3a

How should one sell an item to a buyer whose value for the item will only be realized next week? E.g. consider selling a flight to some executive who may or may not have a meeting with a client next week. Suppose that both the seller and the buyer only know a distribution, F , from which the buyer's value, v , for the item will be drawn. One way the seller could go about this sale is to make a take-it-or-leave-it offer today. The offer reads

“pay the expected value today to get the item next week.” A risk-neutral buyer would find this offer attractive, hence the seller would extract the full surplus. The unsettling feature of the afore-described mechanism is that, for some realizations of v , the bidder ends up with negative utility. In particular, while our mechanism is interim Individually Rational (IR), it is not ex-post IR. How could we fix this? One way is to wait until next week when the value is realized and make a take-it-or-leave-it offer of the item at an optimal monopoly price. The new mechanism is clearly ex-post IR, but its revenue could be much smaller than that of the previous one. Still, this trivial mechanism extracts the best possible revenue among all ex-post IR mechanisms, as a simple argument can establish. However, this optimality argument fails when several items are to be sold over consecutive periods. In this paper, we provide a characterization of the revenue-optimal, ex-post IR, dynamic mechanism selling k items over k periods to a bidder whose values are independent. In particular, we optimize the seller’s revenue subject to the following strong individual rationality condition: at each period, the stage utility of the agent, defined to be the surplus from that period’s allocation minus the agent’s payment, must be non-negative. In particular, the non-negativity of the stage utilities implies that, at the end of each period, the agent’s realized utility from participating in the mechanism so far is non-negative. We provide extensions to multiple bidders and an infinite horizon with discount factors.

Optimal Auctions with Restricted Allocations

Ian Kash, Rafael Frongillo

Session: EC-3a

We study the problem of designing optimal auctions under restrictions on the set of permissible allocations. In addition to allowing us to restrict to deterministic mechanisms, we can also indirectly model non-additive valuations. We prove a strong duality result, extending a result due to Daskalakis et al. [2015], that guarantees the existence of a certificate of optimality for optimal restricted mechanisms. As a corollary of our result, we provide a new characterization of the set of allocations that the optimal mechanism may actually use. To illustrate our result we find and certify optimal mechanisms for four settings where previous frameworks do not apply, and provide new economic intuition about some of the tools that have previously been used to find optimal mechanisms.

Does Information Revelation Improve Revenue?

Costis Daskalakis, Christos Papadimitriou, Christos Tzamos

Session: EC-3a

We study the problem of optimal auction design in a valuation model, explicitly motivated by online ad auctions, in which there is two-way informational asymmetry, in the sense that private information is available to both the seller (the item type) and the bid-

ders (their type), and the value of each bidder for the item depends both on his own and the item's type. Importantly, we allow arbitrary auction formats involving, potentially, several rounds of signaling from the seller and decisions by the bidders, and seek to find the optimum co-design of signaling and auction (we call this optimum the “optimum augmented auction”). We characterize exactly the optimum augmented auction for our valuation model by establishing its equivalence with a multi-item Bayesian auction with additive bidders. Surprisingly, in the optimum augmented auction there is no signaling whatsoever, and in fact the seller need not access the available information about the item type until after the bidder chooses his bid. Suboptimal solutions to this problem, which have appeared in the recent literature, are shown to correspond to well-studied ways to approximate multi-item auctions by simpler formats, such as grand-bundling (this corresponds to Myerson's auction without any information revelation), selling items separately (this corresponds to Myerson's auction preceded by full information revelation as in [Fu et al. 2012]), and fractional partitioning (this corresponds to Myerson's auction preceded by optimal signaling). Consequently, all these solutions are separated by large approximation gaps from the optimum revenue.

Simple Mechanisms for Agents with Complements

Michal Feldman, Ophir Friedler, Jamie Morgenstern, Guy Reiner

Session: EC-3a

We study the efficiency of simple auctions in the presence of complements. Devanur et al. [2015] introduced the single-bid auction, and showed that it has a price of anarchy (PoA) of $O(\log m)$ for complement-free (i.e., subadditive) valuations. Prior to our work, no non-trivial upper bound on the PoA of single bid auctions was known for valuations exhibiting complements. We introduce a hierarchy over valuations, where levels of the hierarchy correspond to the degree of complementarity, and the PoA of the single bid auction degrades gracefully with the level of the hierarchy. This hierarchy is a refinement of the Maximum over Positive Hypergraphs (MPH) hierarchy [Feige et al. 2015], where the degree of complementarity d is captured by the maximum number of neighbours of a node in the positive hypergraph representation. We show that the price of anarchy of the single bid auction for valuations of level d of the hierarchy is $O(d^2 \log(m/d))$, where m is the number of items. We also establish an improved upper bound of $O(d \log m)$ for a subclass where every hyperedge in the positive hypergraph representation is of size at most 2 (but the degree is still d). Finally, we show that randomizing between the single bid auction and the grand bundle auction has a price of anarchy of at most $O(m^{1/2})$ for general valuations. All of our results are derived via the smoothness framework, thus extend to coarse-correlated equilibria and to Bayes Nash equilibria.

On Voting and Facility Location

Michal Feldman, Amos Fiat, Iddan Golomb

Session: EC-3b

We study mechanisms for candidate selection that seek to minimize the social cost, where voters and candidates are associated with points in some underlying metric space. The social cost of a candidate is the sum of its distances to each voter. Some of our work assumes that these points can be modeled on the real line, but other results of ours are more general. A question closely related to candidate selection is that of minimizing the sum of distances for facility location. The difference is that in our setting there is a fixed set of candidates, whereas the large body of work on facility location considers every point in the metric space to be a possible candidate. This setting gives rise to three types of candidate selection mechanisms which differ in the granularity of their input space (single candidate, ranking and location mechanisms). We study the relationships between these three classes of mechanisms. While it may seem that Black's 1948 median algorithm is optimal for candidate selection on the line, this is not the case. We give matching upper and lower bounds for a variety of settings. In particular, when candidates and voters are on the line, our universally truthful spike mechanism gives a [tight] approximation of two. When assessing candidate selection mechanisms, we seek several desirable properties: (a) efficiency (minimizing the social cost) (b) truthfulness (dominant strategy incentive compatibility) and (c) simplicity (a smaller input space). We quantify the effect that truthfulness and simplicity impose on the efficiency.

Towards Large-Scale Deliberative Decision-Making: Small Groups and the Importance of Triads

Ashish Goel, Lee David

Session: EC-3b

Though deliberation is a critical component of democratic decision-making, existing deliberative processes do not scale to large groups of people. Motivated by this, we propose a model in which large-scale decision-making takes place through a sequence of small group interactions. Our model considers a group of participants, each having an opinion which together form a graph. We show that for median graphs, a class of graphs including grids and trees, it is possible to use a small number of three-person interactions to tightly approximate the wisdom of the crowd, defined here to be the generalized median of participant opinions, even when agents are strategic. Interestingly, we also show that this sharply contrasts with small groups of size two, for which we prove an impossibility result. Specifically, we show that it is impossible to use sequences of two-person interactions satisfying natural axioms to find a tight approximation of the generalized median, even when agents are non-strategic. Our results demonstrate the potential of small group interactions for reaching global decision-making properties.

The Unreasonable Fairness of Maximum Nash Welfare

Ioannis Caragiannis, David Kurokawa, Hervé Moulin, Ariel Procaccia, Nisarg Shah, Junxing Wang

Session: EC-3b

The maximum Nash welfare (MNW) solution - which selects an allocation that maximizes the product of utilities - is known to provide outstanding fairness guarantees when allocating divisible goods. And while it seems to lose its luster when applied to indivisible goods, we show that, in fact, the MNW solution is unexpectedly, strikingly fair even in that setting. In particular, we prove that it selects allocations that are envy free up to one good - a compelling notion that is quite elusive when coupled with economic efficiency. We also establish that the MNW solution provides a good approximation to another popular (yet possibly infeasible) fairness property, the maximin share guarantee, in theory and - even more so - in practice. While finding the MNW solution is computationally hard, we develop a nontrivial implementation, and demonstrate that it scales well on real data. These results lead us to believe that MNW is the ultimate solution for allocating indivisible goods, and underlie its deployment on a popular fair division website.

How Effective Can Simple Ordinal Peer Grading Be?

Ioannis Caragiannis, George Krimpas, Alexandros Voudouris

Session: EC-3b

Ordinal peer grading has been proposed as a simple and scalable solution for computing reliable information about student performance in massive open online courses. The idea is to outsource the grading task to the students themselves as follows. After the end of an exam, each student is asked to rank – in terms of quality – a bundle of exam papers by fellow students. An aggregation rule will then combine the individual rankings into a global one that contains all students. We define a broad class of simple aggregation rules and present a theoretical framework for assessing their effectiveness. When statistical information about the grading behaviour of students is available, the framework can be used to compute the optimal rule from this class with respect to a series of performance objectives. For example, a natural rule known as Borda is proved to be optimal when students grade correctly. In addition, we present extensive simulations and a field experiment that validate our theory and prove it to be extremely accurate in predicting the performance of aggregation rules even when only rough information about grading behaviour is available.

Assortment Optimization under a Random Swap based Distribution over Permutations Model

Antoine Desir, Vineet Goyal, Danny Segev

Session: EC-3b

Assortment planning is an important problem that arises in many industries such as retailing and airlines where one of the key challenges is to identify the “right model” for the consumer preferences and substitution behavior. Distribution over preference lists or permutations is the most general framework for modeling preferences but is intractable in general. In this paper, we present a parsimonious distribution over permutations model that is induced by *random swaps* from a central preference list (which we also refer to as the *prototype list*). In particular, a random list from this distribution can be sampled as follows: sample N from a given distribution on the number of swaps and starting from the initial prototype list, perform N random swaps. A random swap operation consists of selecting a random pair of items in the current list and swapping their positions. We consider two types of random swaps: *i*) swapping an arbitrary pair of items, and *ii*) swapping an adjacent pair of items. More precisely, a pair is picked uniformly at random out of all $\binom{n+1}{2}$ possible pairs in *i*), and out of all n pairs of adjacent items in *ii*). If the distribution over the number of swaps has sufficient large support, the distribution over permutations has non-zero probability on all preference lists. This model is motivated by practical applications where consumers preferences generally have many common items appear according to the same relative order and differ only in a small number of items. The prototype list used to generate a random preference list can intuitively be thought of as the mode of the distribution implied by the random swap model. This model also captures the well known Mallows distribution over permutation that is specified by a model permutation and a concentration parameter that determines how the probability of permutations decrease as a function of the distance from the modal permutation. Therefore, this is a fairly general model for consumer preferences.

We devise a polynomial-time approximation scheme (PTAS) for the assortment optimization problem under the random swap model for both types of random swaps. In other words, for any accuracy level $\epsilon > 0$, we show how to compute an assortment with expected revenue at least $(1 - \epsilon)$ times the optimal, in roughly $O(n^{O(1/\epsilon)})$ time. Our algorithm is based on establishing a surprising sparsity property, proving the existence of small-sized assortments that can be efficiently completed into near-optimal ones, crucially utilizing certain symmetries in the distribution over permutations. In particular, we show that among the set of items that do not exist in the prototype list, it is optimal to select a revenue ordered set of items, i.e., the top- k highest revenue ones (for some k). We then make use of a dynamic programming based algorithm to select the core set of items from the prototype.

For the case of arbitrary swaps, we present an improved PTAS, based on approximate

dynamic programming. In particular, we propose an algorithm whose running time for any accuracy level $\epsilon > 0$ depends polynomially on n and $O((1/\epsilon)^{O((1/\epsilon) \cdot \log(1/\epsilon))})$. A result of this nature is also referred to as an EPTAS. We also show that our results can be extended to more general settings where we have capacity constraints on the assortment and when the distribution over permutations is generated from a mixture of several initial lists. Therefore, our model provides a tractable framework for capturing consumer preferences under fairly general settings.

Planning Problems for Sophisticated Agents with Present Bias

Jon Kleinberg, Sigal Oren, Manish Raghavan

Session: EC-4a

Present bias, the tendency to weigh costs and benefits incurred in the present too heavily, is one of the most widespread human behavioral biases. It has also been the subject of extensive study in the behavioral economics literature. While the simplest models assume that decision-making agents are naive, reasoning about the future without taking their bias into account, there is considerable evidence that people often behave in ways that are sophisticated with respect to present bias, making plans based on the belief that they will be present-biased in the future. For example, committing to a course of action to reduce future opportunities for procrastination or overconsumption are instances of sophisticated behavior in everyday life. Models of sophisticated behavior have lacked an underlying formalism that allows one to reason over the full space of multi-step tasks that a sophisticated agent might face, and this has made it correspondingly difficult to make comparative or worst-case statements about the performance of sophisticated agents in arbitrary scenarios. In this paper, we incorporate the framework of sophistication into a graph-theoretic model that we used in recent work for modeling naive agents. This new synthesis of two formalisms - sophistication and graph-theoretic planning - uncovers a rich structure that wasn't apparent in the earlier behavioral economics work on this problem, including a range of findings that shed new light on sophisticated behavior. In particular, our graph-theoretic model makes two kinds of new results possible. First, we give tight worst-case bounds on the performance of sophisticated agents in arbitrary multi-step tasks relative to the optimal plan, along with worst-case bounds for related questions. Second, the flexibility of our formalism makes it possible to identify new phenomena about sophisticated agents that had not been seen in prior literature: these include a surprising non-monotonic property in the use of rewards to motivate sophisticated agents; a sharp distinction in the performance of agents who overestimate versus underestimate their level of present bias; and a framework for reasoning about commitment devices that shows how certain classes of commitments can produce large gains for arbitrary tasks.

Procrastination with Variable Present Bias

Nick Gravin, Nicole Immorlica, Brendan Lucier, Emmanouil Pountourakis

Session: EC-4a

Individuals working towards a goal often exhibit time inconsistent behavior, making plans and then failing to follow through. One well-known model of such behavioral anomalies is present-bias discounting: individuals over-weight present costs by a bias factor. This model explains many time-inconsistent behaviors, but can make stark predictions in many settings: individuals either follow the most efficient plan for reaching their goal or procrastinate indefinitely. We propose a modification in which the present-bias parameter can vary over time, drawn independently each step from a fixed distribution. Following Kleinberg and Oren (2014), we use a weighted task graph to model task planning, and measure the cost of procrastination as the relative expected cost of the chosen path versus the optimal path. We use a novel connection to optimal pricing theory to describe the structure of the worst-case task graph for any present-bias distribution. We then leverage this structure to derive conditions on the bias distribution under which the worst-case ratio is exponential (in time) or constant. We also examine conditions on the task graph that lead to improved procrastination ratios: graphs with a uniformly bounded distance to the goal, and graphs in which the distance to the goal monotonically decreases on any path.

A Dynamic Model of Crowdfunding

Saeed Alaei, Azarakhsh Malekian, Mohamed Mostagir

Session: EC-4a

Crowdfunding is quickly emerging as an alternative to traditional methods of funding new products. In a crowdfunding campaign, a seller solicits financial contributions from a crowd, usually in the form of pre-buying an unrealized product, and commits to producing the product if the total amount pledged is above a certain threshold. We provide a model of crowdfunding in which consumers arrive sequentially and make decisions about whether to pledge or not. Pledging is not costless, and hence consumers would prefer not to pledge if they think the campaign will not succeed. This can lead to cascades where a campaign fails to raise the required amount even though there are enough consumers who want the product. The paper introduces a novel stochastic process - anticipating random walks - to analyze this problem. The analysis helps explain why some campaigns fail and some do not, and provides guidelines about how sellers should design their campaigns in order to maximize their chances of success. More broadly, Anticipating Random Walks can also find application in settings where agents make decisions sequentially and these decisions are not just affected by past actions of others, but also by how they will impact the decisions of future actors as well.

Blockchain Mining Games

Aggelos Kiayias, Elias Koutsoupias, Maria Kyropoulou, Yiannis Tselekounis

Session: EC-4a

We study the strategic considerations of miners participating in the bitcoin's protocol. We formulate and study the stochastic game that underlies these strategic considerations. The miners collectively build a tree of blocks, and they are paid when they create a node (mine a block) which will end up in the path of the tree that is adopted by all. Since the miners can hide newly mined nodes, they play a game with incomplete information. Here we consider two simplified forms of this game in which the miners have complete information. In the simplest game the miners release every mined block immediately, but are strategic on which blocks to mine. In the second more complicated game, when a block is mined it is announced immediately, but it may not be released so that other miners cannot continue mining from it. A miner not only decides which blocks to mine, but also when to release blocks to other miners. In both games, we show that when the computational power of each miner is relatively small, their best response matches the expected behavior of the bitcoin designer. However, when the computational power of a miner is large, he deviates from the expected behavior, and other Nash equilibria arise.

The Invisible Hand of Dynamic Market Pricing

Vincent Cohen Addad, Alon Eden, Michal Feldman, Amos Fiat

Session: EC-4b

Walrasian prices, if they exist, have the property that one can assign every buyer some bundle in her demand set, such that the resulting assignment will maximize social welfare. Unfortunately, this assumes carefully breaking ties amongst different bundles in the buyer demand set. Presumably, the shopkeeper cleverly convinces the buyer to break ties in a manner consistent with maximizing social welfare. Lacking such a shopkeeper, if buyers arrive sequentially and simply choose some arbitrary bundle in their demand set, the social welfare may be arbitrarily bad. In the context of matching markets, we show how to compute dynamic prices, based upon the current inventory, that guarantee that social welfare is maximized. Such prices are set without knowing the identity of the next buyer to arrive. We also show that this is impossible in general (e.g., for coverage valuations), but consider other scenarios where this can be done. We further extend our results to Bayesian and bounded rationality models.

Lottery Pricing Equilibria

Shaddin Dughmi, Alon Eden, Michal Feldman, Amos Fiat, Stefano Leonardi

Session: EC-4b

We extend the notion of Combinatorial Walrasian Equilibrium, as defined by FGL13, to settings with budgets. When agents have budgets, the maximum social welfare as tradi-

tionally defined is not a suitable benchmark since it is overly optimistic. This motivated the liquid welfare of DP14 as an alternative. Observing that no combinatorial Walrasian equilibrium guarantees a non-zero fraction of the maximum liquid welfare in the absence of randomization, we instead work with randomized allocations and extend the notions of liquid welfare and Combinatorial Walrasian Equilibrium accordingly. Our generalization of the Combinatorial Walrasian Equilibrium prices lotteries over bundles of items rather than bundles, and we term it a lottery pricing equilibrium. Our results are two-fold. First, we exhibit an efficient algorithm which turns a randomized allocation with liquid expected welfare W into a lottery pricing equilibrium with liquid expected welfare $(3 - \sqrt{5})/2W (\approx 0.3819W)$. Next, given access to a demand oracle and an α -approximate oblivious rounding algorithm for the configuration linear program for the welfare maximization problem, we show how to efficiently compute a randomized allocation which is (a) supported on polynomially-many deterministic allocations and (b) obtains [nearly] an α fraction of the optimal liquid expected welfare. In the case of subadditive valuations, combining both results yields an efficient algorithm which computes a lottery pricing equilibrium obtaining a constant fraction of the optimal liquid expected welfare.

Online Budgeted Allocation with General Budgets

Nathaniel Kell, Debmalaya Panigrahi

Session: EC-4b

We study the online budgeted allocation (also called Adwords) problem, where a set of impressions arriving online are allocated to a set of budget-constrained advertisers to maximize revenue. Motivated by connections to Internet advertising, several variants of this problem have been studied since the seminal work of Mehta, Saberi, Vazirani, and Vazirani (FOCS 2005). However, this entire body of work focuses on a single budget for every advertising campaign, whereas in order to fully represent the actual agenda of an advertiser, an advertising budget should be expressible over multiple tiers of user-attribute granularity. A simple example is an advertising campaign that is constrained by an overall budget but is also accompanied by a set of sub-budgets for each target demographic. In such a contract scheme, an advertiser can specify their true user-targeting goals, allowing the publisher to fulfill them through relevant allocations. In this paper, we give a complete characterization of the Adwords problem for general advertising budgets. In the most general setting, we show that, unlike in the single-budget Adwords problem, obtaining a constant competitive ratio is impossible and give asymptotically tight upper and lower bounds. However for our main result, we observe that in many real-world scenarios (as in the above example), multi-tier budgets have a laminar structure, since most relevant consumer or product classifications are hierarchical. For laminar budgets, we obtain a competitive ratio of $e/(e - 1)$ in the small bids case, which matches the best known Adwords result for single budgets. Our algorithm has a primal-dual structure and gener-

alizes the primal-dual analysis for single-budget Adwords first given by Buchbinder, Jain, and Naor (ESA 2007). However many new ideas are required to overcome the barriers introduced by laminar budgets - our algorithm uses a novel formulation that overcomes non-monotonicity in the syntactically defined dual variables, as well as a dynamically maintained labeling scheme that tracks the “most-limiting” budgets in the hierarchy.

Matroid Online Bipartite Matching and Vertex Cover

Wang Yajun, Sam Chiu-wai Wong

Session: EC-4b

The Adwords and Online Bipartite Matching problems have enjoyed a renewed attention over the past decade due to their connection to Internet advertising. Our community has contributed, among other things, new models (notably stochastic) and extensions to the classical formulations to address the issues that arise from practical needs. In this paper, we propose a new generalization based on matroids and show that many of the previous results extend to this more general setting. Because of the rich structures and expressive power of matroids, our new setting is potentially of interest both in theory and in practice. In the classical version of the problem, the offline side of a bipartite graph is known initially while vertices from the online side arrive one at a time along with their incident edges. The objective is to maintain a decent approximate matching from which no edge can be removed. Our generalization, called Matroid Online Bipartite Matching, additionally requires that the set of matched offline vertices be independent in a given matroid. In particular, the case of partition matroids corresponds to the natural scenario where each advertiser manages multiple ads with a fixed total budget. Our algorithms attain the same performance as the classical version of the problems considered, which are often provably the best possible. We present $1 - 1/e$ -competitive algorithms for Matroid Online Bipartite Matching under the small bid assumption, as well as a $1 - 1/e$ -competitive algorithm for Matroid Online Bipartite Matching in the random arrival model. A key technical ingredient of our results is a carefully designed primal-dual waterfilling procedure that accommodates for matroid constraints. This is inspired by the extension of our recent charging scheme for Online Bipartite Vertex Cover. Finally, given that only few online problems were studied in the submodular fashion, the techniques introduced in this paper for tackling submodularity in the online setting may be of independent interest.

Dynamic Pricing in a Labor Market: Surge Pricing and Flexible Work on the Uber Platform

Keith Chen

Session: EC Plenary / Kalai Prize

In many markets, new technologies allow traditional jobs to be divided into discrete tasks that are widely distributed across workers and dynamically priced given prevailing sup-

ply and demand conditions. This “sharing” or “gig” economy represents a more flexible work system, and is most common in two-sided markets in which a firm acts as a platform to connect service providers and consumers. One prominent example of this is the ride-sharing company Uber, which connects riders and driver-partners, and dynamically prices trips using a system known as surge pricing. In this talk, I discuss the practical problems of designing such a dynamic pricing system, how that dynamic pricing coordinates workers who can now earn compensation on a flexible schedule, and more broadly how the “gig” economy is evolving and growing as a form of market organization.

Intrinsic Robustness of the Price of Anarchy

Tim Roughgarden

Session: EC Plenary / Kalai Prize

The price of anarchy is a measure of the inefficiency of selfish behavior that has been successfully analyzed in many applications, including network routing, resource allocation, auctions, and even models of basketball. It is defined as the worst-case ratio between the welfare of a Nash equilibrium and that of an optimal (first-best) solution. Seemingly, a bound on the price of anarchy is meaningful only if players successfully reach some Nash equilibrium. The main result of this paper is that for many of the classes of games in which the price of anarchy has been studied, results are “intrinsically robust”: a bound on the worst-case price of anarchy for pure Nash equilibria *necessarily* implies the exact same worst-case bound for much larger sets of outcomes, including mixed Nash equilibria, correlated equilibria, and sequences of outcomes generated by natural experimentation strategies (such as successive best responses or simultaneous regret-minimization). We also discuss subsequent developments, such as generalizations to incomplete-information games with applications to mechanism design.

Imperfect-Recall Abstractions with Bounds in Games

Christian Kroer, Tuomas Sandholm

Session: EC-5a

Imperfect-recall abstraction has emerged as the leading paradigm for practical large-scale equilibrium computation in imperfect-information games. However, imperfect-recall abstractions are poorly understood, and only weak algorithm-specific guarantees on solution quality are known. We develop the first general, algorithm-agnostic, solution quality guarantees for Nash equilibria and approximate self-trembling equilibria computed in imperfect-recall abstractions, when implemented in the original (perfect-recall) game. Our results are for a class of games that generalizes the only previously known class of imperfect-recall abstractions for which any such results have been obtained. Further, our analysis is tighter in two ways, each of which can lead to an exponential reduction in the solution quality error bound. We then show that for extensive-form games that satisfy

certain properties, the problem of computing a bound-minimizing abstraction for a single level of the game reduces to a clustering problem, where the increase in our bound is the distance function. This reduction leads to the first imperfect-recall abstraction algorithm with solution quality bounds. We proceed to show a divide in the class of abstraction problems. If payoffs are at the same scale at all information sets considered for abstraction, the input forms a metric space, and this immediately yields a 2-approximation algorithm for abstraction. Conversely, if this condition is not satisfied, we show that the input does not form a metric space. Finally, we provide computational experiments to evaluate the practical usefulness of the abstraction techniques. They show that running counterfactual regret minimization on such abstractions leads to good strategies in the original games.

A Hydraulic Approach to Equilibria of Resource Selection Games

Yannai Gonczarowski, Moshe Tennenholtz

Session: EC-5a

Drawing intuition from a (physical) hydraulic system, we present a novel framework, constructively showing the existence of a strong Nash equilibrium in resource selection games (i.e., asymmetric singleton congestion games) with nonatomic players, the coincidence of strong equilibria and Nash equilibria in such games, and the uniqueness of the cost of each given resource across all Nash equilibria. Our proofs allow for explicit calculation of Nash equilibrium and for explicit and direct calculation of the resulting (unique) costs of resources, and do not hinge on any fixed-point theorem, on the Minimax theorem or any equivalent result, on linear programming, or on the existence of a potential (though our analysis does provide powerful insights into the potential, via a natural concrete physical interpretation). A generalization of resource selection games, called resource selection games with I.D.-dependent weighting, is defined, and the results are extended to this family, showing the existence of strong equilibria, and showing that while resource costs are no longer unique across Nash equilibria in games of this family, they are nonetheless unique across all strong Nash equilibria, drawing a novel fundamental connection between group deviation and I.D.-congestion. A natural application of the resulting machinery to a large class of constraint-satisfaction problems is also described.

Hardness Results for Signaling in Bayesian Zero-Sum and Network Routing Games

Umang Bhaskar, Yu Cheng, Young Kun Ko, Chaitanya Swamy

Session: EC-5a

We study the optimization problem faced by a perfectly informed principal in a Bayesian game, who reveals information to the players about the state of nature to obtain a desirable equilibrium. This signaling problem is the natural design question motivated by

uncertainty in games and has attracted much recent attention. We present new hardness results for signaling problems in (a) Bayesian two-player zero-sum games, and (b) Bayesian network routing games. For Bayesian zero-sum games, when the principal seeks to maximize the equilibrium utility of a player, we show that it is NP-hard to obtain an additive FPTAS. Our hardness proof exploits duality and the equivalence of separation and optimization in a novel way. Further, we rule out an additive PTAS assuming planted clique hardness, which states that no polynomial time algorithm can recover a planted clique from an Erdős-Rényi random graph. Complementing these, we obtain a PTAS for a structured class of zero-sum games (where obtaining an FPTAS is still NP-hard) when the payoff matrices obey a Lipschitz condition. Previous results ruled out an FPTAS assuming planted-clique hardness, and a PTAS only for implicit games with quasi-polynomial-size strategy sets. For Bayesian network routing games, wherein the principal seeks to minimize the average latency of the Nash flow, we show that it is NP-hard to obtain a (multiplicative) $(4/3 - \epsilon)$ -approximation, even for linear latency functions. This is the optimal inapproximability result for linear latencies, since we show that full revelation achieves a $(4/3)$ -approximation for linear latencies.

The Mysteries of Security Games: Equilibrium Computation Becomes Combinatorial Algorithm Design

Xu Haifeng

Session: EC-5a

The security game is a basic model for resource allocation in adversarial environments. Here there are two players, a defender and an attacker. The defender wants to allocate her limited resources to defend critical targets and the attacker seeks his most favorable target to attack. In the past decade, there has been a surge of research interest in analyzing and solving security games that are motivated by applications from various domains. Remarkably, these models and their game-theoretic solutions have led to real-world deployments in use by major security agencies like the LAX airport, the US Coast Guard and Federal Air Marshal Service, as well as non-governmental organizations. Among all these research and applications, equilibrium computation serves as a foundation. This paper examines security games from a theoretical perspective and provides a unified view of various security game models. In particular, each security game can be characterized by a set system E which consists of the defender's pure strategies; The defender's best response problem can be viewed as a combinatorial optimization problem over E . Our framework captures most of the basic security game models in the literature, including all the deployed systems; The set system E arising from various domains encodes standard combinatorial problems like bipartite matching, maximum coverage, min-cost flow, packing problems, etc. Our main result shows that equilibrium computation in security games is essentially a combinatorial problem. In particular, we prove that, for any set

system E , the following problems can be reduced to each other in polynomial time: (0) combinatorial optimization over E ; (1) computing the minimax equilibrium for zero-sum security games over E ; (2) computing the strong Stackelberg equilibrium for security games over E ; (3) computing the best or worst (for the defender) Nash equilibrium for security games over E . Therefore, the hardness [polynomial solvability] of any of these problems implies the hardness [polynomial solvability] of all the others. Here, by “games over E ” we mean the class of security games with arbitrary payoff structures, but a fixed set E of defender pure strategies. This shows that the complexity of a security game is essentially determined by the set system E . We view drawing these connections as an important conceptual contribution of this paper.

The Seasonality Of Paid Search Effectiveness From A Long Running Field Test

Quinn Ye, Saarthak Malik, Ji Chen, Haijun Zhu

Session: EC-5b

Paid Search, also known as Search Engine Marketing (SEM), has been the largest channel in online advertising by revenue. Yet its causal effectiveness has been difficult to measure. At eBay marketplace we have developed a hybrid Geo+User experiment approach, and conducted a long-running field test over 17-month period to understand the incrementality of paid search on one of the largest e-commerce platforms in the U.S. The experiment results indicate that paid search campaigns drive statistically significant sales lift to the eBay site, and a portion of the direct sales made via paid search is incremental. More importantly, such incrementality demonstrates strong seasonality during the year, and do not necessarily correlate with the paid search spend levels. Our results also show that the new user acquisition lift is higher than the immediate sales lift on the eBay site from paid search campaigns. These findings provide critical insights for paid search and overall online advertising investment strategies.

Returns to Consumer Search: Evidence from eBay

Thomas Blake, Chris Nosko, Steven Tadelis

Session: EC-5b

A growing body of empirical literature finds that consumers are relatively limited in how much they search over product characteristics. We assemble a dataset of search and purchase behavior from eBay to quantify the returns, and thus implied costs, to consumer search on the internet. The extensive nature of the eBay data allows us to examine a rich and detailed set of questions related to search in a way that previous structural models cannot. In contrast to the literature, we find that consumers search a lot: on average 36 times per purchase over 3 (distinct) days, with most sessions ending in no purchase. We find that search costs are relatively low, in the region of 25 cents per search page.

We pursue the analysis further by, i) examining how users refine their search, ii) how search behavior spans multiple search sessions, and iii) how the amount of search relates to finding lower prices.

The Good, the Bad, and the Unflinchingly Selfish: Cooperative Decision-Making can be Predicted with high Accuracy when using only Three Behavioral Types

Ziv Epstein, Alexander Peysakhovich, David Rand

Session: EC-5b

The human willingness to pay costs to benefit anonymous others is often explained by social preferences: rather than only valuing their own material payoff, people also care in some fashion about the outcomes of others. But how successful is this concept of outcome-based social preferences for actually predicting out-of-sample behavior? We investigate this question by having 1067 human subjects each make 20 cooperation decisions, and using machine learning to predict their last 5 choices based on their first 15. We find that decisions can be predicted with high accuracy by models that include outcome-based features and allow for heterogeneity across individuals in baseline cooperativeness and the weights placed on the outcome-based features (AUC=0.89). It is not necessary, however, to have a fully heterogeneous model – excellent predictive power (AUC=0.88) is achieved by a model that allows three different sets of baseline cooperativeness and feature weights (i.e. three behavioral types), defined based on the participant’s cooperation frequency in the 15 training trials: those who cooperated at least half the time, those who cooperated less than half the time, and those who never cooperated. Finally, we provide evidence that this inclination to cooperate cannot be well proxied by other personality/morality survey measures or demographics, and thus is a natural kind (or “cooperative phenotype”).

Understanding Emerging Threats to Online Advertising

Ceren Budak, Sharad Goel, Justin Rao, Georgios Zervas

Session: EC-5b

Two recent disruptions to the online advertising market are the widespread use of ad-blocking software and proposed restrictions on third-party tracking, trends that are driven largely by consumer concerns over privacy. Both primarily impact display advertising (as opposed to search and native social ads), and affect how retailers reach customers and how content producers earn revenue. It is, however, unclear what the consequences of these trends are. We investigate using anonymized web browsing histories of 14 million individuals, focusing on “retail sessions” in which users visit online sites that sell goods and services. We find that only 3% of retail sessions are initiated by display ads, a figure that is robust to permissive attribution rules and consistent across widely varying market segments. We further estimate the full distribution of how retail sessions are initiated,

and find that search advertising is three times more important than display advertising to retailers, and search advertising is itself roughly three times less important than organic web search. Moving to content providers, we find that display ads are shown by 12% of websites, accounting for 32% of their page views; this reliance is concentrated in online publishing, e.g., news outlets) where the rate is 91%. While most consumption is either in the long-tail of websites that do not show ads, or sites like Facebook that show native, first-party ads, moderately sized web publishers account for a substantial fraction of consumption, and we argue that they will be most affected by changes in the display advertising market. Finally, we use estimates of ad rates to judge the feasibility of replacing lost ad revenue with a freemium or donation-based model.

Mechanism Design for Subadditive Agents via an Ex Ante Relaxation

Shuchi Chawla, Benjamin Miller

Session: EC-6a

We consider the problem of maximizing revenue for a monopolist offering multiple items to multiple heterogeneous buyers. We develop a simple mechanism that obtains a constant factor approximation under the assumption that the buyers' values are additive subject to a matroid feasibility constraint and independent across items. Importantly, different buyers in our setting can have different constraints on the sets of items they desire. Our mechanism is a sequential variant of two-part tariffs. Prior to our work, simple approximation mechanisms for such multi-buyer problems were known only for the special cases of all unit-demand or all additive value buyers. Our work expands upon and unifies long lines of work on unit-demand settings and additive settings. We employ the ex ante relaxation approach developed by [Alaei-FOCS11] for reducing a multiple-buyer mechanism design problem with an ex post supply constraint into single-buyer problems with ex ante supply constraints. Solving the single-agent problems requires us to significantly extend a decomposition technique developed in the context of additive values by [LY-PNAS13] and its extension to subadditive values by [rw-15].

Where to Sell: Simulating Auctions From Learning Algorithms

Hamid Nazerzadeh, Renato Paes Leme, Afshin Rostamizadeh, Umar Syed

Session: EC-6a

Ad exchange platforms connect online publishers and advertisers and facilitate the sale of billions of impressions every day. We study these environments from the perspective of a publisher who wants to find the profit-maximizing exchange in which to sell his inventory. Ideally, the publisher would run an auction among exchanges. However, this is not usually possible due to practical business considerations. Instead, the publisher must send each impression to only one of the exchanges, along with an asking price. We model the problem as a variation of the multi-armed bandits problem in which exchanges (arms) can

behave strategically in order to maximize their own profit. We propose mechanisms that find the best exchange with sub-linear regret and have desirable incentive properties.

A Near-Optimal Exploration-Exploitation Approach for Assortment Selection

Agrawal Shipra, Vashist Avadhanula, Vineet Goyal, Assaf Zeevi

Session: EC-6a

We consider an online assortment optimization problem, where in every round, the retailer offers a K -cardinality subset (assortment) of N substitutable products to a consumer, and observes the response. We model consumer choice behavior using the widely used multinomial logit (MNL) model, and consider the retailer's problem of dynamically learning the model parameters, while optimizing cumulative revenues over the selling horizon T . Formulating this as a variant of a multi-armed bandit problem, we present an algorithm based on the principle of "optimism in the face of uncertainty." A naive MAB formulation would treat each of the $\binom{N}{K}$ possible assortments as a distinct "arm," leading to regret bounds that are exponential in K . We show that by exploiting the specific characteristics of the MNL model it is possible to design an algorithm with $\tilde{O}(\sqrt{NT})$ regret, under a mild assumption. We demonstrate that this performance is nearly optimal, by providing a (randomized) instance of this problem on which any online algorithm would incur at least $\Omega(\sqrt{NT/K})$ regret.

Minimizing Regret with Multiple Reserves

Tim Roughgarden, Joshua Wang

Session: EC-6a

We study the problem of computing and learning non-anonymous reserve prices to maximize revenue. We first define the Maximizing Multiple Reserves (MMR) problem in single-parameter matroid environments, where the input is m valuation profiles $v^1, \dots, v^m$, indexed by the same n bidders, and the goal is to compute the vector r of (non-anonymous) reserve prices that maximizes the total revenue obtained on these profiles by the VCG mechanism with reserves r . We prove that the problem is APX-hard, even in the special case of single-item environments, and give a polynomial-time $1/2$ -approximation algorithm for it in arbitrary matroid environments. We then consider the online no-regret learning problem, and show how to exploit the special structure of the MMR problem to translate our offline approximation algorithm into an online learning algorithm that achieves asymptotically time-averaged revenue at least $1/2$ times that of the best fixed reserve prices in hindsight. On the negative side, we show that, quite generally, computational hardness for the offline optimization problem translates to computational hardness for obtaining vanishing time-averaged regret. Thus our hardness result for the MMR problem implies that computationally efficient online learning requires approximation, even in the special case of single-item auction environments.

General Threshold Model for Social Cascades: Analysis and Simulations

Jie Gao, Golnaz Ghasemiesfeh, Grant Schoenebeck, Fang-Yi Yu

Session: EC-6b

Social behaviors and choices spread through interactions and may lead to a cascading behavior. Understanding how such social cascades spread in a network is crucial for many applications ranging from viral marketing to political campaigns. The behavior of cascade depends crucially on the model of cascade or social influence and the topological structure of the social network. In this paper we study the general threshold model of cascades which are parameterized by a distribution over the natural numbers, in which the collective influence from infected neighbors, once beyond the threshold of an individual u , will trigger the infection of u . By varying the choice of the distribution, the general threshold model can model cascades with and without the submodular property. In fact, the general threshold model captures many previously studied cascade models as special cases, including the independent cascade model, the linear threshold model, and k -complex contagions. We provide both analytical and experimental results for how cascades from a general threshold model spread in a general growing network model, which contains preferential attachment models as special cases. We show that if we choose the initial seeds as the early arriving nodes, the contagion can spread to a good fraction of the network and this fraction crucially depends on the fixed points of a function derived only from the specified distribution. We also show, using a coauthorship network derived from DBLP databases and the Stanford web network, that our theoretical results can be used to predict the infection rate up to a decent degree of accuracy, while the configuration model does the job poorly.

Impact of Community Structure on Cascades

Mehrdad Moharrami, Vijay Subramanian, Mingyan Liu, Marc Lelarge

Session: EC-6b

The threshold model is widely used to study the propagation of opinions and technologies in social networks. In this model individuals adopt the new behavior based on how many neighbors have already chosen it. We study cascades under the threshold model on sparse random graphs with community structure to see whether the existence of communities affects the number of individuals who finally adopt the new behavior. Specifically, we consider the permanent adoption model where nodes that have adopted the new behavior cannot change their state. When seeding a small number of agents with the new behavior, the community structure has little effect on the final proportion of people that adopt it, i.e., the contagion threshold is the same as if there were just one community. On the other hand, seeding a fraction of population with the new behavior has a significant impact on the cascade with the optimal seeding strategy depending on how strongly the

communities are connected. In particular, when the communities are strongly connected, seeding in one community outperforms the symmetric seeding strategy that seeds equally in all communities.

Dynamics of Evolving Social Groups

Noga Alon, Michal Feldman, Yishay Mansour, Sigal Oren, Moshe Tennenholtz

Session: EC-6b

Exclusive social groups are ones in which the group members decide whether or not to admit a candidate to the group. Examples of exclusive social groups include academic departments and fraternal organizations. In the present paper we introduce an analytic framework for studying the dynamics of exclusive social groups. In our model, every group member is characterized by his opinion, which is represented as a point on the real line. The group evolves in discrete time steps through a voting process carried out by the group's members. Due to homophily, each member votes for the candidate who is more similar to him (i.e., closer to him on the line). An admission rule is then applied to determine which candidate, if any, is admitted. We consider several natural admission rules including majority and consensus. We ask: how do different admission rules affect the composition of the group in the long term? We study both growing groups (where new members join old ones) and fixed-size groups (where new members replace those who quit). Our analysis reveals intriguing phenomena and phase transitions, some of which are quite counterintuitive.

Dynamic Conflict on A Network

Marcin Dziubinski, Sanjeev Goyal, David Minarsch

Session: EC-6b

Players are endowed with resources. A player can engage in conflict with others to enlarge his resources. The set of potential conflicts is defined by a contiguity network. Players are farsighted and aim to maximize their resources. They decide on whether to wage war or remain peaceful. The winner of a war takes control of the loser's node and resources; he then decides on whether to wage war against other neighbours, or to stay peaceful. The game ends when either all players choose to be peaceful or when only one player is left. We study the influence of the technology of conflict and the structure of the network on war and peace. Our first result identifies a threshold property in the technology of conflict: above this threshold, every ruler wishes to wage war and, eventually, there is a hegemon. Below the threshold, resources and networks determine the prospects for peace and the number of kingdoms. We develop sufficient conditions for war and provide examples with lasting peace.

Pricing with Limited Knowledge of Demand

Maxime Cohen, Georgia Perakis, Robert Pindyck

Session: EC-7a

How should a firm price a new product for which little is known about demand? We propose a pricing rule that can be used if the firm can estimate (even roughly) the maximum price it can charge and still expect to sell some units, and the firm need not know in advance the quantity it will sell. The rule is simple: Set price as though the demand curve were linear. We show that if the true demand curve is one of many commonly used demand functions, or even a more complex function, and if marginal cost is known and constant, the firm can expect its profit to be close to what it would earn if it knew the true demand curve. We derive analytical performance bounds for a variety of demand functions, calculate expected profit performance for randomly generated demand curves, and evaluate the welfare implications of our pricing rule.

The Strange Case of Privacy in Equilibrium Models

Rachel Cummings, Katrina Ligett, Malleesh Pai, Aaron Roth

Session: EC-7a

We study how privacy technologies affect user and advertiser behavior in a simple economic model of targeted advertising. In our model, a consumer first decides whether or not to buy a good, and then an advertiser chooses an advertisement to show the consumer. The consumer's value for the good is correlated with her type, which determines which ad the advertiser would prefer to show to her - and hence, the advertiser would like to use information about the consumer's purchase decision to target the ad that he shows. In our model, the advertiser is given only a differentially private signal about the consumer's behavior - which can range from no signal at all to a perfect signal, as we vary the differential privacy parameter. This allows us to study equilibrium behavior as a function of the level of privacy provided to the consumer. We show that this behavior can be highly counter-intuitive, and that the effect of adding privacy in equilibrium can be completely different from what we would expect if we ignored equilibrium incentives. Specifically, we show that increasing the level of privacy can actually increase the amount of information about the consumer's type contained in the signal the advertiser receives, lead to decreased utility for the consumer, and increased profit for the advertiser, and that generally these quantities can be non-monotonic and even discontinuous in the privacy level of the signal.

Bayesian Exploration: Incentivizing Exploration in Bayesian Games

Yishay Mansour, Aleksandrs Slivkins, Vasilis Syrgkanis, Zhiwei Steven Wu

Session: EC-7a

We consider a ubiquitous scenario in the Internet economy when individual decision-makers (henceforth, agents) both produce and consume information as they make strategic choices in an uncertain environment. This creates a three-way tradeoff between exploration (trying out insufficiently explored alternatives to help others in the future), exploitation (making optimal decisions given the information discovered by other agents), and incentives of the agents (who are myopically interested in exploitation, while preferring the others to explore). We posit a principal who controls the flow of information from agents that came before to the ones that arrive later, and strives to coordinate the agents towards a socially optimal balance between exploration and exploitation, not using any monetary transfers. The goal is to design a recommendation policy for the principal which respects agents' incentives and minimizes a suitable notion of regret. We extend prior work in this direction to allow the agents to interact with one another in a shared environment: at each time step, multiple agents arrive to play a Bayesian game, receive recommendations, choose their actions, receive their payoffs, and then leave the game forever. The agents now face two sources of uncertainty: the actions of the other agents and the parameters of the uncertain game environment. Our main contribution is to show that the principal can achieve constant regret when the utilities are deterministic (where the constant depends on the prior distribution, but not on the time horizon), and logarithmic regret when the utilities are stochastic. As a key technical tool, we introduce the concept of explorable actions, the actions which some incentive-compatible policy can recommend with non-zero probability. We show how the principal can identify (and explore) all explorable actions, and use the revealed information to perform optimally. In particular, our results significantly improve over the prior work on the special case of a single agent per round, which relies on assumptions to guarantee that all actions are explorable. Interestingly, we do not require the principal's utility to be aligned with the cumulative utility of the agents; instead, the principal can optimize an arbitrary notion of per-round reward.

Persuasion with Limited Communication

Shaddin Dughmi, David Kempe, Ruixin Qiang

Session: EC-7a

We examine information structure design, also called “persuasion” or “signaling”, in the presence of a constraint on the amount of communication. We focus on the fundamental setting of bilateral trade, which in its simplest form involves a seller with a single item to price, a buyer whose value for the item is drawn from a common prior distribution over n different possible values, and a take-it-or-leave-it-offer protocol. A mediator with access to the buyer's type may partially reveal such information to the seller in order to

further some objective such as the social welfare or the seller’s revenue. We study how a limit on the number of bits of communication affects this setting in two respects: (1) How much does this constraint reduce the optimal welfare or revenue? (2) What effect does constraining communication have on the computational complexity of the mediator’s optimization problem? In the setting of maximizing welfare under bilateral trade, we exhibit positive answers for both questions (1) and (2). Whereas the optimal unconstrained scheme may involve n signals (and thus $\log(n)$ bits of communication), we show that $O(\log(n) \log 1/\epsilon)$ signals suffice for a $1-\epsilon$ approximation to the optimal welfare, and this bound is tight. This largely justifies the design of algorithms for signaling subject to drastic limits on communication. As our main result, we exhibit an efficient algorithm for computing a $(M-1)/M(1-1/e)$ -approximation to the welfare-maximizing scheme with at most M signals. This result hinges on an intricate submodularity argument which relies on the optimality of a greedy algorithm for solving a certain linear program. For the revenue objective, the surprising logarithmic bound on the number of signals does not carry over: we show that $\Omega(n)$ signals are needed for a constant factor approximation to the revenue of a fully informed seller. From a computational perspective, however, the problem gets easier: we show that a simple dynamic program computes the signaling scheme with M signals maximizing the seller’s revenue. Observing that the signaling problem in bilateral trade is a special case of the fundamental Bayesian Persuasion model of Kamenica and Gentzkow, we also examine the question of communication-constrained signaling more generally. Specifically, in this model there is a sender (the mediator), a receiver (the seller) looking to take an action (setting the price), and a state of nature (the buyer’s type) drawn from a common prior. The state of nature encodes both the receiver’s utility and the sender’s objective as a function of the receiver’s action. Our results for bilateral trade with the revenue objective imply that limiting communication to M signals can scale the sender’s utility by a factor of $O(M/n)$ in general, where n denotes the number of states of nature. We also show that our positive algorithmic results for bilateral trade do not extend to communication-constrained signaling in the Bayesian Persuasion model. Specifically, we show that it is NP-hard to approximate the optimal sender’s utility to within any constant factor in the presence of communication constraints.

Computational Extensive-Form Games

Joseph Halpern, Rafael Pass, Lior Seeman

Session: EC-7b

We define solution concepts appropriate for computationally bounded players playing a fixed finite game. To do so, we need to define what it means for a computational game, which is a sequence of games that get larger in some appropriate sense, to represent a single finite underlying extensive-form game. Roughly speaking, we require all the games in the sequence to have essentially the same structure as the underlying game, except that

two histories that are indistinguishable (i.e., in the same information set) in the underlying game may correspond to histories that are only computationally indistinguishable in the computational game. We define a computational version of both Nash equilibrium and sequential equilibrium for computational games, and show that every Nash (resp., sequential) equilibrium in the underlying game corresponds to a computational Nash (resp., sequential) equilibrium in the computational game. One advantage of our approach is that if a cryptographic protocol represents an abstract game, then we can analyze its strategic behavior in the abstract game, and thus separate the cryptographic analysis of the protocol from the strategic analysis.

Ascending-Price Algorithms for Unknown Markets

Xiaohui Bei, Jugal Garg, Martin Hoefer

Session: EC-7b

We design a simple ascending-price algorithm to compute a $(1+\epsilon)$ -approximate equilibrium in Arrow-Debreu exchange markets with weak gross substitute (WGS) property, which runs in time polynomial in market parameters and $\log 1/\epsilon$. This is the first polynomial-time algorithm for most of the known tractable classes of Arrow-Debreu markets, which is easy to implement and avoids heavy machinery such as the ellipsoid method. In addition, our algorithm can be applied in an unknown market setting without exact knowledge about the number of agents, their individual utilities and endowments. Instead, our algorithm only relies on queries to a global demand oracle by posting prices and receiving aggregate demand for goods as feedback. When demands are real-valued functions of prices, the oracles can only return values of bounded precision based on real utility functions. Due to this more realistic assumption, precision and representation of prices and demands become a major technical challenge, and we develop new tools and insights that may be of independent interest. Furthermore, our approach also gives the first polynomial-time algorithm to compute an exact equilibrium for markets with spending constraint utilities, a piecewise linear concave generalization of linear utilities. This resolves an open problem posed by [DuanM15].

Competitive Equilibrium and Trading Networks: A Network Flow Approach

Ozan Candogan, Markos Epitropou, Rakesh Vohra

Session: EC-7b

Under full substitutability of preferences, it has been shown that a competitive equilibrium exists in trading networks, and is equivalent (after a restriction to equilibrium trades) to (chain) stable outcomes. In this paper, we formulate the problem of finding an efficient outcome as a generalized submodular flow problem on a suitable network. Equivalence with seemingly weaker notions of stability follows directly from the optimality conditions, in particular the absence of improvement cycles in the flow problem. Our

formulation yields strongly polynomial algorithms for finding competitive equilibria in trading networks, and testing (chain) stability.

Average Case Performance of Replicator Dynamics in Potential Games via Computing Regions of Attraction

Ioannis Panageas, Georgios Piliouras

Session: EC-7b

What does it mean to fully understand the behavior of a network of adaptive agents? The golden standard typically is the behavior of learning dynamics in potential games, where many evolutionary dynamics, e.g., replicator dynamics, are known to converge to sets of equilibria. Even in such classic settings many questions remain unanswered. We examine issues such as: Point-wise convergence: Does the system always equilibrate, even in the presence of continuums of equilibria? Computing regions of attraction: Given point-wise convergence can we compute asymptotic stability of each equilibrium (e.g., estimate its volume, geometry)? System invariants: Invariant functions remain constant along every system trajectory. This notion is orthogonal to the game theoretic concept of a potential function, which always strictly increases/decreases along system trajectories. Do dynamics in potential games exhibit invariant functions? If so, how many? How do these functions look like? Based on these geometric characterizations, we propose a novel quantitative framework for analyzing the efficiency of potential games with many equilibria. The predictions of different equilibria are weighted by their probability to arise under evolutionary dynamics given uniformly random initial conditions. This average case analysis is shown to offer novel insights in classic game theoretic challenges, including quantifying the risk dominance in stag-hunt games and allowing for more nuanced performance analysis in networked coordination and congestion games with large gaps between price of stability and price of anarchy.

Strategic Payment Routing in Financial Credit Networks

Frank Cheng, Junming Liu, Kareem Amin, Michael Wellman

Session: EC-8a

Credit networks provide a flexible model of distributed trust, which supports transactions between untrusted counterparties through paths of intermediaries. We extend this model by introducing interest rates (prices on lines of credit), both as a means to incentivize credit issuance and to provide a framework for modeling networks of financial relationships. Including interest rates poses a new constraint on transactions, as intermediaries will route payments only if the interest received covers any interest paid. We account for these constraints in an efficient algorithm for finding the maximum transaction flow between two agents in a financial network. There are generally many feasible payment paths serving a given transaction, and we show that the policy for selecting among such

paths can have a substantial effect on liquidity, as measured by steady-state probability of transaction success. Finally, we consider the situation where the transaction source can choose among heuristic path selection mechanisms, in order to maximize their payoff. Through empirical game-theoretic analysis, we find that routing is inefficient due to the positive externality of choices promoting network liquidity. However, agent choices do reflect some consideration of overall network liquidity, in addition to their own interest payments.

Sybil Detection Using Latent Network Structure

Grant Schoenebeck, Aaron Snook, Fang-Yi Yu

Session: EC-8a

Sybil attacks, in which an adversary creates a large number of identities, present a formidable problem for the robustness of recommendation systems. One promising method of sybil detection is to use data from social network ties to implicitly infer trust. Previous work along this dimension typically a) assumes that it is difficult/costly for an adversary to create edges to honest nodes in the network; and b) limits the amount of damage done per such edge, using conductance-based methods. However, these methods fail to detect a simple class of sybil attacks which have been identified in online systems. Indeed, conductance-based methods seem inherently unable to do so, as they are based on the assumption that creating many edges to honest nodes is difficult, which seems to fail in real-world settings. We create a sybil defense system that accounts for the adversary's ability to launch such attacks yet provably withstands them by: (1) Not assuming any restriction on the number of edges an adversary can form, but instead making a much weaker assumption that creating edges from sybils to most honest nodes is difficult, yet allowing that the remaining nodes can be freely connected to. (2) Relaxing the goal from classifying all nodes as honest or sybil to the goal of classifying the core nodes of the network as honest; and classifying no sybil nodes as honest. (3) Exploiting a new, for sybil detection, social network property, namely, that nodes can be embedded in low-dimensional spaces.

Economic Recommendation Systems

Gal Bahar, Moshe Tennenholtz, Rann Smorodinsky

Session: EC-8a

In the on-line Explore & Exploit [E& E] literature, central to Machine Learning, a central planner is faced with a set of alternatives, each yielding some unknown reward. The planner's goal is to learn the optimal alternative as soon as possible, via experimentation. A typical assumption in this model is that the planner has full control over the experiment design and implementation. When experiments are implemented by a society of self-motivated agents the planner can only recommend experimentation but has no power

to enforce it. The first paper to marry the social aspects with the challenge of E& E, a new research domain for which we coin the term “social explore and exploit”, is Kremer et. al. [Kremer et al. 2014]. In that work the authors introduce a naive setting (We use the notion of a “naive setting” for settings where the optimal non-social explore and exploit scheme is trivial - try all actions sequentially, each once, and settle on the optimal one thereafter) and study optimal explore and exploit schemes that account for agents’ incentives. To be more specific, [Kremer et al. 2014] identify an incentive compatible scheme with which a central planner can asymptotically steer the users towards taking the optimal action. Whereas [Kremer et al. 2014] account for agents’ incentives and in particular the misalignment of incentives of the agents and the planner it ignore other societal aspects. In particular, [Kremer et al. 2014] make an implicit assumption that agents cannot see nor communicate with any other agent. It turns out that, when observability is factored in, the scheme proposed by Kremer et. al. is no longer incentive compatible, leading to market failure. In this work we introduce observability into the framework of social E& E. We study the design of recommendation systems when agents can (partly) observe each other. In particular, we investigate the conditions on the social network which allow for asymptotically optimal outcomes. Thus, we extend [Kremer et al. 2014] by adding the additional layer of a social network and show conditions under which the essence of their results, albeit with a different mechanism, can still be maintained even though agents may observe each other. Intuitively, the more agents can see each other the less power resides within the central planner. Formally, let a visibility graph over N agents be a graph where agents serve as the nodes, and an edge (a, b) implies that agents a and b can observe each other’s action. A visibility graph is an $(\alpha; \beta)$ -graph if the number of nodes with degree greater than N^α is bounded by N^β . Our main result is that for a sufficiently large N , if the visibility graph is an $(\alpha; \beta)$ -graph, where $2\alpha + \beta < 1$, then there exists a deterministic incentive-compatible algorithm leading to approximately optimal outcome. On the other hand we show that for the complete graph asymptotically optimal outcome can not be obtained by any probabilistic incentive-compatible algorithm. As the complete graph is a $(0; 1)$ -graph, our result is tight.

Clearing Payments in Financial Networks with Credit Default Swaps

Steffen Schuldensucker, Sven Seuken, Stefano Battison

Session: EC-8a

We consider the problem of clearing a system of interconnected banks that have been exposed to a shock on their assets. Due to this shock, some of the banks may go into bankruptcy and default on their obligations towards other banks. Clearing means computing the payments to be made from each bank to each other bank in accordance with bankruptcy law. The design of good clearing mechanisms is challenging because of the complex and often cyclic interdependencies in realistic financial networks. Eisenberg

and Noe (2001) showed that when banks can only enter into debt contracts with each other, then there always exists a unique Pareto efficient clearing payment vector and it can be computed in polynomial time. Rogers and Veraart (2013) extended this result to a setting where defaulting banks can only recover part of their assets. In the present paper, we show that the situation changes radically when banks can also enter into credit default swaps (CDSs), i.e., financial derivative contracts that depend on the default of another bank. Extending the models in both abovementioned pieces of work, we first prove that in financial networks with CDSs, a clearing payment vector may not even exist. This implies that the value of a contract may not be well-defined. In other cases, there may be several clearing vectors, none of which is individually preferred by all banks, thus forcing the clearing mechanism to favor one bank over another. On the computational side, we prove that determining whether a clearing vector exists is already NP-hard. We then develop a new analysis framework to derive constraints on the contract space under which these problems are alleviated. Our results can be used to inform the discussion on different policy proposals. We show that routing all contracts via a central counterparty would not even guarantee existence. In contrast, we show that banning “naked” (speculative) CDSs would re-establish an existence guarantee for a unique Pareto efficient clearing payment vector. The full version of this paper is available at <http://www.ifi.uzh.ch/ce/publications/Clearing/CDSs.pdf>

Petty Envy When Assigning Objects

Thayer Morrill

Session: EC-8b

Envy of another person’s assignment is “justified” if you “deserve” the object and it is possible to assign you to the object. Currently, the literature only considers whether or not the agent deserves the object and ignores whether or not assigning her to it is possible. This paper defines a fair set of assignments in terms of what is possible. We prove that a fair set of assignments has the same properties as the set of stable matches: the Lattice Theorem, Decomposition Lemma, and Rural Hospital Theorem all hold. Moreover, there is a unique, student-optimal fair assignment: the assignment made by Kesten’s Efficiency Adjusted Deferred Acceptance mechanism when all students consent.

“Strategic” Behavior in a Strategy-proof Environment

Avinatan Hassidim, Romm Assaf, Ran I. Shorrer

Session: EC-8b

A mechanism is said to be strategy-proof if no agent has an incentive to misrepresent her true preferences. This property is considered highly desirable for mechanisms that are used in real-life markets. And indeed, many of the great success stories of market design employ strategy-proof mechanisms, such as the second-price sealed-bid auction (Vickrey

1961), or Deferred Acceptance (DA, Gale and Shapley 1962; Dubins and Freedman 1981; Roth 1982). Specifically, in school-choice settings, the appeal of strategy-proof mechanisms is one of the main reasons many school districts choose the applicant-proposing version of DA over pre-existing mechanisms. At the core of the attractiveness of these mechanisms is the assumption that agents report their preferences truthfully in strategy-proof environments. We present direct field evidence of preference misrepresentation by applicant's under the applicant-proposing DA. Our study is based on the recently re-designed admission process in Israel for graduate studies in psychology (MA or direct PhD track), where several participating institutions offer positions in the same study track, but under different terms. In particular, in some cases only some of the positions are funded.

On Matching and Thickness in Heterogeneous Dynamic Markets

Maximilien Burq, Itai Ashlagi, Patrick Jaillet, Vahideh Manshadi

Session: EC-8b

We study dynamic matching in an infinite-horizon stochastic networked market, in which some agents are a priori more difficult to match than others. Agents have compatibility-based preferences and can match either bilaterally, or indirectly through chains. We study the effect matching technologies and matching policies have on efficiency in markets with different compositions of hard and easy-to-match agents. First, we analyze myopic matching policies and identify a strong connection between market thickness and the efficiency driven by the matching technology. We show that when “hard-to-match” agents join the market more frequently than “easy-to-match” ones, moving from bilateral matchings to chains significantly increases efficiency. Otherwise, the difference between matching bilaterally or through a chain is negligible. Second, we show that the lack of thickness cannot be compensated by non-myopic matching policies implying that the only way to thicken the market fruitfully is by attracting more agents.

What Matters in School Choice Tie-breakings? How Competition Guides Design

Itai Ashlagi, Afshin Nikzad

Session: EC-8b

School districts that adopt the Deferred Acceptance (DA) mechanism to assign students to schools face the tradeoff between fairness and efficiency when selecting how to exogenously break ties among equivalent students. We analyze a model with random generated preferences for students and compare two tie-breaking rules: a single lottery (STB) and DA with a separate lottery for each school (MTB). We consider three different notions for this comparison: stochastic dominance of rank distributions, variance of students' ranks, and number of Pareto improving pairs (pairs of students whom would be better off by

swapping their positions). We identify that the balance between supply and demand is the determinant factor in these comparisons. When there is a shortage of seats, the rank distribution under STB stochastically dominates the rank distribution under MTB, and also, has a smaller variance. In addition, MTB creates “many” Pareto improving pairs, while STB creates none. When there is a surplus of seats, we show that neither random assignment under these mechanisms stochastically dominates the other, variance of the rank distribution is lower under MTB, and MTB generates few Pareto improving pairs. Our findings imply that “popular” schools should use a single common lottery to break ties. Finally, numerical experiments using NYC school choice data confirm our predictions.

The Pareto Frontier for Random Mechanisms

Timo Mennle, Sven Seuken

Session: EC-9a

In many situations, a group of individuals (called “agents”) must collectively decide on one of several alternatives, e.g., elect the next president. “Ordinal mechanisms” are systematic procedures to make such decisions based on the agents’ preference orders over the alternatives. A mechanism is “strategyproof” if it makes truthful reporting of preferences a dominant strategy. Strategyproofness is therefore the gold standard among the incentive concepts. However, the seminal impossibility result of Gibbard [1977] showed that strategyproofness also greatly restricts the design space of ordinal mechanisms even if they can use randomization. In particular, it is incompatible with many other common desiderata, such as Condorcet consistency, stability, or egalitarian fairness. Thus, trade-offs between strategyproofness and other desiderata are necessary. In this paper, we study these trade-offs. We use approximate strategyproofness to define “manipulability”, a measure to quantify the incentive properties of non-strategyproof mechanisms, and we introduce “deficit,” a measure to quantify the performance of mechanisms with respect to another desideratum. A mechanism that minimizes the deficit subject to a particular bound on manipulability is called “optimal” at this bound; and the mechanisms that are optimal at some bound form the “Pareto frontier”. Our main contribution is a structural characterization of this Pareto frontier: we show that there exists a finite set of “supporting manipulability bounds,” such that it suffices to identify optimal mechanisms at each of them. Other mechanisms along the Pareto frontier can then be constructed as “hybrids” (i.e., convex combinations) of these optimal mechanisms. This allows a concise representation of the Pareto frontier in terms of a finite number of optimal mechanisms and their hybrids. In combination with linear programming, we can exploit this characterization to compute the whole Pareto frontier algorithmically. To illustrate its shape, we apply our results to determine the Pareto frontier for two different desiderata, namely Plurality and Veto scoring, in settings with 3 alternatives and up to 18 agents.

Mechanism Design with Selective Verification

Dimitris Fotakis, Christos Tzamos, Manolis Zampetakis, Joosung Lee

Session: EC-9a

We introduce a general approach based on selective verification and obtain approximate mechanisms without money for maximizing the social welfare in the general domain of Utilitarian Voting. Having a good allocation in mind, a mechanism with verification selects few critical agents and detects, using a verification oracle, whether they have reported truthfully. If yes, the mechanism produces the desired allocation. Otherwise, the mechanism ignores any misreports and proceeds recursively with the remaining agents. We obtain randomized truthful (or almost truthful) mechanisms without money that verify only $O(\log m/\epsilon)$ agents, where m is the number of outcomes, independently of the total number of agents, and are $(1 - \epsilon)$ -approximate for the social welfare. We also show that any truthful mechanism with a constant approximation ratio needs to verify $\Omega(\log m)$ agents. A remarkable property of our mechanisms is immunity (to agent misreports), namely that their outcome depends only on the reports of the truthful agents.

Mechanisms with Referrals: VCG Mechanisms and Multilevel Mechanisms

Joosung Lee

Session: EC-9a

We study mechanisms for environments in which only some of the agents are directly connected to a mechanism designer and the other agents can participate in a mechanism only through the connected agents' referrals. Agents' network connections are private information, which can be strategically concealed by avoiding making referrals; while the mechanism designer wants to elicit the agents' private information about both payoff types and network connections. The set of feasible allocations is endogenously determined by the actual participants induced by referrals.

In such an environment with a varying population, we define a VCG mechanism as a benchmark for an efficient mechanism. It is incentive compatible and individually rational, but it generically runs a deficit as it requires too much compensation for referrals. Alternatively as a budget-surplus mechanism, we introduce a multilevel mechanism, in which each agent is compensated by the agents who would not be able to participate without her referrals. Under a multilevel mechanism, we show that fully referring one's acquaintances is a dominant strategy and agents have no incentive to under-report their payoff type if the social welfare is submodular.

As applications, a single-item auction and a public good provision game are studied. We show that a multilevel mechanism guarantees a revenue higher than any standard auction. In a public good provision game, a principal can achieve an efficient and budget-balanced allocation through a multilevel mechanism if the agents have a binary preference on the

public good.

Large Market Games with Near Optimal Efficiency

Richard Cole, Yixin Tao

Session: EC-9b

As is well known, many classes of markets have efficient equilibria, but this depends on agents being non-strategic, i.e. that they declare their true demands when offered goods at particular prices, or in other words, that they are price-takers. An important question is how much the equilibria degrade in the face of strategic behavior, i.e. what is the Price of Anarchy (PoA) of the market viewed as a mechanism? Often, PoA bounds are modest constants such as $4/3$ or 2 . Nonetheless, in practice a guarantee that no more than 25% or 50% of the economic value is lost may be unappealing. This paper asks whether significantly better bounds are possible under plausible assumptions. In particular, we look at how these worst case guarantees improve in the following large settings. Large Walrasian auctions: These are auctions with many copies of each item and many agents. We show that the PoA tends to 1 as the market size increases, under suitable conditions, mainly that there is some uncertainty about the numbers of copies of each good and demands obey the gross substitutes condition. We also note that some such assumption is unavoidable. Large Fisher markets: Fisher markets are a class of economies that has received considerable attention in the computer science literature. A large market is one in which at equilibrium, each buyer makes only a small fraction of the total purchases; the smaller the fraction, the larger the market. Here the main condition is that demands are based on homogeneous monotone utility functions that satisfy the gross substitutes condition. Again, the PoA tends to 1 as the market size increases. Furthermore, in each setting, we quantify the tradeoff between market size and the PoA.

Rate of Price Discovery in Iterative Combinatorial Auctions

Jacob Abernethy, Sébastien Lahaie, Matus Telgarsky

Session: EC-9b

We study a class of iterative combinatorial auctions which can be viewed as subgradient descent methods for the problem of pricing bundles to balance supply and demand. We provide concrete convergence rates for auctions in this class, bounding the number of auction rounds needed to reach clearing prices. Our analysis allows for a variety of pricing schemes, including item, bundle, and polynomial pricing, and the respective convergence rates confirm that more expressive pricing schemes come at the cost of slower convergence. We consider two models of bidder behavior. In the first model, bidders behave stochastically according to a random utility model, which includes standard best-response bidding as a special case. In the second model, bidders can behave arbitrarily (even adversarially), and meaningful convergence relies on properly designed activity rules.

On the Efficacy of Static Prices for Revenue Management in the Face of Strategic Customers

Yiwei Chen, Vivek Farias

Session: EC-9b

The present paper considers a canonical revenue management problem wherein a monopolist seller seeks to maximize revenues from selling a fixed inventory of a product to customers who arrive over time. We assume that customers are forward looking and strategize on the timing of their purchase, an empirically confirmed aspect of modern customer behavior. In the event that customers were myopic, foundational work by Gallego and van Ryzin [1994] established that static prices were asymptotically optimal for this problem. In stark contrast, for the case where customers are forward looking, available results in mechanism design and dynamic pricing offer no such simple solution and are also constrained by restrictive assumptions on customer type. The present paper studies the revenue management problem while assuming forward looking customers. We demonstrate that for a broad class of customer utility models, static prices surprisingly continue to remain asymptotically optimal in the scaling regime where inventory and demand grow large. We further show that irrespective of regime, an optimally set static price guarantees the seller revenues that are within at least 63.2% of that under an optimal dynamic mechanism. The class of customer utility models we consider is parsimonious and enjoys empirical support. It also subsumes many of the utility models considered for this problem in existing mechanism design research; we allow for multi-dimensional customer types. We also allow for a customer's disutility from waiting to be positively correlated with his valuation. Our conclusions are thus robust and provide a simple solution to what is considered a challenging problem of dynamic mechanism design.

Truthful Outcomes from Non-Truthful Position Auctions

Paul Duetting, Felix Fischer, David Parkes

Session: EC-10a

We exhibit a property of the VCG mechanism that can help explain the surprising rarity with which it is used even in settings with unit demand: a relative lack of robustness to inaccuracies in the choice of its parameters. For a standard position auction environment in which the auctioneer may not know the precise relative values of the positions, we show that under both complete and incomplete information a non-truthful mechanism supports the truthful outcome of the VCG mechanism for a wider range of these values than the VCG mechanism itself. The result for complete information concerns the generalized second-price mechanism and lends additional theoretical support to the use of this mechanism in practice. Particularly interesting from a technical perspective is the case of incomplete information, where a surprising combinatorial equivalence helps us to avoid

confrontation with an unwieldy differential equation.

Dynamic Mechanism Design with Budget Constrained Buyers under Limited Commitment

Santiago Balseiro, Omar Besbes, Gabriel Y. Weintraub

Session: EC-10a

We study the dynamic mechanism design problem of a seller that repeatedly auctions independent items over a discrete time horizon to buyers that face a cumulative budget constraint. A driving motivation behind our model is the emergence of real-time bidding markets for online display advertising in which such budgets are prevalent. We assume the seller has a strong form of limited commitment: she commits to the rules of the current auction but cannot commit to those of future auctions. We show that the celebrated Myersonian approach that leverages the envelope theorem fails in this setting, and therefore, characterizing the dynamic optimal mechanism appears intractable. In turn, we make three main contributions. First, we show that the Myersonian approach is recovered in a corresponding fluid continuous-time model in which the time interval between consecutive items becomes negligible. Second, we leverage this approach to characterize the optimal dynamic direct-revelation mechanism, highlighting novel incentives at play in settings with buyers' budget constraints and seller's limited commitment. Third, we provide theoretical results that provide support for using the prescription arising from the fluid continuous-time model in the original discrete-time model.

Feature-based Dynamic Pricing

Maxime Cohen, Ilan Lobel, Renato Paes Leme

Session: EC-10a

We consider the problem faced by a firm that receives highly differentiated products in an online fashion and needs to price them in order to sell them to its customer base. Products are described by vectors of features and the market value of each product is linear in the values of the features. The firm does not initially know the values of the different features, but it can learn the values of the features based on whether products were sold at the posted prices in the past. This model is motivated by a question in online advertising, where impressions arrive over time and can be described by vectors of features. We first consider a multi-dimensional version of binary search over polyhedral sets, and show that it has exponential worst-case regret. We then propose a modification of the prior algorithm where uncertainty sets are replaced by their Lowner-John ellipsoids. We show that this algorithm has a worst-case regret that is quadratic in the dimensionality of the feature space and logarithmic in the time horizon.

Fair Resource Allocation in A Volatile Marketplace

Mohammad Hossein Bateni, Yiwei Chen, Dragos Ciocan, Vahab Mirrokni

Session: EC-10b

We consider the setting where a seller must allocate a collection of goods to budgeted buyers, as exemplified by online advertising systems where platforms decide which impressions to serve to various advertisers. Such resource allocation problems are challenging for two reasons: (a) the seller must strike a balance between optimizing her own revenues and guaranteeing fairness to her (repeat) buyers and (b) the problem is inherently dynamic due to the uncertain, time-varying supply of goods available with the seller. We propose a stochastic approximation scheme akin to a dynamic market equilibrium. Our scheme relies on frequent re-solves of an Eisenberg-Gale convex program, and does not require the seller to have any knowledge about how goods arrival processes evolve over time. The scheme fully extracts buyer budgets (thus maximizing seller revenues), while at the same time provides a 0.47 approximation of the proportionally fair allocation of goods achievable in the offline case, as long as the supply of goods comes from a wide family of (possibly non-stationary) Gaussian processes. We then extend our results to a more general family of metrics called α -fairness. Finally, we deal with a multi-objective problem where the seller is concerned with both the proportional fairness and efficiency of the allocation, and propose a hybrid algorithm which achieves a 0.27 bi-criteria guarantee against fairness and efficiency.

Revealed Preference at Scale: Learning Personalized Preferences from Assortment Choices

Nathan Kallus and Madeleine Udell

Session: EC-10b

We consider the problem of learning the preferences of a heterogeneous population by observing choices from an assortment of products, ads, or other offerings. Our observation model takes a form common in assortment planning applications: each arriving customer is offered an assortment consisting of a subset of all possible offerings; we observe only the assortment and the customer's single choice.

In this paper we propose a mixture choice model with a natural underlying low-dimensional structure, and show how to estimate its parameters. In our model, the preferences of each customer or segment follow a separate parametric choice model, but the underlying structure of these parameters over all the models has low dimension. We show that a nuclear-norm regularized maximum likelihood estimator can learn the preferences of all customers using a number of observations much smaller than the number of item-customer combinations. This result shows the potential for structural assumptions to speed up learning and improve revenues in assortment planning and customization. We provide a specialized factored gradient descent algorithm and study the success of the

approach empirically.

Dynamic Taxes for Polynomial Congestion Games

Vittorio Bilò and Cosimo Vinci

Session: EC-10b

We consider the efficiency of taxation in congestion games with polynomial latency functions along the line of research initiated by [Caragiannis et al., *ACM Transactions on Algorithms*, 2010] who focused on both pure and mixed Nash equilibria in games with affine latencies only. By exploiting the primal-dual method [Bilò, *Proceedings of the 10th Workshop on Approximation and Online Algorithms*, 2012], we obtain interesting upper bounds with respect to a variety of different solution concepts ranging from approximate pure Nash equilibria up to approximate coarse correlated equilibria, and including also approximate one-round walks starting from the empty state. Our findings show a high beneficial effect of taxation which increases more than linearly with the degree of the latency functions. In some cases, a tight relationship with some well-studied polynomials in Combinatorics and Number Theory, such as the Touchard and the Geometric polynomials, arises. In these cases we can also show matching lower bounds, albeit under mild assumptions; interestingly, our upper bounds are derived by exploiting the combinatorial definition of these polynomials, while our lower bounds are constructed by relying on their analytical characterization.

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